FATIMA ZARAH MUSA BELLO

TOWARDS A DIGITAL CAPABILITY MATURITY FRAMEWORK FOR TERTIARY INSTITUTIONS

TOWARDS A DIGITAL CAPABILITY MATURITY FRAMEWORK FOR TERTIARY INSTITUTIONS

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To my children

and my mother:

Thank you.

ABSTRACT

Background: The Digital Capability (DC) of an Institution is the extent to which the institution's culture, policies, and infrastructure enable and support digital practices (Killen et al., 2017), and maturity is the continuous improvement of those capabilities. As technology continues to evolve, it is likely to give rise to constant changes in teaching and learning, potentially disrupting Tertiary Education Institutions (TEIs) and making existing organisational models less effective. An institution's ability to adapt to continuously changing technology depends on the change in culture and leadership decisions within the individual institutions. Change without structure leads to inefficiencies, evident across the Nigerian TEI landscape. These inefficiencies can be attributed mainly to a lack of clarity and agreement on a development structure.

Objectives*:* This research aims to design a structure with a pathway to maturity, to support the continuous improvement of DC in TEIs in Nigeria and consequently improve the success of digital education programmes.

Methods*:* I started by conducting a Systematic Literature Review (SLR) investigating the body of knowledge on DC, its composition, the relationship between its elements and their respective impact on the Maturity of TEIs. Findings from the review led me to investigate further the key roles instrumental in developing Digital Capability Maturity in Tertiary Institutions (DCMiTI).

The results of these investigations formed the initial ideas and constructs upon which the proposed structure was built. I then explored a combination of quantitative and qualitative methods to substantiate the initial constructs and gain a deeper understanding of the relationships between elements/sub-elements. Next, I used triangulation as a vehicle to expand the validity of the findings by replicating the methods in a case study of TEIs in Nigeria. Finally, after using the validated constructs and knowledge base to propose a structure based on CMMI concepts, I conducted an expert panel workshop to test the model's validity.

Results*:* I consolidated the body of knowledge from the SLR into a universal classification of 10 elements, each comprising sub-elements. I also went on to propose a classification for DCMiTI. The elements/sub-elements in the classification indicate the success factors for digital maturity, which were also found to positively impact the ability to design, deploy and sustain digital education. These findings were confirmed in a UK University and triangulated in a case study of Northwest Nigeria. The case study confirmed the literature findings on the status of DCMiTI in Nigeria and provided sufficient evidence to suggest that a maturity structure would be a well-suited solution to supporting DCM in the region. I thus scoped, designed, and populated a domain-specific framework for DCMiTI, configured to support the educational landscape in Northwest Nigeria.

Conclusion*:* The proposed DCMiTI framework enables TEIs to assess their maturity level across the various capability elements and reports on DCM as a whole. It provides guidance on the criteria that must be satisfied to achieve higher levels of digital maturity. The framework received expert validation, as domain experts agreed that the proposed Framework was well applicable to developing DCMiTI and would be a valuable tool to support TEIs in delivering successful digital education. Recommendations were made to engage in further iterations of testing by deploying the proposed framework for use in TEI to confirm the extent of its generalisability and acceptability.

Keywords: digital capability, digital transformation, digital education, nigeria, organisational maturity, continuous improvement, change management, tertiary education institutions

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"In Africa, there is a concept known as 'ubuntu' - the profound sense that we are human only through the humanity of others; that if we are to accomplish anything in this world, it will in equal measure be due to the work and achievement of others."

- Nelson Mandela

A PhD is an experience that alters the course of one's thinking. It has been a training of articulation, innovation, and resilience, which I could not have accomplished alone. First and foremost, ٱلْحَمْدُ لِلَّٰهِ (Alhamdulillah) – all thanks and praise are to Allah for seeing me through this journey. I acknowledge the favour HE has bestowed upon me, and I am grateful. I pray the knowledge I have gained and shared is beneficial to me and others. I would like to thank my children, Aysha, Ammar, and Saara, for putting up with my eccentricities and long hours; this research would not have been possible without their patience and understanding. Then, my dear mother, to whom I owe all that I am and all that I have achieved. Her tireless, unwavering support and unrelenting love throughout my life, but more so, every day of this journey, has made it feel like we did this together – this PhD is ours. I must equally thank my father – knowing I have him in my corner has always been my strength. Next, I would like to thank my siblings Rukaiya, Ameera, Osama, Amina, Hauwa, Chantal, and Mohammed for their willingness to help me physically with school runs when I worked late nights, emotionally with motivation and love; and for being bonus parents to my children – providing me with the perfect support system to make this research work possible. I'd also like to thank my fellow PhD colleagues at UH who have walked this journey with me; and all my friends who have put up with endless conversations about my research. A Special thanks to Sumiyya, Zina and Fareeda - who have been true friends of virtue. Last but by no means least, I thank the giants upon whose shoulders I have stood: Dr Nathan Baddoo, Dr Mariana Lilley, and Dr Paul Wernick, who have each supported me in their own unique ways, providing valuable comments and guidance, collectively bringing out the best in me.

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GLOSSARY

Capability Maturity: the ability to adapt processes and procedures, enabling efficient delivery of a product or service.

Collaboration: The collaboration culture - Collaborative working, learning, and teaching; driven by cooperation, participation and facilitated through communication, connectivity, and Infrastructure.

Creation & Innovation: The creation and innovation culture - Creation of digital content and media production. The ability to create new ideas, projects, and content. Design innovation and innovation of new approaches to using technology for learning & teaching.

Digital Capability: the ability of an organisation to sustain effective and efficient use of digital assets to support teaching, learning, and working through continuous evaluation, selection and adoption of new technologies and acquiring necessary skills for full utilisation.

Digital divide: the difference between demographics and regions with access to modern digital technology and those with limited access. This technology can include the mobile phones, computers, and the Internet, among other digital equipment.

Digital literacy: an individual's ability to produce clear information through writing and other forms of communication on various digital platforms.

Digital well-being: a digital extension of general well-being values of specific groups of individuals. The concept of well-being is socially structured, so it depends on values and norms within a specific social environment.

External environment: The environment in which the institution is physically situated: country or city.

Framework: A framework is a set of guidelines.

Guidelines: instruction or indication of how something should be done.

Individual skills: An Individual's interpersonal and technical skills, and their readiness/ willingness to achieve their full potential.

Infrastructure: The Infrastructure that supports the Tertiary Institution, from basic physical structures, network infrastructure, connectivity, hardware, software, and usability.

Institution: A type of organisation; in the context of this study, we refer to the 'academic institution' where knowledge is imparted, and degrees are awarded.

Learning, training & development: The Learning and teaching practices and methodologies aimed at acquiring new knowledge or skills.

Organisation: an organised group of people with a particular purpose.

Resources, tools & content: The learning resources, tools, and content, including social networks used to support institutional goals.

Stakeholders: All levels of student, staff, and management roles within an institution. Including the government agencies and ministries.

Tertiary Education: education post primary and secondary school, offering a diverse range of classes and qualifications to achieve a degree, Higher National Diplomas, or any other qualifications the institution may offer.

Tertiary Institution (TI): An organisation where teaching and learning take place. Students study for degrees, and academic research is undertaken. Certificates are awarded at the end of the degree programme.

Terms used in the DCMiTI Framework

1 Infrastructure: the basic physical structures, network infrastructure, connectivity, infrastructure hardware and operating software that supports the functions and operation of the institution.

1.1 **Basic physical infrastructure**: the physical building in which learning takes place and other support locations such as data centres and administration.

1.2 **Network infrastructure**: the hardware and software resources of an entire network that enable network connectivity, communication, operations, and management of an enterprise network. It provides the communication path and services between users, processes, applications, and external networks/the internet.

1.3 **Connectivity**: the interconnection capacity between platforms, systems, and applications (internet, intranet etc.)

1.4 **Hardware and software**: the range of essential hardware and software required to install and manage operating environments.

1.5 **Electrical power solutions**: mains and alternate power supply sources, including solar panels, inverters, Uninterruptible Power Supplies (UPS) and generators.

1.6 **Technical support**: provision of support from documents and technical staff with technical issues, both hardware and software.

1.7 **Usability considerations**: those considerations about usability factors, ergonomics, aesthetics etc.

1.8 **ICT maintenance & upgrades**: maintenance and upgrades of ICT facilities, both hardware and software.

2 Tertiary Education Institution: an organisation where learners study a variety of programmes and academic research takes place. Matters related to the structure and policies.

2.1 **Management responsibilities**: a solid understanding of the Digital Capability-related responsibilities that fall within their respective roles.

2.2 **Capital Investment**: the capital investments injected into the TI facilities towards digital capabilities and the financial commitment to continuously supporting digital education.

2.3 **Institutional policies**: fundamental policies, organisational standards and regulations put in place to govern and standardise matters related to the effective use of technology and management of digital capabilities.

***Strategic plan**: indication of the direction the TI intends to take, outlining long-term goals and an implementation plan of how those goals will be achieved.

2.4 **Institutional culture**: the institution's social and professional interaction norms, e.g., work ethic and learning culture, etc.

2.5 **Data analytics**: the ability to source, analyse and use data to draw out information to support learning, and infrastructure and support organisational efficiency.

***Data analysis** is the use of different techniques to analyse the data.

***Data visualisation** uses the data to draw out themes that inform various decisions and plans to improve organisation efficiency.

2.6 **Digital presence**: the existence of the TI on the internet and other digital/social platforms. Including availability of research work etc. Availability of infrastructure to support a digital community where members can associate themselves with TI's digital presence.

3 Stakeholders: All levels of learner, tutor, technical and administrative roles within the institution. (Note: all stakeholders are considered learners at a point in time in a digital learning environment, often as part of broader responsibilities).

3.1 **Roles & responsibilities**: the various roles that impact successful digital education delivery and outcomes and the key responsibilities each role is required to uptake.

3.2 **Online presence (digital identity)**: the digital identity of individual stakeholders and their association with TI's digital presence. Digital presence includes the extent of digital engagement and the ability to leverage online platforms to support stakeholder roles.

3.3 **Knowledge of well-being**: general awareness of the impact of technology on society. Understanding the physical and psychological issues associated with frequent use of digital. Understanding the adverse effects of digital overconsumption and misuse on mental health and understanding individual responsibilities to manage a healthy work-life balance. Knowledge of the social, professional, and ethical issues related to digital media.

4 Learning, Training & Development: learning and teaching activities and practices aimed at acquiring new knowledge and skills through various learning options.

4.1 **Multiple learning modes**: different modes of learning offered by the TI. For example, analogue eLearning, distance learning, mobile learning etc.

4.2 **Learning strategies**: the variety of learning and teaching strategies to support different learning styles and increase efficiency in the learning process.

4.3 **Use of digital aids**: the utilisation of digital aids in teaching and learning.

4.4 **Continuous professional development**: skilling and upskilling tutors and other staff on various skills to support digital education. Including ICT training, pedagogical skills and other discipline related training and professional accreditations.

4.5 **Learning support services**: learning support skills (e.g., Academic writing, etc.).

4.6 **Learner feedback loop**: analysing assessment outcomes, surveying learner experience, evaluation, reporting and employing reflective practices, and making appropriate changes to the existing methods and methodologies. This process aids in improvement in the overall learning experience.

4.7 **Digital mentorship**: mentorships arrangements to model successful use of digital tools and modelling best practices.

5 Resources, Tools & Content: the resources, tools and content used to facilitate learning and development, including the administrative aspects of digital education programmes.

5.1 **Digital tools (hardware)**: tools using the infrastructure (1) to support teaching and learning, such as assessment, marking and feedback and subject-specific digital equipment used in teaching labs.

5.2 **Digital resources (software)**: the range of software and online learning resources that sits over the basic infrastructure (1); used for learning, including digital libraries, Virtual Learning Environments (VLE), Learning Management Systems (LMS), social networks, among other digital resources and administrative systems used for management and monitoring.

5.3 **Procurement considerations**: those considerations made in procuring tools and resources, such as accessibility, usability, and wellbeing. I am consulting the full range of stakeholders, including end-users.

5.4 **Content**: Learning materials such as lecture slides, notes, and other learning aids, including audio-visual content.

6 Skills: the range of personal, technical, and digital competencies required to support stakeholders in developing their capabilities.

6.1 **Interpersonal skills**: the behaviours an individual uses to interact with others effectively; this includes communication skills, attitude towards learning, readiness/ willingness to engage with digital tools, technological acceptance etc.

6.2 **Digital skills**: using digital resources and tools to access, manage and communicate information.

6.3 **Disciplinary knowledge**: the extent to which an individual understands the subject and keeps up to date with academic progress in the field. Includes an individual's ability to navigate discipline-specific and other tools and resources in a discipline-specific way.

6.4 **Pedagogical skills**: the ability to employ appropriate teaching and learning methods/ practices to deliver learning while utilising digital tools and resources.

7 Wellbeing: the sense of belonging to a safe and secure institution where individuals feel free to communicate, participate and work towards achieving personal development goals while maintaining a healthy work-life balance.

7.1 **Wellbeing**: access to facilities that promote physical and psychological wellbeing and a general awareness/ understanding and accommodation for wellbeing matters. Including workspace set-ups adhering to occupational health guidelines, suitable environmental design and UX design etc.

7.2 **Support**: access to well-being support services to help stakeholders manage overload, occupational health concerns, and mental health services.

7.3 **Psychological safety**: access to an environment that supports the safety and security of individuals, and other matters that may impact the psychological well-being of stakeholders.

8 Creation & Innovation: those elements that support design innovation, the creation of new ideas and approaches, including digital media and content.

8.1 **Innovation culture**: an environment where creativity is enabled, outside-the-box thinking is cultivated and applied within the constraints of 10.3.

8.2 **Content creation**: an environment that facilitates the creation of different online content and materials, such as social media content, documents and lecture slide design, website development, video content, podcasts etc.

9 Collaboration: collaborative working, learning, and teaching activities, methods, and strategies, primarily driven by participation and facilitated by infrastructure.

9.1 **Collaborative working**: the structure, process and skills required for stakeholders to work together to achieve their goals better.

9.2 **Collaborative learning**: the structure, process and skills required for stakeholders to work together to achieve better learning goals.

9.3 **Social networking**: social media or equivalent technology-based platforms to connect and collaborate with other learners, stakeholders, and peers for academic purposes.

10 External Environment: the economic and cultural factors arising from the environment in which the institution is physically and organisationally situated (city/country), including the role of government agencies.

10.1 **Role of government agencies**: agencies, ministries that contribute to the management of the TEI sector, including sector bodies.

10.2 **External interventions**: the ability to access funds and other resources from external public and private sector bodies to support the institutions' development.

10.3 **Consideration of external factors**: the extent to which external contributing factors are accounted for in planning and managing the development and support of digital capabilities.

LIST OF ACRONYMS

DC: Digital Capability

DCM: Digital Capability Maturity

DCMiTI: Digital Capability Maturity in Tertiary Institutions

ET: Educational Technologist

FG: Focus Group

HE: Higher Education

HEI: Higher Education Institution

ICT: Information and Communication Technologies

MFG: Mini Focus Group

RQ1: Research Question One

RQ2: Research Question Two

RQ3: Research Question Three

RQ4: Research Question Four

RQ5: Research Question Five

RQ6: Research Question Six

TE: Tertiary Education

TEI: Tertiary Education Institution

TI: Tertiary Institution

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Conference Papers

Bello Z, Baddoo N, Lilley M, Wernick P. 2019. Investigating Elements that Influence Higher Education Institutions' Digital Maturity. WASET.

Bello Z, Baddoo N, Lilley M, Wernick P. 2019. Towards a Capability Maturity Framework: Adopting the universal elements of Digital Capability Maturity as an Organisational Strategy. In: British Academy of Management 2019 Conference Proceedings.

Conferences (Unpublished)

ALT-C Conference: Investigating the Significance of Educational Technologist's Role in Higher Education. https://altc.alt.ac.uk/2019/sessions/a-171/

Advance, HE STEM Education Conference 2019: The impact of digital capabilities on the quality of STEM teaching.
https://www.advance-he.ac.uk/sites/default/files/2019-12/Session%20abstracts.pdf/Session 1.5b: The impact of digital capabilities on the quality of STEM teaching

INTRODUCTORY CHAPTERS

1. CHAPTER ONE: INTRODUCTION

In this Chapter, I introduce the background research that led to identifying the research problem and raised the investigation into the constructs of Digital Capabilities in Higher Education Institutions; and the proposal of a maturity development structure as a solution to supporting effective digital education in Nigeria. I also present the central argument of this research, followed by actionable objectives, a set of research questions and the strategy used to guide the series of investigations that make up this dissertation.

1.1 Research Motivation

This research has been personal because it was motivated by my anecdotal experiences as a lecturer in Nigeria, where I noted the disparities between the inputs and the outputs in Tertiary Education Institutions. I was thus driven to contribute to the digital transformation in the Tertiary Education sector. Transformations are reported to be more challenging in organisations where digital processes have already been established (Rodrigues, 2017), the changeover has higher cost implications (Barns et al., 2017), and the rate of technology acceptance is slower (Kohnke, 2017). As Nigeria is currently establishing a digital infrastructure, there was no better time to conduct this research and proffer the solution towards a digital Nigeria. The findings in this dissertation support the delivery, deployment, and sustainability of digital education in universities, Polytechnics and Colleges of Education. The consequent knock-on-effects are not limited to educational outcomes; they include long-term cultural capital as well as inestimable economic contributions to the country. Considering my close position with the research topic, I reflect on the concepts of self-awareness and positionality in Section 10.4.

1.2 Background

As technology and online resources permeate all areas of life in working, living, learning and social contexts, organisations are increasingly concerned about utilising technological investments to ensure successful integration into the digital age (Sallé, 2004). Moreover, game-changing innovations have given rise to Digital disruptions - an effect that changes the fundamental expectations and behaviours in a culture, market, industry, and process (Hill, 2017). In the wake of such revolutionary trends, organisations need to develop the ability to assess disruptions and find ways to survive and flourish in a dynamic environment (Berghaus, 2016).

The digital era means the choice is no longer whether to keep up with technology; rather, the challenge is being able to assess and manage the inevitable changes that will continue to arise.

According to Carnall (2018), the **capability to manage change effectively** is a crucial attribute of a successful organisation.

The Tertiary Education sector has seen a paradigm shift as technology has transformed traditional classroom learning with digital education and continues to evolve as technology advances (Aslan and Reigeluth, 2013). This shift has also emphasised the need for academic tutors, learners, and administrators to be digitally capable; and has rendered existing education and administrative structures ineffective (Aslan and Reigeluth, 2013; Wagner et al., 2012); leaving Tertiary Education Institutions (TEIs) scrambling to adjust.

TEIs are arguably the most impactful type of organisation as they produce a large portion of the global workforce across all industries. Tertiary Education is one of the key drivers of competitiveness and often associated with human skills development and economic growth (Montgomery and Fernández-Cárdenas, 2018). Research has named Tertiary Education an enabler and ultimate the driving force for effective nation building (Peretomode and Chukwuma, 2012). “The economic and cultural contributions of TEIs are vast and impact communities worldwide” (Frontier Economics, 2021).

In the United Kingdom, TEIs contribute over £95 billion to the UK economy; they support over 815,000 jobs and account for an estimated £52 billion of GDP (Frontier Economics, 2021). In addition, the digital era has broken international barriers with an increase in multinational companies employing foreign and remote workers - directly translating to higher demand for a digitally capable workforce (Hubschmid-Vierheilig et al., 2020). This shift echoes down to the calibre of learners produced by TEIs; making it of paramount importance that they deliver digitally capable learners who are prepared for a dynamic global economy (Wicht et al., 2019; Hubschmid-Vierheilig et al., 2020).

The UK Higher Education Association (HEA) reported that the number of new entrants into TEIs from Nigeria had increased by 64% from 2020 – 2021 (HSEA, n.d.). Nigeria has a population of 213.4 million as of 2021 (World Bank, 2021), and makes the most significant global workforce contribution in Africa (Ajayi and Ogunode, 2022). As one of UNESCO's developing nations, with a mission towards community development through education, communication, and information (United Nations, n.d.), it is vital to ensure that the TEIs in Nigeria can sustain the inherent disruptions of the digital era and transformation to digital education.

With the increasing attention towards digital transformations and the role of Tertiary Education in delivering skilled learners, institutions are now in pursuit of strategies to promote using appropriate tools to improve skills, quality of education, enhance productivity and competitiveness (Wicht et al.,

2019; Zhao et al., 2021). Digital transformations are complex and require holistic analysis of internal strengths and weakness to develop new approaches to successfully manage such change (Arsenijević et al., 2018). Different variations of maturity modelling have been used to measure and improve capabilities since the concept was first introduced by the Software Engineering Institute at Carnegie Mellon University in 1986 (Paulk et al., 1993).

Therefore, I have undertaken this research to navigate the complexities of Digital Capabilities in the Tertiary Education landscape and to explore the affordances of maturity modelling as a strategy to enable TEIs in Nigeria to remain competitive and create growth.

1.2.1 Digital Education

"Improved learning comes from a dual focus on the body of knowledge 'content' and how to learn 'process" (Murray-Harvey and Keeves, 1994) cited in (Thompson, 2006). Cunliffe (2008) speculated that it would soon become a requirement for stakeholders to assume their roles in a digital future, i.e., learners and tutors alike. Fast forward to 2016, the global viewpoint was that socioeconomic development was increasingly driven by technological developments and the appropriate application of technical skills. Specifically teaching and learning are considered fundamental to the construction of a knowledge economy and the social cultural development in all nations (Dennis et al., 2016); and the same applies till date.

Modern day teaching and learning where digital skills and capabilities are developed, happens through the delivery of digital education (Hubschmid-Vierheilig et al., 2020). Digital Education is the use of technology and digital tools in teaching and learning; often used synonymously with Technology Enhanced Learning (TEL) and electronic Learning (e-Learning); although Digital Education encompasses a broader spectrum of digital practices, such as online communities, webinars, social media, blended learning, mobile learning etc.

Exposure to digital Education has seen increased access to information, higher learning engagement and a richer collaborative environment, thereby enriching the learning experience; exposing learners to new opportunities, better development, and better prospects for improving overall academic standards. Digital Education has become the most viable method of developing people within organisations because the options and flexibility it offers have proven to be effective. Furthermore, the positive correlations between people's productivity and organisational outcomes mean that developing individual capability would consequently result is developing organisational capability.

Research have also examined the drawbacks of integrating digital education in HEIs, and despite limitations such as reduced human interactions, technological acceptance, potential impacts on learners' wellbeing etc, overall, the benefits outweigh the shortcomings (Arkorful and Abaidoo, 2014); and TEIs continue to deliver a variety of digital education programmes.

For learners and tutors, digital skills include the need to know how to use digital tools, find good quality information, be critically aware of the strengths and shortcomings of such information, be able to make sense, interpret and apply that information for their needs; then communicate the findings and, potentially, also develop both confidence and creativity in using and engaging with digital tools and resources (Cunliffe, 2008).

In addition, the growing preference for electronic information in place of print media in TEIs means learners and tutors must utilise those resources for better research output (Egberongbe, 2016). Different disciplines and subject areas have shown a significant divergence in the types and uses of digital resources(Kemp and Jones, 2007), nonetheless digital.

Furthermore, the emergence of digital education has ushered in global facilitation of access to information using computers, the Internet, and the networked environment (Simon and Ogom, 2015); as well as improved academics' appreciation of the research process. Hence digital education practices are fast becoming an integral aspect of teaching and research.

The transformation to digital leaves no aspect of the organisation untouched. Saiti and Prokopiadou (2009) observed the significance of adopting new technologies in administrative processes to keep up with the changing demands, suggesting that an institutions capability is not limited teaching and learning processes but inclusive of administrative elements as well.

Digital education has been accepted and slowly embedded into the UK TEI landscape, with a big push towards digital literacies and capabilities in the last decade (Handley, 2018); further exasperated by the covid-19 pandemic (Iansiti and Richards, 2020). However, the rapid increase in the number of international students in UK Universities, coming from Nigeria was a statistic worthy of further examination.

1.2.2 In Context: Tertiary Education in Nigeria

Nigeria is a large and diverse country that stretches from the southern delta regions of the Atlantic Ocean to the northern sub-Saharan region of Africa with a teaming population above 213.4 million people as of 2021 (World Bank, 2021). This growing population necessitates developments in Tertiary

Education Institutions (TEI) to accommodate the increasing number of learners seeking higher qualifications. The demand for education is so high because education is not only an investment in human capital, but it is also a pre-requisite for economic development and a large steppingstone towards global competitiveness (Asiyai, 2014).

The history of Tertiary Education in Nigeria began with the University College of Ibadan established in 1948 as an affiliate of the University College of London (UCL). Then in 1959, the Sir Eric Ashby Commission was set up by the Federal Government to carry out a comprehensive needs-based assessment that produced the first-ever comprehensive official review of TE needs of the country. The Ashby Report highlighted the need to focus on strengthening education because it was a necessary tool for achieving national economic expansion and the social emancipation of individual citizens (Daniel-Kalio, 2018; Akanbi, 2017; Ogunyinka et al., 2015; Imam, 2012). The Implementation of the Ashby report led to the establishment of other TEIs by 1962, namely: Obafemi Awolowo University in the western region, Ahmadu Bello University in the Northern region, and the University of Lagos in the Federal Capital (Olayinka et al., 2017) cited (Babalola et al., 2007).

Today, the Tertiary sector is composed of universities, polytechnics, colleges of education, institutions of technology and other higher learning institutions affiliated to professional specialized institutions offering correspondence programmes, diplomas, and certificates (Erhieyovwe and Ukavwe, 2019; Nagbi and Christian, 2019). Although categorised differently, all public institutions are run by the government; with universities managed by federal and state government, while other institutions operate under parent ministries (Nagbi and Christian, 2019).

The aims of TEIs in Nigeria as outlined by the Federal Ministry of Education (2004) section 8 (59) are: "Contribution to national development through high level manpower training; Development and inculcation of proper values for the survival of the individual and the society; Development of the intellectual capabilities of the individual to understand and appreciate their local and external environment; Acquisition of both physical and intellectual skills which will enable the individual to be a self-reliant and useful member of the society; Promotion and encouragement of scholarship and community services; and for national unity and the promotion of national and international understanding and interaction" (Ministry of Education, 2004).

The entire sector is governed by various commissions under the Federal Ministry of Education setup to coordinate institutions management. For example, universities are managed by the National Universities Commission (NUC) who's main objective is to ensure the orderly development of university education (Ekundayo and Ajayi, 2009); Colleges of Education are managed by the National

Commission of Colleges of Education and Polytechnics are managed by the National Board of Technical Education etc. These commissions manage policy, maintenance, accreditation, and resource allocation among other responsibilities (Nagbi and Christian, 2019).

1.2.2.1 Technology in Education

Much like other countries around the globe, Nigeria recognises the need for integrating technology into the education system. The last two decades, has witnessed the adoption and application of digital resources in teaching and learning. Institutions have provided platforms for accessing and utilising information to enhance teaching, learning and research productivity across faculties (Ani et al., 2015. However, the potential of the Nigerian TEI system to fulfil this responsibility is frequently thwarted by systemic and political issues (Asiyai, 2014).

Ivwighreghweta and Igere (2014) investigated the impact of the infrastructures, namely connectivity of internet on academic performance in selected TEIs in Nigeria and found many learners had good ICT literacy, but limited access was available within the institutions so many resulted to using cyber cafés to access relevant academic materials. Learners in the study also divulged that usage of online tools and content helps towards assessments. Furthermore, the study identified e-resources among the most common resource used although information overload, slow internet speeds and low availability of computer terminals were identified among the problems impeding effective usage among other systemic issues (Ivwighreghweta and Igere, 2014).

In another study, Ahmed and Bukar (2016) conducted research in Adamawa state university, Northern Nigeria. The study reported learners who were able to utilise the internet for both personal and academic purposes were using personal devices (Ahmed and Bukar, 2016). Moreover, another study reported on learners among science subjects in private universities who did have access to the using personal mobile devices; prioritised their usage for educational and communication purposes such as checking emails, active participation on social media and knowledge acquisition to search engines. Suggesting that the institutions themselves are not always able to meet up to the needs of the learners.

Learners experience poor connectivity and the high cost of data usage as their significant challenges (Fasae and Adegbilero-Iwari, 2015). Otunla (2013) conceded that many undergraduate learners accessed and used the internet through their mobile devices and personal laptops using a wireless modem to create a mobile hotspot; few reported having internet access through the university run computer centre, and none reported having access on their mobile devices through the University (Otunla, 2013). Many institutions in Nigeria do not have clear vision guiding their activities (Ubogu and

Veronica, 2018a), suggesting the communication infrastructures to support the delivery of digital education required further attention.

Higher education in Nigeria has been subject to various academic and non-academic critiques over the years (Ani et al., 2015); inadequate funding (Afolayan, 2015), poor quality of physical infrastructures (Anifowose and Lawal, 2013; Isa et al., 2014), availability of resources and technical assistance (Eteokleous, 2008), have all been put forward as critical factors impacting the efficient usage and exploitation of new technological capabilities. In addition, sub-optimal access and usage of digital Infrastructures frustrates the delivery of teaching and learning in many institutions (Otunla, 2013; Ahmed and Bukar, 2016; Asiyai, 2014).

Researchers have highlighted the need for TEIs in Nigeria to catch up with global innovations in educational practices (Saiti and Prokopiadou, 2009) and the need for public and private sector support (Ubogu and Veronica, 2018); as a result, the Tertiary Education landscape has seen a variety of national and international investments in the sector.

1.2.2.2 Investments in Tertiary Education

The Tertiary Education sector receives 40% of the education funding budget, in comparison to primary and secondary education which both receive 30% (Ubogu and Veronica, 2018), confirming it is regarded as a significant sector.

Nonetheless, inadequate funding is still reported as one of the inhibiting factors to successful deployment of digital education in TEIs (Ubogu and Veronica, 2018); however, the government has set up various agencies mandated to support and fund development projects in the sector.

The Tertiary Education Trustfund (TETFund) is an intervention agency established to manage, distribute, and monitor education to public tertiary institutions. The have delivered numerous infrastructural development project providing fundamental structures, as well as technology centres for TEIs across the country (Nagbi and Christian, 2019).

The Nigerian National Communication Commission (NCC) are only one of the government bodies that support TEIs with connectivity and bandwidth; the Petroleum Technology Development Fund (PTDF) provide funding for training, development, and research; in addition to other public and private sector funds.

Countless international investments have been made, towards the development of Tertiary Education, for example, the World Bank disbursed $130 million for education projects in Nigeria under the

Science and Technology Education Post-Basic (STEP-B) project with the goal of supporting the production of better qualified learners and higher quality research. STEP-B is only one of the numerous international investments toward Nigerian Tertiary Education sector (WorldBank, n.d.).

The continued concern and investments into Tertiary Education in Nigeria indicates that the technologies available has not delivered their perceived value in terms of making educational and administrative processes more efficient; and in many cases digital education is rendered ineffective. TEIs continue to report limitations in their ability to utilise technology in the delivery of teaching and learning. While most studies point the finger at inadequate funding, and Cecilia et al. (2017) concedes, however concludes that new approaches are required if real transformation is to be achieved (Cecilia O. et al., 2017).

One significant yet unrecognised problem which has not been reported from the perspective of the Nigerian landscape is the tendency to implement digital initiatives in silos, from a technology centred approach, which has been reported to result in competition for scarce resources and result in efficiencies and conflicts (Raab and Griffin-Cryan, 2011; Rodrigues, 2017); all of which are evident in Nigeria.

Rodrigues (2017) powerfully expressed the need for TEIs to "look at digital holistically and transform by applying digital thinking across everything they do; how they operate internal processes; and how they source their core mission". The use of a holistic and integrated framework would allow TEIs to manage all digital initiatives and approaches while considering stakeholders, technologies, and core processes (Rodrigues, 2017). This maybe a viable solution to getting more value out of existing technological investments and support the efficient allocation of future investments.

1.2.3 Maturity Modelling

Maturity models are an evolution of Nolan's Stage theory of computing evolution in organisations (King and Kraemer, 1984), in which the shortcomings of Nolan's theory were addressed to provide a more evolutionary approach. The best-known model is the Capability Maturity Model® (CMM), which was first introduced to support software process improvement. The primary use was to enable individuals, institutions, and organisations to carry out self-assessments on the maturity of different parts of their processes against established reference points (Humphrey, 1998).

"*A maturity model conceptually represents phases of increasing quantitative or qualitative capability changes of a maturing element in order to assess its advances with respect to defined focus area*."(Kohlegger et al., n.d.)

The most popular models are those based on the improved Capability Maturity Model Integration (CMMI) (CMMI, 2006). The CMMI typically has five levels, each specifying a new foundation of practices upon which higher levels are built - essentially building maturity. Although CMMI was originally designed for software products and services, over the years, the structure of the maturity levels and the mechanisms used to determine levels have been adopted by other models in several subject areas (Valdés et al., 2011).

Typically, the focus area of a model determines which indicators would be used to assess maturing elements.

1.1.4.1 Maturity Models in Education

Several investigations have been undertaken in the last two decades to develop maturity models for education.

The frequency of use of these maturity model concepts in e-Learning lead to what is commonly known the e-Learning Maturity Model (eMM). Most of these models were developed to provide a means by which Institutions could assess and compare their capability to develop, deploy and support e-learning activities. The eMM is mainly focused on learners rather than the institutions development. An example of the application of the eMM in school education was reported by (Liang & Wang, 2009). A CMM framework was adopted during the ICT Test Projects in rural schools in Shanghai. It was evident from this study that using ICT to provide appropriate structure positively impacted the effectiveness and efficiency of educational experiences. One of the principles under the philosophy implicit in Neuhasuer's model was that: a mature course design based on best practices, combined with good instruction and the efficient use of the model, may be linked to positive student outcomes (Neuhauser, 2004).

Both Marshall and Mitchel (2004) and Neuhauser (2004) reported on the outcomes of applying maturity model concepts in eLearning. The results of applying the eMM provide information that may be considered invaluable towards university strategic planning activities.

Most of the presented models have the same distinct levels of maturity. They all describe practices and/or processes the organisation must ideally achieve at each level. Quite different from the original models they were based on, many eMMs do not explicitly describe key process areas. With the exceptions of the models developed by (Dounos & Bohoris, 2007) and that by Marshall and Mitchel (2004), they specify these processes as well as the methodologies and evaluation techniques that are considered to position an institution at the correct level of maturity.

Most of the models present 'what to do', but few, with the exception of (Dounos and Bohoris, 2007a), suggest ‘how’. The ‘how’ are the steps of maturity that need to be taken in order to improve institutional processes.

However, many maturity models simply build on their predecessors with no review on the appropriateness of their design decision, Kohlegger et al. (2019) suggested the need for reflection and assessment of maturity modelling concepts before implementing pre-prescribed criteria.

1.3 Central Argument and Problem statement

Despite continued investments in education and technology, TEIs in Nigeria continue to show limitations in their ability to deliver digital education effectively. There is evidence to suggest an overall need for more sophistication in the way digital platforms are deployed to facilitate teaching and learning in TEIs. The sub-optimal use of digital infrastructure frustrates the delivery of teaching and learning and results in a plethora of knock-on effects that inhibit the efficient and effective delivery of digital education programmes.

The problems include, but are not limited to, underutilisation of resources, inadequate funding, inadequate maintenance of existing infrastructures, poor learning outcomes, limited professional development opportunities and lack of motivation. These adverse effects extend to the widening of the digital divide in terms of access and utilisation, and as a result, the product of Nigerian TEIs may struggle to keep up with the global digital economy.

In this study, I suggest the inefficiencies in digital education may be attributed to the absence of a development structure upon which digital capabilities are built.

Given the need for a new strategy to support transformation (Cecilia et al., 2017), Rodrigues (2017) recommendations on a holistic framework to manage digital initiatives, in addition to Kohlegger’s (2019) criticism of maturity models building upon predecessors without review of the various elements involved; this study investigates the composition of Digital Capabilities in the TEIs and tenders the use Digital Capability Maturity as a strategy to support digital education, realise the benefits of technological investments and create growth.

To address, this research problem, the aims and objectives of this research are stated below.

1.4 Aims and Objectives of the Research

This research work aims to propose a development structure upon which TEIs in Nigeria can build and sustain Digital Capabilities. The structure will provide a means of assessing an institutions level of digital maturity to generate a roadmap that shows the path to continuous improvement. The structure will provide guidance on how to optimise ICT investments and allow TEIs to reach higher levels of digital maturity. Consequently, the structure will support the efficient and effective implementation of digital education programmes in TEIs in Nigeria.

The primary objectives of the study are to:

1. Identify the key elements that contribute to Digital Capability Maturity in Tertiary Institution (DCMiTI)
2. Develop a DCMiTI Framework based on the existing CMM concepts
3. Establish a prioritised improvement roadmap toward enhancing DCMiTI
4. Assess the perceived quality of the proposed solution/ DCMiTI Framework

1.5 Research Questions

To investigate the concept of DCMiTI and exploit the benefits that developing DCM offers toward more effective and efficient digital education, my dissertation answers the following six research questions listed below. Table 1-1 shows which research questions were addressed in each study.

Table 1-1: Research questions addressed in each study

Chapter	**Chapter 3**	**Chapter 4**	**Chapter 5**	**Chapter 6**	**Chapter 7**	**Chapter 8**
Research Question	**Study 1**: Systematic Review	**Study 2**: Educational technologists	**Study 3**: Investigating DCMiTI (UK)	**Study 4**: Investigating DCMiTI (Nigeria)	**Developing a solution**	**Study 5**: Expert Panel
RQ1	✓		✓	✓		
RQ2	✓	✓	✓	✓		
RQ3	✓					
RQ4	✓			✓		
RQ5					✓	
RQ6						✓

Research Question 1: What elements contribute to Digital Capability Maturity?

This research question explored the secondary data in current academic literature to identify candidate elements considered to contribution to Digital Capability Maturity. It brought together existing knowledge on digital capabilities and organisational maturity. As a result, I will determine the composition of DCM. This research question is theoretically addressed in Chapter 3, extended in Chapter 4, and empirically supported in Chapters 5 and 6.

Research Question 2: How do these elements affect the Digital Capability Maturity of Tertiary Institutions?

This research question extends from RQ1 to narrow the scope of the literature search to Tertiary Institutions of learning. In addition, the question investigates how the candidate elements identified in RQ1 are reported to affect maturity. As a result, I will situate the concept of DCM in the context of TEIs. This research question is theoretically addressed in Chapter 3, extended in Chapter 4, and empirically supported in Chapters 5 and 6.

Research Question 3: What is the status of research on Digital Capability Maturity in Tertiary Institutions?

This research question investigates the status of research in the DCMiTI domain and explores techniques used to develop digital maturity in TEIs. The question tries to uncover existing efforts towards using Capability Maturity as a mechanism for improving the efficiency and effectiveness of digital education. This research question identifies the research gap and anchors this PhD research within the context of current academic literature. This research question is addressed theoretically in Chapter 3.

Research Question 4: What is the status of Digital Capability Maturity in Tertiary Institutions in Nigeria?

This PhD aims to propose a solution for digital maturity initiatives in TEIs in Nigeria. Therefore, the research question investigates the status of research efforts on DCMiTI in the Nigerian TE landscape. This research question is theoretically addressed in Chapter 3 and empirically supported in Chapter 6.

Research Question 5: What is the solution to addressing the absence of a development structure for DCMiTI?

This research question employs the findings from Study 1 to Study 5 to propose an evidence-based structure that supports the development of DCMiTI. I address this question in Chapter 7.

Research Question 6: Is the proposed solution reasonable to support the implementation of digital education?

This research question assesses the proposed solution. Given the PhD programme has a limited duration that would not be sufficient for a practical evaluation of the proposed Framework, this question evaluates experts' perceptions of the proposed Framework based on their knowledge and experience in digital education and maturity modelling. I address this question in Chapter 8.

In Chapter 9, I provide answers to all the research questions.

1.6 Contributions to Knowledge

This dissertation is an original research effort, and it is essential as it breaks down the concept of DCMiTI and reassembles its composition in an original, transparent, and replicable manner. In addition, I propose an evidence-based structure for the development of DCM designed to support efficient and effective digital education. Finally, this research will contribute to the current body of knowledge on DCMiTI as follows:

1. Proposing an optimisation solution for DCMiTI in the form of a Maturity Framework.
2. Established a universal composition of DC that may be configured to different institutions.
3. Confirms that developing DC has a positive effect on Overall Institutional Maturity
4. Confirms the positive link between DC and Digital Education
5. Adds credence to existing frameworks.
6. Provides an overarching support structure that considers DCMiTI from a holistic perspective.
7. Presents DCMiTI with a maturity pathway for digital education.
8. Contributes to research on Digital Capabilities from Northwest Nigeria
9. Presents an evidence-based Maturity Framework based on CMMI and configured to DCMiTI in NW Nigeria.

1.7 Research Strategy

The overall research process involved a series of empirical and non-empirical processes as shown in Figure 1-1.

1.7.1 Stage 1: Pre-empirical stage

The background section of this Chapter introduces the general research idea. After highlighting the 1.4 Aims and Objectives of the Research, I formulated a set of six 1.5 Research Questions to guide the research process. In CHAPTER THREE: SYSTEMATIC LITERATURE REVIEW, I report a Systematic Literature Review (SLR) on DCMiTI. The results (theory) of the research questions addressed in this Chapter, were used to propose the theoretical constructs of DCMiTI. I then tested these constructs during the empirical stage of the research work.

1.7.2 Stage 2: Empirical stage

The empirical stage of the research involved proposing constructs of DCMiTI based on theoretical findings. The constructs were then subject to a recursive substantiation exercise which involved the

design, data collection, data analysis and reporting of findings in confirming the agreement of the constructs.

The refined DCMiTI constructs, and the knowledge base gained during these investigations were used to propose a solution to the research problem. Finally, the proposed solution was validated in a final study closing off the research process and reporting the body of work presented in this dissertation.

I detail all the body of studies and techniques used in CHAPTER TWO: RESEARCH METHODOLOGY.

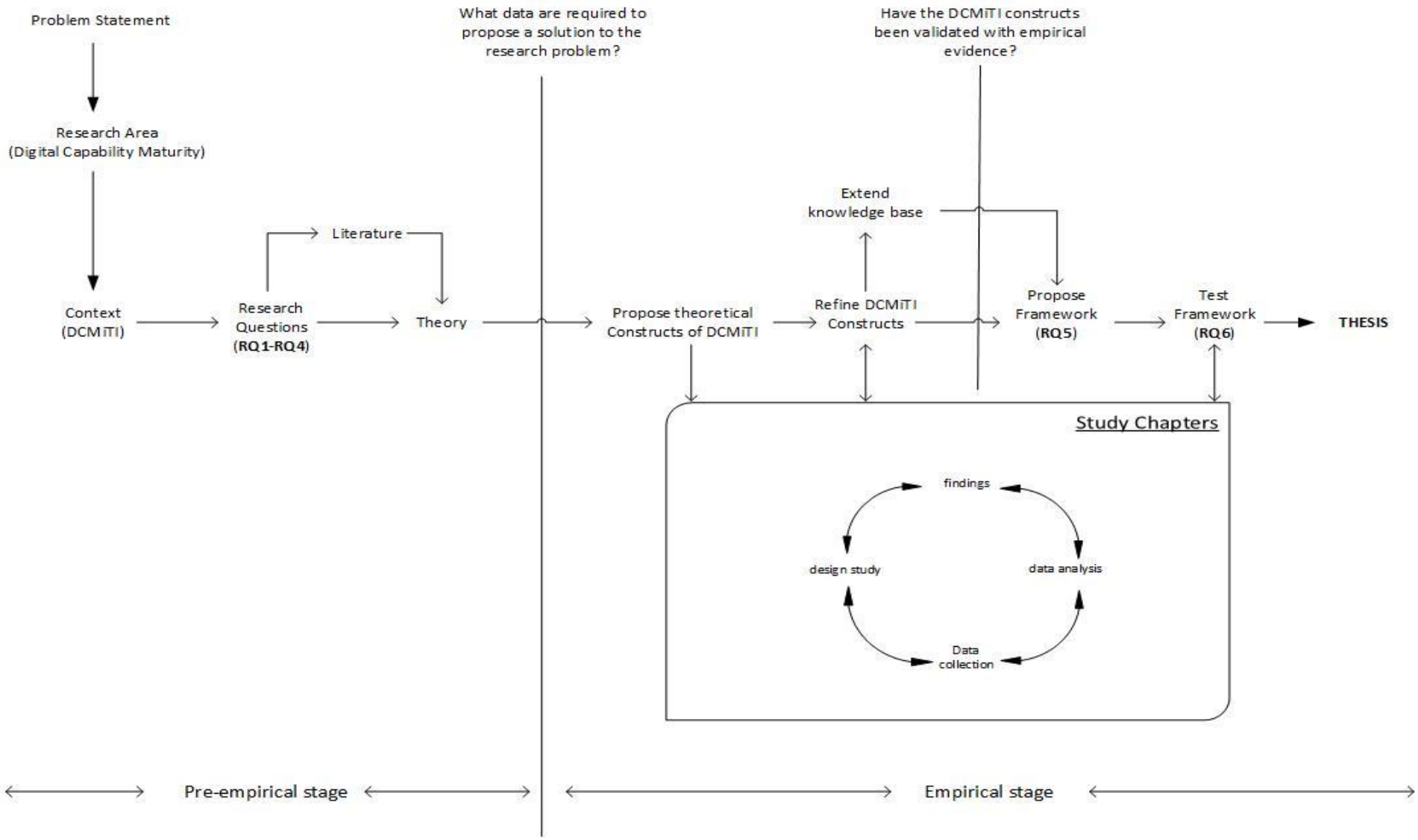

Figure 1-1: Model of research plan

1.8 Structure of the Dissertation

The remainder of this thesis is as follows:

Chapter 2 presents an overview of the philosophical approach used to address the research questions in this dissertation.

Chapter 3 presents a Systematic Review of elements contributing to Digital Capability Maturity in Tertiary Education Institutions (DCMiTI). In this Chapter, I establish the relationship between DCM and digital education; I discuss the elements contributing to DCMiTI and the relationships between them. Lastly, I report on the status of research on DCMiTI in Nigeria. This Chapter concludes with theoretical answers to the first four research questions of this dissertation.

Chapter 4 extends one of the key findings from the Literature review to remove any ambiguity from the knowledge base that would be used to build the DCMiTI Framework. This Chapter presents the findings from exploring the key functions of Educational Technologists and their synonymous roles and reports on their impact on the effective implementation of Digital Maturity initiatives in TEIs.

Chapter 5 presents the methods and results of a confirmation study in a UK University, supporting the literature findings with empirical evidence that confirms the elements that affect Digital Capability Maturity in literature are the same as those in practice. Consequently, this Chapter validates the answers to research questions 1 - 3.

Chapter 6 presents the findings from Investigating DCMiTI in a case study of four different types of Tertiary Education Institutions. In this Chapter, I contextualise the research effort to TEIs in Northwest Nigeria. This Chapter further supports answers to research questions 1 – 3 and provides empirical support for the answer to Research Question 4.

Chapter 7 exploits the findings from previous chapters and details the process of assembling the proposed DCMiTI Framework to support TEIs in assessing their Digital Capability Levels and providing strategic guidance on how to achieve higher maturity levels. This Chapter provides evidence to answer Research Question 5.

Chapter 8 presents the results of investigating the efficacy of the proposed DCMiTI Framework with an expert panel. In this Chapter, I validate the proposed Framework and provide suggestions on how the Framework may be improved. Finally, this Chapter presents evidence to answer Research Question 6.

Chapter 9 discusses the results of all the studies in relation to the overall objective of this PhD and provides answers to all the Research Questions (RQ1 to RQ6).

Lastly, ***Chapter 10*** concludes this research work, presenting the contributions to knowledge and recognising its limitations. In this Chapter, I also provide recommendations for future work.

2. CHAPTER TWO: RESEARCH METHODOLOGY

In this chapter, I describe the overall approach and strategy adopted in this research. I explain the theoretical approach underpinning the whole research process; the research design, data collection methods, analysis techniques and sampling strategy used to address the Research Questions. I also offer the rationale and justification behind the chosen techniques and how they align with the overall research methodology.

Note: *It is essential to emphasize the distinction between research methodology and research methods. As such, I want to highlight that subsequent chapters of this study each include their own dedicated methods section. In these sections, I specifically discuss the techniques and tools employed to collect, analyse, and interpret the data within the respective studies. These methods are discussed within the broader context of the overall research methodology.*

2.1 Research Philosophy

A research philosophy refers to the set of principles concerning the stance from which the research is conducted (Creswell and Creswell, 2017). In this section, I report the compilation of beliefs, assumptions, and values embraced in this study, which have served as guiding principles for the chosen methodological approach and influenced my understanding of the nature of knowledge. This research philosophy can be perceived as the lens through which I, as the researcher, have conceptualized and conducted the various studies comprising this dissertation.

2.1.1 Overview of common research principles

A research philosophy is often discussed in terms of **ontology and epistemology**. Ontology pertains to the nature of existence and the authenticity of information, while epistemology relates to the knowledge and understanding necessary for research and the methods employed to acquire it (Crotty, 1998; Easterbrook et al., 2008).

In academic studies, philosophical positions are commonly categorized as **positivism and interpretivism**. Positivism assumes that knowledge is objective and exists independently of the subject being studied, while interpretivism recognizes that individuals have subjective perceptions and understandings of reality. As a result, positivist studies tend to employ a scientific approach, emphasizing the testing of phenomena and the collection of empirical evidence. Conversely, interpretivist studies often adopt a qualitative approach, placing emphasis on exploring subjective meanings and interpretations (Dourish and Bell, 2011).

Table 2-1: A general overview of characteristics of different research philosophies

Research Philosophy	Key Characteristics	Epistemology	Ontology	Research Approach
Positivism	- Objective reality independent of the observer - Emphasis on empirical evidence and quantifiable data - Deductive reasoning and hypothesis testing - Value-neutrality and objectivity in research	- Objectivist view of knowledge - Knowledge is discovered through empirical observation - Verification and generalization of theories	- Realist ontology - Belief in a single reality - External existence of social phenomena	- Deductive approach - Hypothesis testing - Quantitative research methods - Control and manipulation of variables
Interpretivism	- Subjective reality constructed by individuals - Emphasis on understanding social phenomena from the perspectives of participants - Inductive reasoning and meaning-making - Acknowledgement of researcher's values and biases in research	- Constructivist view of knowledge - Knowledge is socially constructed and context-bound - Interpretation and understanding of human behaviour	- Constructivist ontology - Belief in multiple subjective realities - Subjective experience and social construction of reality	- Inductive approach - Qualitative research methods - Emphasis on context and subjective meaning - Interpretation and understanding of social phenomena
Pragmatism	- Focus on practical outcomes and usefulness of research - Emphasis on problem-solving and application - Integration of theory and practice - Flexible and adaptable research methods	- Pragmatic view of knowledge - Knowledge is determined by its practical consequences - Action-oriented research - Learning through experimentation and experience	- Pragmatic ontology - Emphasis on practical consequences and problem-solving - Reality is contextual and constantly evolving	- Mixed methods approach - Combination of quantitative and qualitative research methods - Problem-solving and practical application of research
Constructivism	- Emphasis on social construction of reality - Recognition of multiple realities and perspectives - Active involvement of participants in knowledge creation - Reflexivity and awareness of the researcher's role in shaping research outcomes	- Constructivist view of knowledge - Knowledge is co-constructed through interactions - Subjective interpretation and negotiation of meaning	- Constructivist ontology - Belief in multiple constructed realities - Reality is subjective and context-dependent	- Inductive and deductive approaches - Mixed methods research - Emphasis on participant perspectives and co-creation of knowledge

There are several major research philosophies or paradigms, including positivism, interpretivism, pragmatism, and constructivism. Each research philosophy has its own assumptions and principles which can guide the choice of research methods, the way data is collected and analysed, and the interpretation of research findings. Table 2-1 provides an overview of the characteristics of the different research philosophies considered; I then share the philosophy adopted in this research by explaining my rationale and assumptions in 2.1.3 Rationale.

My personal beliefs align most closely with the paradigms of interpretivism and constructivism, which both emphasize the subjective nature of reality and the importance of understanding social phenomena from the perspectives of individuals. However, there are subtle differences between the two:

Interpretivism in computer science research focuses on understanding social phenomena and the subjective interpretations individuals assign to their experiences (Orlikowski, 1992) . Researchers employing interpretivism aim to explore and interpret these meanings using qualitative research methods such as interviews, observations, and textual analysis. The researcher's role is to make sense of the subjective perspectives expressed by participants. This approach is particularly relevant in computer science research when studying human behaviour, user experiences, and the social aspects of technology. It facilitates the examination of user interactions, usability testing, user-centered design, and the exploration of the social implications of computer systems (Dourish and Bell, 2011).

Constructivism, as an alternative to interpretivism, focuses on the social construction of reality, highlighting the role of individuals and society in shaping knowledge. It recognizes that reality is not pre-existing but is constructed through interactions and social processes. Within a constructivist framework, researchers aim to explore how knowledge is co-constructed through social interactions and how different perspectives contribute to the construction of reality. While constructivism may not be as commonly used in mainstream computer science research, it can still be relevant in specific contexts. For instance, in educational technology research, constructivism can inform the design of learning environments that foster active engagement and knowledge construction (Jonassen, 1999; Fleck and Fitzpatrick, 2019). By adopting a constructivist perspective, researchers can delve into the active construction of knowledge and the impact of individual agency in shaping their understanding of the world.

2.1.2 Philosophical stance and Assumptions

In summary, I find the stance of constructivist philosophies particularly favourable as it aligns seamlessly with my personal beliefs about the world, we live in. Applefield (2000) eloquently describes

it as world where meaning or understanding is constructed from an interaction between ideas and experiences. This extends to the belief that there are multiple realities of any truth, and such realities can be explored by investigating the meaning that different research participants give to the topic of investigation (Bryman, 1984).

Moreover, constructivism is well-suited to the phenomena under investigation, given the inherent contextual dependency of educational technology. As I take this philosophical stance to underpin the research work, I further detail the explicit assumptions inherent in this choice as follows:

Assumption 1: Knowledge is socially constructed

Individuals actively construct their understanding of the world through their interactions with others and the social context in which they are situated as such the research method will focus on exploring a diverse range of perspectives from multiple stakeholders to draw interpretations of DCMiTI. This subjectively also means the research process must continuously engage in peer review and validation exercises.

Assumption 2: Multiple realities exist

Reality is not fixed or universal, but rather varies among individuals and social groups based on their experiences, beliefs, and cultural backgrounds. Therefore, studies will focus on capturing and analysing a range of subjective opinion from multiple stakeholders in different institutions, acknowledging that different stakeholder from different TEIs may interpret and understand the DCMiTI in different ways.

Assumption 3: Context influences knowledge construction

Knowledge is shaped by the specific social, cultural, and historical context of the environment in which it is developed and shared. Therefore, the research will consider the contextual factors that influence the participants' perspectives and interpretations and will explore how the phenomenon is understood within specific contexts. Therefore, after conducting a comprehensive exploration of the phenomenon in the initial four chapters, the research and solution were specifically focused and customized to the unique environmental setting of Northwest Nigeria.

These assumptions guided my approach to data collection, analysis, and interpretation, as they prioritize understanding subjective experiences, exploring diverse perspectives, and recognizing the influence of social and cultural contexts on knowledge construction.

In the following section, I provide a rationale for my study design within the context of constructivism.

2.1.3 Rationale for choices in research methods

In the context of this research, the initial idea - '*construct*' of DCMiTI was generated as a result of my systematic literature review. Constructivism advocates that the opinion of stakeholders plays a crucial and active role in helping understand the domain (Gray, 2021) – suggesting the concept of DCMiTI would be better interpreted by surveying relevant stakeholders. Thus, my reasoning for employing **survey research methods** to substantiate my initial constructs and further extend the understanding of DCMiTI, before using the constructs as a basis for proposing a development structure.

To this end, I surveyed different Tertiary Education stakeholders in a series of studies to understand their opinions as follows: (1) Learners and tutors on the outcomes of my systematic review (2) Educational Technologists on their role in developing DCMiTI (3) Learners, tutors, and management in investigating the impact of DCMiTI and lastly, (4) Experts on the proposed DCMiTI Framework.

Assuming stakeholders' opinions are based on their experiences, then the constructivist approach meant gathering the results of the different surveys listed above and interpreting the data to establish acceptable constructs on DCMiTI based on a combination of theory and real-world experiences.

DCMiTI Constructs = ((Theory (SLR + initial ideas)) + (survey research (experiences)))

The final artefact (Appendix Y: The Proposed DCMiTI Framework v1.1) is a representation of the sound peer-reviewed constructs, supported by existing theories on maturity frameworks.

The next section details the overall approach to solving the research problem using this methodology. Followed by the detailed data-collection techniques adopted and how they also align with the overall research philosophy.

2.2 Overall Methodological Approach

The research aimed to investigate why, ***despite continued investments in technology, TEIs in Nigeria continue to show limitations in their ability to deliver digital education effectively***.

My PhD work suggests that the ineffective delivery of digital education may be due to limited digital capabilities and the absence of a development structure upon which such capabilities are built. Therefore, I believe that the introduction of a development structure upon which Digital Capabilities can be developed and supported will play a major role in improving the effectiveness of digital education.

To investigate this problem, I undertook a series of studies as listed below and summarised in Table 2-2.

Study 1: The first study was a Systematic Literature Review to establish the link between developing DCM and improved digital education delivery; and to produce generalisable knowledge about the elements contributing to Digital Capability Maturity in Tertiary Institutions (DCMiTI).

Study 2: A brief qualitative investigatory study was undertaken to explore one key aspect of the Systematic review and ensure a sound knowledge base upon which the DCMiTI structure would be constructed.

Study 3: Study 3 was a mixed methods study. The quantitative experiment substantiated the theoretical findings from the systematic review with empirical evidence. Followed by a qualitative study to provide more contextual, real-world knowledge about how the elements affect the digital maturity of TEIs.

Study 4: In study 4, I replicated the mixed method approach to triangulate the concept of DCMiTI and contextualise it to the Nigerian Tertiary Education setting.

Framework: With an established causal relation between DCM and digital education delivery; a sound body of knowledge from theory and the real world, and a validated classification of the elements that contribute to DCM, I constructed a DCMiTI Framework aimed at supporting the development of digital capabilities and consequently supporting the implementation of digital education programmes in Northwest Nigeria.

Study 5: In a final mixed-methods study, I evaluated the perceived usefulness of the proposed solution with a group of global experts in Digital Capabilities and Maturity Modelling.

Table 2-2: Summary of studies undertaken towards developing a DCMiTI Framework

Stages	Type	Primary data collection	Objective	Title	Data Collection Method	Sampling technique	Analysis Technique	Research question addressed
Study 1	SLR (Theoretical)	NO (secondary data)	Assess the problem domain and establish a causal relationship between DCM and digital education delivery	A Systematic Review of Elements contributing to DCM	SLR	Custom search string	Thematic analysis	RQ1-4
Study 2	Empirical	YES	Explore the key roles that impact the development of DCMiTI	The Impact of Educational Technologists on the development of DCM	Mini-focus group	Purposive sampling	Content analysis	RQ2
Study 3	Empirical	YES	Substantiate SLR findings and extend understanding of DCMiTI	Investigating DCMiTI in a UK University	Questionnaire/ Interview	Purposive/ Probability	Descriptive statistics/ content analysis	RQ1 and RQ2
Study 4	Empirical	YES	Substantiate SLR findings and contextualise the concept of DCMiTI to NW Nigeria	Investigating DCMiTI in Four TEIs in Nigeria	Questionnaire/ Interview	Purposive/ Proportional	Descriptive statistics/ content analysis	RQ1, RQ2 and RQ4
Framework	Development	NO	Use knowledge of DCMiTI to propose a development structure to support digital education delivery	Developing a DCMiTI Framework	-	N/A	-	RQ5
Study 5	Empirical	YES	Evaluate the usefulness of the proposed DCMiTI Framework	Evaluating the proposed DCMiTI Framework	Expert Panel Workshop (questionnaires and discussion)	Purposive	Descriptive statistics/ content analysis	RQ6

2.3 Data Collection Methods and Analysis Techniques

In this section, I provide the justifications for my various choices of data collection methods and analysis techniques used.

2.3.1 A Systematic Literature Review

Study 1 employed a Systematic review as a non-empirical but scientific method of gather existing information to answer the research question RQ1 to RQ4. Systematic reviews are typically used as a means of identifying and interpreting a wide range of available research relevant to a particular research question or topic (Kitchenham et al., 2009). In 2017, at the start of this thesis, the topic of digital capabilities was under-researched, therefore a systematic review was suitable as an initial study to provide a clear and comprehensive overview on the status of research in Digital Capability Maturity (DCM) in Tertiary Education Institutions.

The systematic aspect of the review meant using a set of inclusion and exclusion criteria so that other researchers can easily replicate the study (Brereton et al., 2007). My review was systematically designed and controlled using replicable search terms and a clear set of criteria to return qualifying peer reviewed academic literature on the topic. This method reduced bias when selecting papers to include in the review (Appendix A: SLR References).

The results from Study 1 were analysed using thematic analysis (Lochmiller, 2021; Scharp and Sanders, 2018; Ibrahim, 2012) to identify common themes that resulted in the assembly of an initial classification of elements contributing to DCMiTI (Table 3-5**Error! Reference source not found.**). I report this method in detail under the study chapter in 3.3 Methods.

2.3.2 A Mini Focus Group

Study 2 involved a mini-focus group to further explore one of the key findings from the SLR which deserved further investigation.

Focus groups are a qualitative technique used to understand an issue at a deeper level than can ordinarily be assessed through other survey techniques (Tichy et al., 1995; Langford and McDonagh, 2002; Kontio et al., 2004). Mini focus groups are a similar to focus group discussions, only smaller because they involve fewer participants, typically between 2 to 5 (Kamberelis and Dimitriadis, 2005; Nyumba et al., 2018), and they are usually made up of people with high level expertise in the area of investigation (Nyumba et al., 2018).

Mini focus groups were an appropriate method of enquiry as they are generally used to add meaning and understanding to existing knowledge or to get the 'why' and 'how' of a research question (Nyumba et al., 2018), thus I used this technique to further investigate 'why' Educational Technologists (ETs) were underrepresented in literature and 'how' they affect the development of DCMiTI.

The mini-focus group consisted of 5 open-ended questions (Mini Focus Group Session Schedule and Moderator guidelines) to help guide the discussion. Qualitative investigations are often piloted to help the researcher assess the acceptability of the questions (Oringderff, 2004; Eldridge et al., 2016).

As with larger focus groups, mini groups are typically recorded and transcribed for analysis (Shull et al., 2008; Rabiee, 2004), as this reduces the likelihood of missing any important information that may not be captured in note taking. The audio-recording was transcribed verbatim and uploaded to Nvivo (Nvivo, n.d.) for content analysis. I report this method in detail under the study chapter in section 4.3 Methods.

2.3.3 Mixed method: Questionnaires and Interviews

In Study 3 and Study 4, I investigated the initial ideas about DCMiTI using a mixed method approach, utilising the advantages of both quantitative and qualitative techniques (Denscombe, 2008). This investigation was well-suited to this method of enquiry because the combination of approaches provides better insight and understanding into the research problem than using either approach alone, particularly in the study of complex phenomena (Creswell, 2015) such as DCMiTI.

Using mixed methods allowed me to extend the breadth and depth of my investigation by using different methods for different inquiry components (Yu et al., 2017; Creswell and Clark, 2018), i.e., using the quantitative technique to substantiate the literature findings from Study 1: SLR with primary empirical data, then using the qualitative to further explore the domain and extend the understanding of DCMiTI from the perspective of management stakeholders.

The two approaches complement each other in that, the qualitative results are used to provide more clarity on quantitative data (Greene et al., 2016), this is often referred to as an embedded approach as shown in **Error! Reference source not found.**, where the quantitative (QUAN) results are embedded i n the qualitative (qual) narrative.

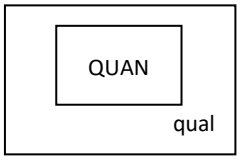

Figure 2-1: Quantitative data embedded in qualitative data

I also considered the challenges associated with embedded designs, such as: difficulty in connecting the findings and the possibility of bringing bias into the research by collecting qualitative information in the middle of quantitative study. To circumvent these risks, it was necessary to maintain transparency in the analysis process, which I have documented in the study chapters in section 5.4 Results and Analysis.

I conducted each study in two sequential phases, so the first phase was the quantitative investigation, which was undertaken and analysed to explore participants views on elements contributing to DCMiTI; before moving onto the second phase, that was the qualitative investigation which provided a narrative to rationalize the results. Finally reporting quantitative results with a qualitative narrative (QUAN-qual) thus combining theory, practice, and empirical evidence to draw the conclusions used to inform the construction of the DCMiTI structure.

Study 3 was intended as an exploratory study to firstly explore the domain in richer depth, and secondly to pilot the survey tools and analysis techniques amongst a smaller population before embarking on the larger case study in Nigeria.

Once Study 3 yielded successful outcomes, the tools and techniques were slightly adjusted and used to conduct Study 4. Table 2-3 summaries the details of the two mixed-method studies.

Table 2-3: summary of the two mixed-method studies used to investigate DCMiTI

	Study 3: Exploratory Study	**Study 4: A Case study of NW Nigeria**
Goal	The primary goal was to collect survey responses from Tertiary Education stakeholders. The secondary goal was to test the effectiveness of the survey tools and techniques.	The goal was to collect survey responses from Tertiary Education stakeholders across a range of different types of TEIs in Nigeria that would be reflective of the population of the study.
Location	United Kingdom	Nigeria
No. of TEI surveyed	1 University	1 University 1 Polytechnic 1 Federal College of Education 1 Monotechnic
Sampling	Probability sampling	Purposive / Proportional *
Questionnaire Administration method	The questionnaire was administered using onlinesurvey.com on dedicated tablets solely for the purpose of the study	The survey was administered using manual pen-to-paper questionnaires to avoid losing any data due to limitations of internet connectivity
Interview participants	TEI Stakeholders/ Management	TEI Stakeholders/ Management
Interview location	Interviews were conducted in pre-booked meeting rooms on the university campus	Interviews were conducted in pre-booked meeting rooms on the TEI campus
Data capture	Audio-recording	Audio-recording
Data Collection	Data was exported to SPSS for analysis	The data was manually entered into excel and imported to SPSS for analysis

*details of how these three techniques were employed in this study is reported in 2.4 Sampling Strategy and further detailed in 6.3 Methods.

2.3.3.1 Questionnaires

Questionnaires measured respondents' agreements with each element in the classification and agreements on their effect on DCMiTI. Questionnaires lend themselves well to survey research (Ghazi et al., 2019) and allowed me to efficiently gather data from large groups of participants (Patten, 2017), which was important considering I surveyed a sample size representative of the Northwest Nigeria based on (Krejcie and Morgan, 1970).

The questionnaires consisted of 20 questions measured on a 7-point Likert scale and 10 questions measured on a 10-point ranking scale, followed by 1 open-ended question.

A 7-point Likert scale was used to gather participants agreement levels because researchers have suggested that 5-point scales are not sensitive enough to reflect participants true evaluations and larger number of choice points improves scale reliability (Cummins and Gullone, 2000). Furthermore, 7-point scales have been shown to be more accurate, easier to use and they provide a better reflection of respondent's true evaluation compared to higher ordered scales (Finstad, 2009). The power of ranking scales in measuring the priority of options (Preston and Colman, 2000; Finstad, 2009) qualified this as well-suited method to gain insight on the order significance of elements in the classification of DCMiTI.

Study 4 replicated the questionnaire used in Study 3, with a few variations based on pragmatic decisions made along the way:

1. The case study of northwest Nigeria (Study 4) used pen-to-paper questionnaires as opposed to the electronic surveys used in the UK Study. This was due to limitations of internet connectivity and bandwidth to load the electronic questionnaires in Nigeria. Additionally, the target population far outweighed the number of tablets available and given the limited duration of time I had to complete the study; the decision was made to conduct the survey manually.
2. Study 3 was intended as an exploratory study to explore the survey tools and analysis techniques that would be used to investigate DCMiTI in practise. Therefore, Study 3 recruited a smaller number of participants - study 3 recruited participants at random with no sampling strategy, while Study 4 employed a full sampling strategy before collecting data.

2.3.3.2 Interviews

Semi-structured Interviews are a more personal survey method used when a specific target population is involved (Patton, 2002). Management staff of TEIs are in a unique position of having access to

learning and professional development, observing the day-to-day running of the institution as well as seeing the TEI from a managerial standpoint. Therefore, management staff were an ideal stakeholder to target to gain a more in depth understanding of DCMiTI through their lived experiences.

Interviews were conducted to explore the opinions of TEI management on 'how' the elements affect digital maturity, while leaving room for respondents to mention new elements that may not have been captured in the initial classification. This technique was particularly helpful for gathering richer information (Carruthers, 1990) about DCMiTI. The semi-structured attribute of interviews was particularly suitable for testing existing theories on DCMiTI while also creating room for new knowledge (Patton, 2002).

A semi-structured interview schedule was prepared with a set of 6 questions to prompt the interview discussion. I piloted the schedule for understandability of the questions to practice my interview facilitation techniques in a way that does not lead the participant. I used the lessons learnt from the pilot to review the interview schedule.

Study 4 had the secondary objective of using interviews to contextualise DCMiTI to the Nigerian Tertiary Education landscape and further explore the prospects of using maturity modelling as a mechanism for supporting the DCM development in Nigerian TEIs. There was no difference in the interview schedule or techniques used for the two studies.

The quantitative data was imported to SPSS (IBM, n.d.) and analysed using descriptive statistics. Interviews were audio recorded and I transcribed the recordings verbatim. Transcripts were used in content analysis. I report both methods in detail under the study chapter in sections 5.3 Methods and 6.3 Methods respectively.

2.3.4 Expert Panel Workshop

The last study employed an online expert panel workshop to assess the validity of the proposed DCMiTI Framework (CHAPTER EIGHT: VALIDATING THE PROPOSED DCMiTI FRAMEWORK) and concludes the research effort.

Given the subjectivity of the first four studies, it was important to choose an objective method of assessing the proposed artefact since the duration of the PhD would not be sufficient to test the framework in the field.

Expert panels are a popular method of gathering a variety of multiple expert viewpoints to synthesize exiting knowledge and identify potential issues (Waltz et al., 2015). Therefore, it was a suitable

method to test the perceived validity of the proposed framework among experts in DC, maturity modelling and experts in the Nigerian TEI setting. One of benefits of using experts is that they often engage better in the survey because it is better understood by them and likely of interest to them, furthermore, using an online approach allowed me to survey diverse group of geographically distributed experts (Khodyakov et al., 2011).

Mathew (2011) used an expert panel to review a maturity model and reported it as a useful method for highlighting potential strengths and weaknesses (Mathew et al., 2011). Results of the expert reviews are typically used to make recommendations on the review artefact (Waltz et al., 2015; Mathew et al., 2011)), thus suggesting it is suitable method to assess and report on the perceived validity of the proposed DCMiTI Framework. The utilization of an expert panel brings significant value to the research process by informing it, synthesizing evidence, and offering diverse perspectives from multiple disciplines (Colquhoun et al., 2014).

A semi-structured expert panel was conducted online via zoom meetings with a group of five geographically distributed experts. The workshop involved a debrief of the research and required that expert participants had reviewed the proposed framework prior to participating.

I used a mixed-method approach to conducting the workshop, as I combined quantitative and qualitative techniques to gain clarity (Greene et al., 2016; Molina-Azorin, 2016; Creswell, 2015) as to the validity of the proposed framework.

The quantitative part of the workshop involved an online questionnaire using Zoom's inbuild functionality (Zoom Support, n.d.) to survey expert participants' opinions on the proposed Framework. The workshop included four types of questions:

1. The first set of questions were measured on a 7-point Likert scale to rate: (1) reasonability, (2) usefulness and (3) applicability of the proposed Framework. I discussed above why I have chosen to use 7-point Likert scales for measuring respondents' opinions.
2. 6 single-choice questions – to gather experts' opinions on the current wording of the 'level descriptors' used in the proposed Framework (the words used to describe maturity levels 0-5). I explain why this question was important in the study CHAPTER EIGHT: VALIDATING THE PROPOSED DCMiTI FRAMEWORK.
3. 2 open-ended questions. The first allowed respondents to share opinions that may not have otherwise been captured, and the other explored their envisaged mode of use for the proposed framework.

The qualitative part of the workshop engaged experts in an open-ended discussion guided by the questionnaire. The discussion focused on furnishing the quantitative data with some rationale as to the experts' opinions.

4. An open-ended discussion guided by the first set of questions on reasonability, usefulness, and applicability of the proposed framework.

The quantitative data from the questionnaires were exported to SPSS and analysed using descriptive statistics. The discussion was recorded and transcribed verbatim. The transcription and the qualitative data from the questionnaires were imported to Nvivo for content analysis.

I report both methods in detail under the study chapter in section 8.3 .

2.4 Sampling Strategy

Sampling methods are the practical techniques used to select participants to engage in the primary data collect methods described in section 2.3 Data Collection Methods and Analysis Techniques above. The sampling techniques used in each study are summarised in Table 2-2; below, I offer the rationale and justification behind these choices.

Given the active role of individuals in constructing their own understanding and knowledge as explained above in section 2.1.2 Philosophical stance and Assumptions and the assumption that knowledge is developed through subjective experiences, multiple perspectives, and the social and cultural contexts. It can then be suggested that choose sampling methods that allow for the exploration of diverse perspectives and experiences to capture the subjective and socially constructed nature of knowledge would be more conducive to the research effort (Creswell, 2015).

For this reason, I explored a range of sampling strategies, and I employed a combination of purposive, probability and proportional sampling techniques across the various studies as I reason below:

Purposive sampling, also known as selective sampling, involves to selection of study participants based on specific criteria (Palinkas et al., 2015). Purposive sampling allowed me to select participants who possessed in-depth knowledge on the research topic which would provide a comprehensive understanding of the DCMiTI. Given the limited duration of the PhD programme, purposive selection of participants would also be time-efficient and enable data capture a large amount of data from specific individuals most relevant and knowledgeable on the research topic, avoiding the need for excessive recruitment and analysis of data from a large and potentially less relevant population.

Nevertheless, to mitigate subjectivity in the participant selection process, the selection criteria of study participants was guided by the findings of the Systematic Literature Review.

Proportional sampling is a technique used to create a sample that reflects the proportions of different subgroups with the study population. The sample is selected in such a way that the relative sizes of the subgroups are preserved in the sample (Fink, 2013). This method was particularly suitable and useful in Study 4 to collect data that would represent the different types of TEIs and represent the opinions of stakeholders in North-West.

Probability sampling, commonly referred to as random sampling, involves the randoms election of participants from a larger population in a way that all members of the population have a equal chance of being included in the sample (Fink, 2013). Probability sampling was suitable in Study 3 because it allowed me to pilot the investigation tools and techniques among a smaller population while still ensuring generalisability of the findings, although the sample was not necessarily representative of the entire population. Probability sampling was again adopted in study 4 in Nigeria, after purposively selecting the TEIs and calculating the proportional sample sizes I needed to collect to represent Northwest Nigeria, groups of participants were selected at random to participate in the study.

Regarding the identification of stakeholders, it is necessary to note that the selection of stakeholder groups engaged in the entire research process was deliberate and informed by the findings derived from the SLR.

In summary, this research embraces a combination of purposive sampling, probability sampling, and proportional sampling techniques to select participants and determine appropriate sample sizes for data collection, as shown in Table 2-2 . These diverse sampling approaches not only align with the constructivist stance adopted in this research but also serve as strategic tools for gathering the necessary data to effectively address the research questions within the specified timeframe of the PhD.

Regarding the identification of stakeholders, it is important to highlight that the selection of stakeholder groups involved in the entire research process was deliberate and informed by the findings from the Systematic Review. The research aimed to involve a diverse range of stakeholders in different the numerous studies, aligning with the specific objectives of each study; in order to explore a wide and diverse range of perspectives and better understand the research domain.

Detailed information regarding the sampling and recruitment process can be found in the respective methods sections of each study chapters.

The next chapter is the first study chapter, detailing the methods, analysis, and results of the systematic literature review.

INVESTIGATING DIGITAL CAPABILITY MATURITY

3. CHAPTER THREE: SYSTEMATIC LITERATURE REVIEW

In this chapter, I report an extensive systematic review of literature, in which I explored the research domain and established the causal relationship between DCM and digital education. The review identified candidate elements contributing to DCM and how they affect the maturity of Tertiary Education Institutions. The results were summarised in a classification of elements which was peer-reviewed at 2 academic conferences (Advance HE STEM Conference and British Academy of Management Conference) both validating the general trajectory of the research work and providing support that the development of DCM would in turn support digital education delivery/ practices. The review provided sufficient evidence to suggest the development of DCMiTI Framework was a worthy undertaking. The findings reported in this chapter, theoretically address the first four research questions of this dissertation:

RQ1: What elements contribute to Digital Capability Maturity?

RQ2: How do these elements affect the Digital Capability Maturity of tertiary institutions?

RQ3: What is the status of research on Digital Capability Maturity?

RQ4: What is the status of research on Digital Capability Maturity in Nigeria?

3.1 Background

At the start of this research in 2017, Digital Capabilities was an uncommon term and little information was available in the domain. Kitchenham, (2004. Pg1 stated that "a systematic literature review is a means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest". Therefore, an extensive review of existing literature was necessary to explore the problem domain before proposing a solution.

The review presented in this chapter provides a clear landscape of the existing body of knowledge around the concept of 'Digital Capability Maturity' and more specifically DCMiTI between 2012 to 2017, with an update on RQ4 in 2023. The review summarises research studies in the field in a way that is fair, rigorous, and auditable and provides a firm basis upon which initial ideas on DCMiTI and the status of its research are formed. Research questions were used to guide the review, with each question building upon the findings of the preceding query.

The systematic review process was heavily based on guidelines provided by (Kitchenham, 2004). The next section lists the aims and objectives used to guide the study, followed by detailed methods used to conduct the review process.

3.2 Aim

The aim of the study was to produce generalisable knowledge about DCM with the goal of establishing the link between DCM and Digital Education. Then reporting the status of research on DCMiTI and narrowing it down to the status of research on DCMiTI in Nigeria.

The study, particularly the data gathering process, was guided by the first four research questions of this dissertation (as listed above).

Below, I describe in detail, the methods used to conduct the review and answer the research questions.

3.3 Methods

I employed a systematic and comprehensive review process to identify literature to address the first four research questions of this dissertation; with each question building upon the answers of the preceding enquiry. A detailed review protocol was built around the research questions RQ1 to RQ4. The full protocol can be seen in Appendix B: Protocol for Systematic Review. Below I provide a synopsis of the review protocol.

3.3.1 Synopsis of review protocol

The protocol describes comprehensively the steps taken to address the scope of the literature search. Including initial identification of papers, abstract screening, and full-text eligibility. In the sections below, I detail each of the stages involved in determining papers to be included in the study.

3.3.1.1 Initial manual search

An initial manual search established the availability of information in the subject area. This was done using *Google Scholar*, *Scopus,* and *IEEE* search engines. The process involved looking at grey literature as well as open access material to identify papers relevant to the research domain and get a clear understanding of the *key terms* used in relation to the research topic. The key terms will be used to construct search string for the automated search. This method identified 25 gold standard papers relevant to digital capabilities and maturity model developing in Tertiary Education. See list of papers in Appendix: Included papers from manual search.

3.3.1.2 Automated search using Scopus

The automated search involved writing search strings using the key terms identified in the manual search, to pass through the selected search engine. The systematic review employed papers from only one search engine (Scopus, n.d.). Earlier versions of the strategy had suggested using several search

engines to eliminate the possibility of introducing bias associated with using a single source. However, Scopus content coverage published by Elsevier in 2017 (Elsevier, 2017) states that Scopus offers the broadest, most integrated coverage of peer-reviewed literature from over 5,000 publishers across all research fields. It is the largest abstract citation database, indexing publishers from other databases including Elsevier, IEEE, Science Direct, SAGE, Taylor & Francis among others; reasoning that it is a sufficiently powerful search engine to use for the purpose of this literature review.

The second reason for choosing Scopus, was due to the magnitude of the search strings I constructed, as shown in Figure 3-1. Scopus was the only search engine that would accept a search string of that length. Other engines truncated the string after 15 strings, limiting the ability to replicate the search in other databases. The review was limited to papers published between 2012 to 2017.

3.3.1.2.1 Search terms used

((*elements* OR *dimensions* OR *attributes* OR *characteristics* OR *constituents* OR *factors* OR *items* OR *facets* OR *as pects*) AND (*contribute* OR *affect* OR *add* OR *furnish* OR *aid* OR *assist* OR *benefit* OR *help* OR *impart* OR *extend* OR *offer* OR *cause* OR *change* OR *influence* OR *sway* OR *impact* OR *strike* OR *"give-rise-to"* OR *"chip-in"* OR *"lead-to"*) AND (*"digital capability"* OR *"digital literacy"* OR *"electronic capability"* OR *"electronic literacy"* OR *"ICT literacy"* OR *"eLearning"* OR *"e-Learning"*) AND ("maturity" OR "improvement" OR "growth" OR "ability" OR "capability" OR "maturation" OR "sophistication" OR "development" OR "matureness" OR "readiness" OR "ripeness"))

Figure 3-1: example of search strings used to return papers for RQ1

Note: Additional search strings for other research questions can be seen in Appendix C: Initial Search Strings

Search strings were constructed for each research question RQ1-RQ4 using a combination of the alternate words and synonyms of the *key terms* identified, and Boolean logic. Figure 3-1 shows an example of the search string used to return papers for RQ1. The full search terms for all RQs can be seen in Appendix C: Search Strings. The number of papers returned from the selected database using these search terms are shown in Table 3-1.

Table 3-1: Number of papers returned by Scopus using search terms

Search terms	No. of papers returned
RQ1	3904
RQ2 + RQ3	4980
RQ4	11
RQ4 Updated	46

3.3.1.2.2 Inclusion/ Exclusion Criteria

Papers identified in table 3-1 were subject to analysis by applying two sets of inclusion and exclusion criteria. The first set of criteria were question specific and reduced the result set as shown in Table 3-2. The second set of criteria were general and applied to all the RQs.

This question specific criterion included the use of *Boolean logic* to create statements of terms that were deemed as irrelevant to the question and topic area in general (e.g., 'NOT'). This criterion was applied to the initial result set, within the search engine itself as an extension of the initial search string as shown in Appendix C: Search Strings. Applying the question specific criteria returned papers that were more relevant to the research questions. The number of papers reduced by 79.6% for RQ1, 88.85% for RQ2 and RQ3 and 30.43% for RQ4.

Table 3-2: Number of papers included after applying question-specific criteria

Search terms	No. of papers returned
RQ1	796
RQ2 + RQ3	555
RQ4	9
RQ4 Updated	32

The next step involved further analysis of papers through the application of general inclusion/exclusion criteria presented in Table 3-3 below. After which, 184 papers were returned for RQ1, 243 for RQ2 and RQ3. RQ4 initially returned 9 papers in 2017, however this increased to 32 when the review was updated in 2023.

Table 3-3: General Inclusion/ Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
1. Papers published in the last 5 years (between October 2012 to October 2017)	1. Exclude papers that were not originally written in English language
2. Papers that answer one or more of the research questions.	2. Incomplete papers or abstracts of an unfinished paper
3. Focuses on the elements of the Digital Capability framework	3. In the form of books and overhead presentations
4. Defines the elements that contribute to Digital Capability	4. Opinion pieces or viewpoints
5. Relate to any Capability Maturity model used in an educational environment	

3.3.1.2.3 Refinement of Included Papers

A two-phase refinement process was then undertaken of papers included from the search results, which included a screening and eligibility exercise. The process aimed to discard papers that were not relevant to the study.

3.3.1.2.3.1 Phase One Refinement (Screening)

This first stage of the refinement process discarded papers easily identified as unrelated to the subject area. This was done by reviewing the title and abstract of each paper and deciding to mark it as

'accept', 'reject', or 'not sure' according to the inclusion and exclusion criteria (Table *3-3*). The accepted papers, and those undecided on, were then included in the peer review process. The 'accept' and 'not sure' papers were screened again independently by two researchers in the field, to decide on a complete set of papers to be included in this phase of the study, while all the rejected papers were excluded. This was a very useful process because using RQ1 as an example, 796 out of 3,904 papers were eligible for the next phase of the study, meaning 80% of papers were rejected as irrelevant to study. The full screening documents for all RQs can be seen in Appendix D: Screening documents.

3.2.3.2 Phase Two Refinement (Eligibility)

The second stage of refinement aimed to discard papers from the remaining set that did not answer the research question. Eligibility involved reading the full-text research papers in detail. The result set of this process was a final set of papers that fully addressed the research questions and complied to the criteria.

At the end of this automated search process, 115 papers were included for RQ1, 137 for RQ2 and RQ3 and 28 papers for RQ4 as shown in Figure 3-2.

3.3.4 Additional Papers Included

A set of twenty-five papers were included in addition to the papers identified in the automated search. These papers were hand selected from the papers identified during the manual search. The decision was made to include them after reading the full text on the basis that these papers identified knowledge not found in the SLR. The intelligence derived from these papers would reinforce and further compliment the results of the review (Included papers from manual search).

280 papers were included from the automated search, in addition to the 25 papers identified in the manuals search, making total of 305 papers included in the analysis. The complete list of included papers can be seen in Appendix A: SLR References.

3.4 Results and Analysis

In this section, I summarise the results of the systematic review and provide an analysis of the findings to suggest theoretical evidence that will be used to answer RQ1 to RQ4. Figure 3-2 summarises how papers were sorted through the review process.

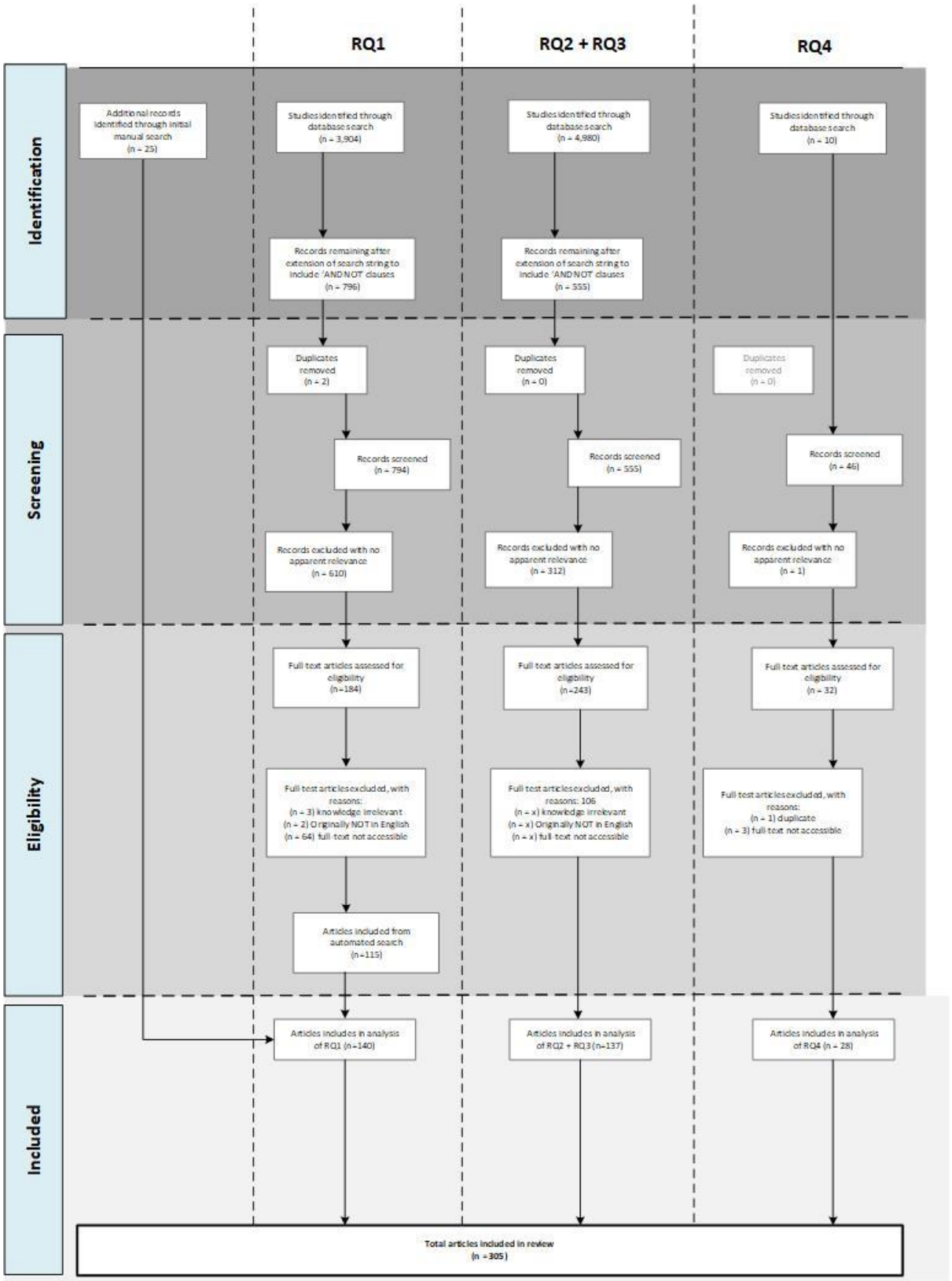

Figure 3-2: papers included in review for each RQ

After reading the full text of all included papers, a subjective analysis was undertaken to extract information that helped to answer the research questions RQ1 to RQ4. Table 3-4 shows the number

of papers used in the analysis of each research question. A comprehensive data extraction sheet can be seen in RQ4 Updated Screening and analysis

Appendix E: Data Extraction.

Table 3-4: papers included in analysis for RQ1 to RQ4

Research Question	No. papers used in analysis
RQ1: What elements contribute to DCM?	115
RQ2: How do these elements affect the DCMiTI?	137
RQ3: What is the status of research on DCM?	
RQ4: What is the status of research on DCM in Nigeria?	28
Manually selected papers included in the review	+25
Total Papers included in Review	**305**

Below I present the results and preliminary analysis of data gathered.

3.4.1 Analysis of RQ1 data

RQ1: What elements contribute to Digital Capability Maturity?

This process was particularly extensive for RQ1 where the goal was to extract elements contributing to Digital Capability. In this process, I identified elements as terms that were explicitly mentioned, as well as a few that were implied as factors. Elements were extracted even if the paper did not go as far as directly addressing the element, but the simple presence of the element justified extraction. The body of knowledge from all the papers combined allowed each of the elements and sub-elements to be defined as presented in the GLOSSARY. Below I describe in detail, how elements were extracted, synthesised, and harmonised to answer the research question.

3.4.1.1 Identification of elements contributing to DCM

An overall analysis of the papers reviewed, found 498 distinguishable elements that affect Digital Capability. However, this initial result set contained a large amount of redundant data, meaning a synthesis of the data was necessary to arrive at a clear and concise result. Figure 3-3 presents the 3-step data synthesis process. The first step after data extraction was to weight the data, according to the number of occurrences of each element. Out of the 498 elements that were found in 140 papers for RQ1 (115 + 25 papers from the manual search), the weightings revealed only 6% of the elements had 10 or more occurrences. While the remaining 94% of elements were less represented in the literature. Figure 3-4 shows the 28 most represented elements and their frequency of occurrence.

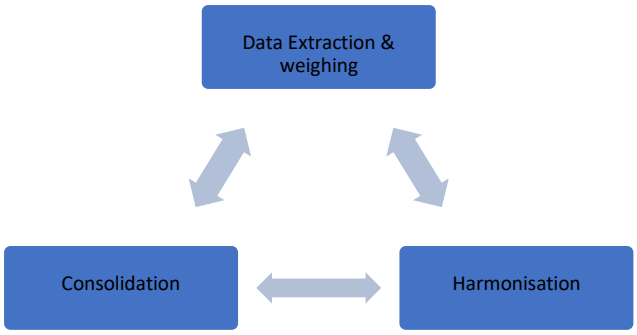

Figure 3-3: data synthesis process

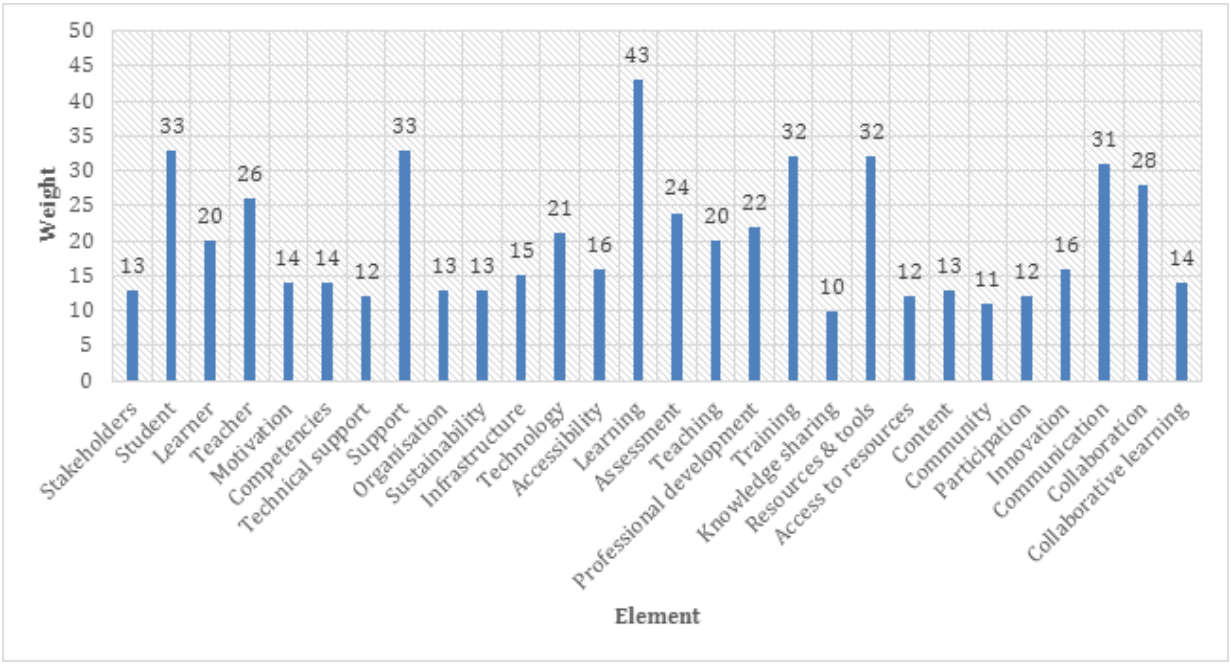

Figure 3-4: most frequently mentioned elements

3.4.1.2 Consolidation of elements

A deeper analysis of the results observed a high number of tautologies. The terms lecturers, teachers, staff, teaching staff, instructors, tutors, educators, facilitators, and trainers are all used in different contexts to describe academic staff whose role is to teach. In essence they are using different terminology to refer to the same or similar concepts. These tautologies resulted in the large number of underrepresented elements, where tutor alone had a weighting of 26 but when combined with the additional 8 terms of like meaning, it had an overall weighting of 54. The second stage of the synthesis resolved this problem through a thematic analysis. The data from the initial result set were further analysed and consolidated according to themes, so that elements using different words to mean the same element, or elements that belonged to the same general category were placed together.

Tautologies were maintained to prevent bias from compromising the integrity of the result set. Notwithstanding, removing the tautologies would have no impact on the themes or their weightings. It does, however, preserve transparency and provide insight into the common terminologies used in the field.

This stage of the synthesis was an iterative process, the first round of analysis discovered 21 themes. Subsequently the final consolidated result set contained 10 elements each with constituting sub-elements as shown in Table 3-5. The overall weightings associated with each element are shown in Figure *3-5*.

The distribution of weightings indicates that 18.7% of the literature was related to learning, training & development, closely followed by resources, tools & content (13.7%), and then collaboration (11.1%). The least attention in literature is given to digital creation and innovation with (3.9%), external factors with (4.7%) and then digital identity and wellbeing with (5.7%).

Table 3-5: candidate elements and constituting sub-elements

	Theme	Consolidated elements	No. of elements	Total weighting	%
1	**External Factors**	External factors	26	54	
		Ministry	11	24	4.6512
2	**Stakeholder**	Stakeholder	1	13	
		Learner	3	55	
		Tutor	9	54	
		Others	21	38	9.5408
3	**Personal skills**	Personal	45	114	
		Technical skills	18	39	9.1234
4	**Digital Identity & wellbeing**	Wellbeing	12	26	
		Support	12	69	5.6649
5	**Organisation**	Organisation	84	188	11.2105
6	**Infrastructure**	Infrastructure	13	32	
		Connectivity	14	31	
		Technology	45	131	
		Usability	7	14	12.4031
7	**Learning, training & development**	Learning	50	158	
		Pedagogy	11	41	
		Training & development	21	114	18.6643
8	**Resources, tools & content**	Resources & tools	34	114	
		Content	13	39	
		Online communities	25	77	13.7150
9	**Digital creation & Innovation**	Innovation	6	27	
		Content[1]	*13	*39	3.9356
10	**Collaboration**	Communication	8	50	
		Collaboration	9	59	
		Online communities[2]	*25	*77	11.0912

*Note: percentages are based on the thematic analysis, so individual elements may belong to one or more themes. As a result, the total number of elements in the table add up to more than 498.

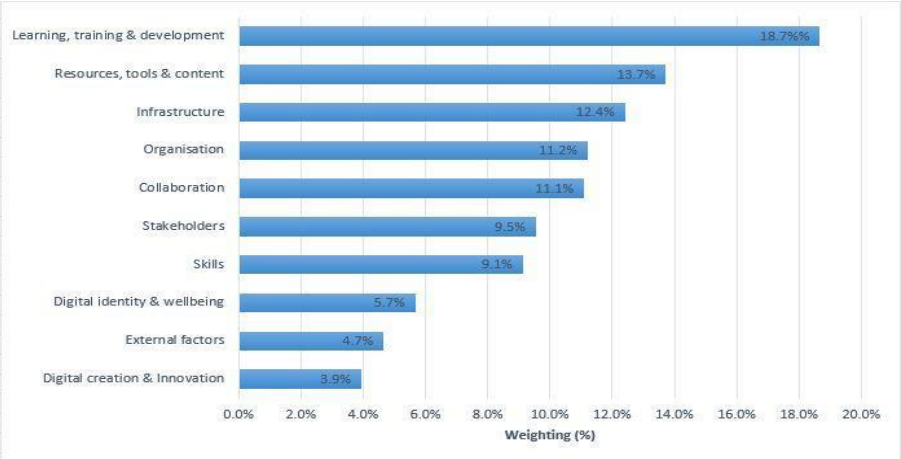

Figure 3-5: Distribution of weighting for each element

3.4.1.3 Harmonisation of elements

The last stage of the synthesis was a harmonization of the themes identified. It involved producing a descriptive narrative around each of themes based on the review of literature. This was considered the final result set Appendix G: Harmonised data.

Table 3-6: stakeholders titles identified in literature

TEI Stakeholder groups
General stakeholders (non-specific)
Learners
Tutors
Departmental heads
Management/ leaders
Administrators
Librarians
IT service staff
Curriculum team
Instructional designers
Digital Champions
Digital specialists
Staff development team
Equality and inclusion specialists
Estate provision staff
Government

[1] Content belongs to two different themes: Resources, tools & content and digital creation & innovation.

[2] Online Communities belongs to two different themes: Resources, tools & content and collaboration.

Another part of this harmonisation included listing the various TEIs stakeholders that were mentioned in the literature as shown in Table 3-6. Stakeholders were consolidated into the following groups: *Government stakeholders*, *TEI management*, *Administrators, Technical staff, tutors*, and *learners*. The notable observation was that there was no indication of educational technologists among stakeholders. This was an interesting finding given my lived experiences of the pertinent role they play in the deployment of digital programmes in TEIs. This gap in knowledge must be addressed to gain a reliable knowledge base upon which a DCMiTI will be built, therefore, I address this knowledge gap in further detail in Chapter Four.

3.4.2 Analysis of data for RQ2 and RQ3

RQ2: How do these elements affect the Digital Capability Maturity of Tertiary Institutions?

This research question was intended to assess the way in the elements identified, impact on an institution digital maturity. 137 papers were reviewed, and the knowledge gained from reading these full text publications was consolidated into a narrative on DCMiTI which can be seen Appendix I: Synthesis of RQ2 Data in a narrative Appendix I: Synthesis of RQ2 Data in a narrative.

In summary, the information extracted from reading these papers suggest that all the key findings listed in Table 3-7 have a positive effect on DCMiTI when they are considered and developed by the TEIs; and an inverse effect when neglected.

Table 3-7: Summary of how elements impact Maturity of TEIs

	Themes	**Key findings**	**Studies**
1	External Environment	- MoE - Cultural capital - Sociocultural factors - Level of digital literacy	S10, S41, S42, S52, S58, S61, S66, S71, S84, S88
2	Digital Environment (TEI)	- Management responsibilities - Open learning philosophy - Well-defined and effective institutional frameworks that support continuously evolving learning environments - Attitude and motivation of learners is greatly influenced by management motivation (Institutional policies and incentives) - Consideration of wellbeing drives institutional policies - Physical elements impact sense of attachment and affect learner performance	S3, S10, S22, S31, S32, S41, S52, S54, S58, S61, S66, S67, S71, S73, S88, S105
3	Stakeholders	- Learners, tutors, and management have been identified as key stakeholders - Each stakeholder is required to take responsibility of their role	S10, S11, S28, S29, S31, S39, S41, S52, S54, S58, S61, S66, S71, S88
4	Personal Skills	- Individual skills affect quality of learning output - Information skills and literacy skills - Cultivation of skills facilitates integration of individuals into digital environments - Cultivation of high-quality skills are more conducive to learners when they are personalised - Positive attitudes towards learning improves enthusiasm and effectiveness - Frequent participation and reflection improve quality of participation and consequently quality of output - Recognition of learning outcomes for further studies or employment is motivation for learners to participate in digital learning - Understanding effects of technology misuse considered as new dimension of digital competence - Tutors' pedagogical skills, including guidance notes and teaching content are essential to learning success	S3, S10, S11, S18, S29, S31, S42, S52, S54, S58, S60, S61, S66, S67, S71, S84, S88, S105

5	Digital Well-being	- Technical support to helps users' complete tasks - Training develops confidence and competency to perform tasks without help - Social works improve careers and shape identities of users - Support users by educating them on the possibilities and implications of technology overload - User friendly tools provide users with comfort in using software and prevent them from feeling over-whelmed with options	S22, S67, S71, S75, S84
6	Infrastructure	- Good infrastructure improves sharing across campus, helps acceptance and success - Networked platforms in teaching environments improve quality of learning and promotes cultivation of higher-quality talents - Technical support for hardware and software - Physical engineering improves performance using best fit for the institution - Design and visual components of learning can increase participation - Security and privacy (some issues can partly be handled by institutional or governmental policies) - Stakeholders' knowledge of infrastructure helps development of competencies	S18, S22, S41, S58, S61, S66, S71, S73, S78
7	Learning, training, and development	- Institutional support to facilitate use of technology in the learning process - Consideration of individuals well-being in using technological tools and devices - Learning strategies impact learner experience and attrition - Course organisation, learning materials and assessment instructions affect learning outcomes - It is important for learning providers and other stakeholders to define clear objectives and use evidence and good practice to improve learning strategies - Effective training improves skills in modern working environments - Active participation has positive effect on learning - Behavioural, cognitive, and emotional engagement impacts learning experiences - Quality of learning impact integration into labour markets - Stakeholders' awareness of dealing with technology	S3, S10, S11, S22, S28, S29, S41, S54, S58, S60, S71, S73, S78, S84, S88, S105
8	Resources, tools, and content	- Collaborative tools encourage participation - Digital learning tools are required to be high quality, inclusive and accessible - Choice of appropriate tools and teaching resources is a balance between pedagogical situation, learning objectives, functional tools, and finances - Choice of platforms and social networks can improve learner participation - Quality of content impact student motivation to learn - Tutors' pedagogical practices when using technological impacts quality of the learning process - Learners exposed to information-educational environments develop improved skills - Work-integrated learning supports curation of competencies for career development	S3, S18, S22, S33, S39, S42, S60, S61, S67, S71, S73, S75, S104, S105
9	Digital creation and innovation	- Stakeholders' involvements and vision for integration of digital technology in learning delivery - Active participation in creative online expression - Frequency of collaborative contributions impacts quality of digital production	S42, S58, S73
10	Collaboration	- Learner centric environments promote collaborative working - Collaborative working is influenced by learner attitude, learning style and work ethic relative to the external environment - Co-creation improves collaborative working - Collaboration with co-creator can lead to improved cognition	S10, S22, S39, S54, S60, S67, S73, S104

Note: serial number for the studies relate to publication which can be seen in Appendix E.

RQ3: What is the status of research on Digital Capability Maturity?

This analysis aimed to identify the various approaches that have been used to investigate the domain of Digital Capabilities within TEIs and possible solutions that have been applied towards effective and sustainable digital education.

A total of 441 studies were identified as relevant to the research question. These results were then screened, and 250 studies were selected to be included in the review. A full list of references is available in Appendix A: SLR References. Just as observed in RQ1 and RQ2, the term Digital Capability was seldom used in academic literature between 2012 – 2018. However, elements identified in the classification were more prominently referred to in the included studies. Most references are to library services, ICT services and e-Learning.

The analysis of the studies took place in two steps:

Step 1: The first step aimed to identify generally the approaches that have been used to support the development of DCMiTI.

Step 2: The second step of analysis aimed to identify existing models and frameworks that have been used as approaches towards the development of DCMiTI.

The first round of analysis found Individual Skills, namely literacies and competencies were the most popular themes in research, followed by library services, ICT services and eLearning.

The second round of analysis draws back to the objective of the research which is the development of a maturity framework for tertiary institutions; I analysed specifically those studies that involved the analysis, design or development of models or frameworks. 21.6% of accepted studies fell under this category.

Based on the pre-identified themes of DCMiTI, Individuals Skills received the most attention in literature. Various efforts have been employed towards the development of individuals skills to improve organisational capability such as workshops, seminars, and different types of training.

Learning, training, and development was the most popular element, closely followed by the Tertiary Institutions, specifically the element of education policy (Weninger, 2017).

3.4.3 Analysis of RQ4 data

3.4.3.1 Summary of Results

RQ4: What is the status of research on Digital Capability Maturity in Nigeria?

This research question aims to uncover any existing guidelines on DCMiTI and report on the status of research in the context of Nigerian Tertiary Education.

When the initial search string was run in 2017, I found 11 relevant papers, of which only 6 were accepted and available for analysis. In 2023, the same search string found 30 relevant papers of which 28 were included in the analysis. This shows a percentage increase of 172.27% in the rate of publication between 2017 and 2023, suggesting that topics linked to DC received increased attention within the academic community as shown by the trend in Figure 3-6.

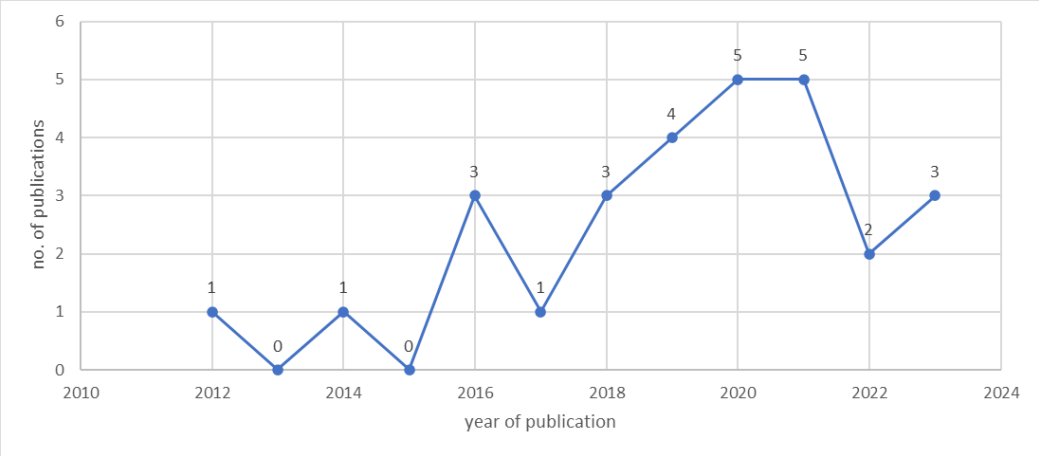

Figure 3-6: trend in publications between 2012-2023/ research effort towards DCMiTI in Nigeria

Out of the (n=30), (n=1) was inaccessible and (n=1) was a duplicate therefore, (n=28) 88.57% of relevant papers were included in this analysis.

Notably, among the papers included in analysis, 93% were journal articles and only 7% were conference papers as shown in *Figure 3-7*. Journal publications often provide comprehensive knowledge or exploration of a topic (Montesi and Mackenzie Owen, 2008), thus indicating the focus in TEI in Nigeria is on conducting in-depth studies contributing to academic understanding of the various pockets of elements that make up DCMiTI. There were no papers in which the concept of DCMiTI in Nigeria was investigated as a whole, thus suggesting the focus of research thus far has not delved into looking at holistic solutions to manage DC.

Furthermore, the higher proportion of journal papers suggests some level of advancement in the subject matter, as the journal publications would have typically accumulated a significant body of research overtime (Montesi and Mackenzie Owen, 2008). This suggests the need to take a closer look into the sub-elements of DCM under investigation in the papers being analysed.

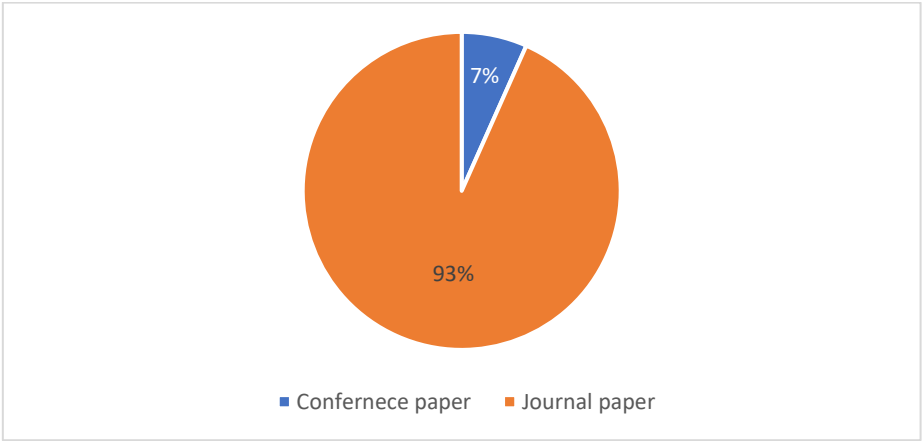

Figure 3-7: portion of results from journal paper vs. conference papers

Figure 3-8 shows that 53.6% of the articles were published under journals of library philosophy and practise suggesting, that the most established areas of research in DCMiTI in Nigeria are Individual skills (IS) and Resources, Tools and Content (RTC). I dissect these topics in relations to the research questions in further detail in the next section.

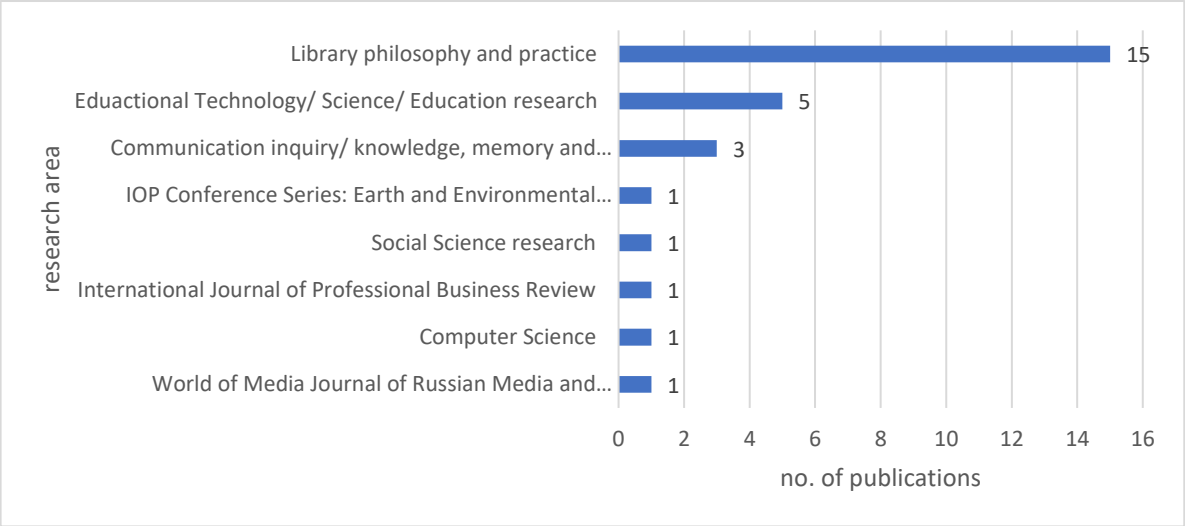

Figure 3-8: journals as an indication of research topic under DCMiTI

Figure 3-9 shows the high percentage of co-authored papers (68%), suggesting the ability to work as a team, sharing ideas and knowledge, which indicates that authors in the Nigerian TEI landscape are actively engaged in collaborative research. We can thus assume that collaboration is a relatively common practise in the Nigerian tertiary education landscape.

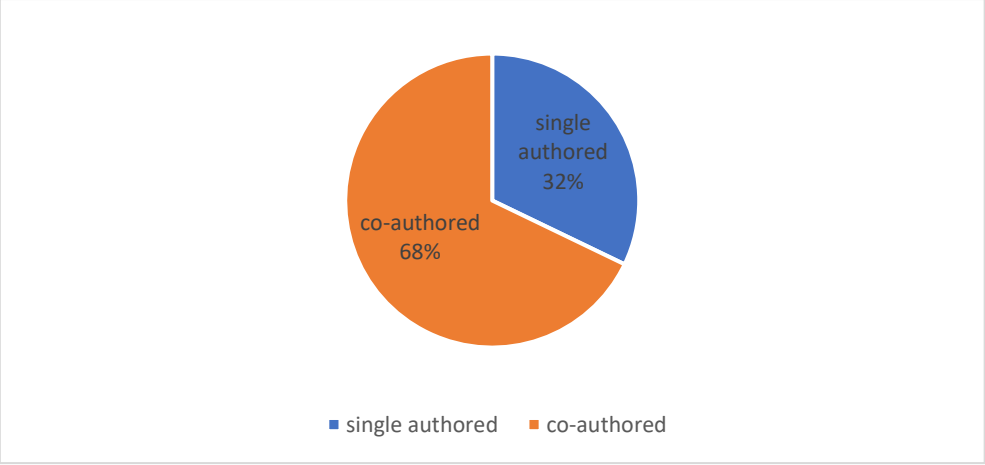

Figure 3-9 distribution of single authored vs. co-authored papers

Notwithstanding, given that distribution is often influenced by expectations and norms of the field (Uddin et al., 2012); the presence of a good portion of single-authored papers (32%) within journals, suggests the ability and independence to conduct research which is potentially a useful attribute given

the numerous sub-elements of DCMiTI – suggesting TEIs in Nigeria, have the capacity to explore niche areas and pursue in depth research in each of the elements and sub-elements.

Regarding the geographical sources of the publication data, I recall that Nigeria is divided into six (6) geopolitical zones to facilitate resource allocation across the nation, therefore *Figure 3-10* shows the distribution of research efforts across the six geo-political zones. (n=3) papers anonymised the location of the TEIs under study, among the 25 papers which disclosed the locations, 24% were not specific to any physical location as these studies were distributed across the country, with one study distributed across Africa (although they had the highest number of participants from Nigeria).

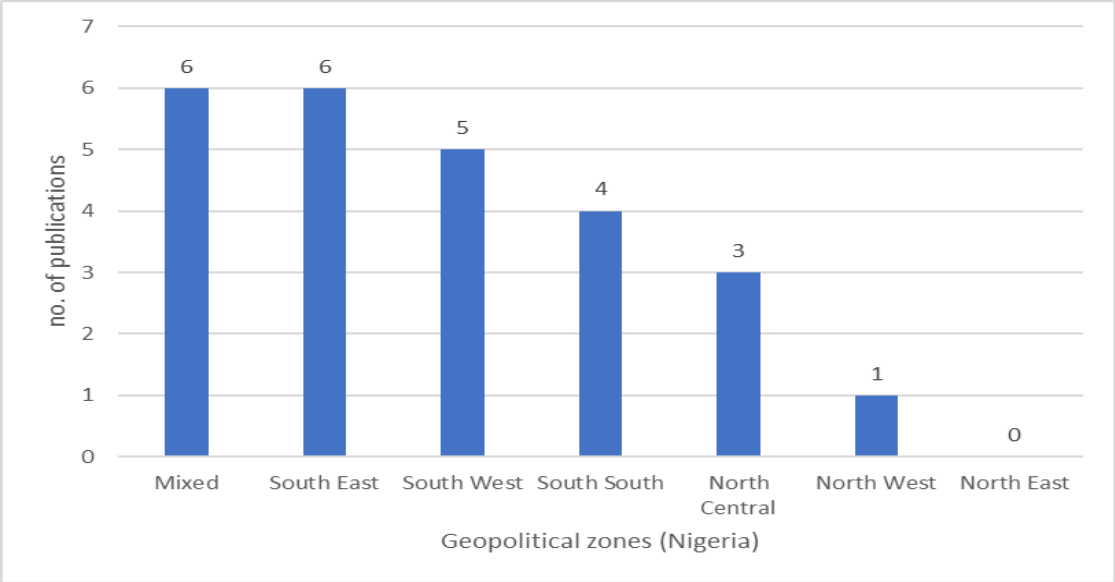

Figure 3-10 distribution of research effort across Nigeria's 6 geopolitical zones

Among the studies that were specific to a geographical location, the South-East indicated the highest research effort with 24% of publications focused on that region, closely followed by the South-West with 20% and the South-South with 16%. The North Central indicated 12%, North West had 4% and none of the research data came from the North East Zone. This suggests that the Southern regions have given the most attention to academic endeavours in relation to DCMiTI, with the northern regions lagging.

Summary of RQ4 data:

- Most of the research effort regarding DCMiTI in Nigeria stems from the Southern geopolitical zones.
- The North zones have shown increased research interest in publications related to DCMiTI between 2012-2023.
- TEIs in Nigeria are actively engaged in collaborative research efforts.

- The most popular areas of research in Nigeria are in Library skills, literacy, and access to information, which in relation to DCMiTI correspond to Individual Skills (IS) and Resources, Tools and Contents (RTC).

3.4.3.2 Review of Included papers for RQ4

Before I proceed to answer the research question, I briefly summarise the content of the references included in RQ4 and their respective points in the narrative. While there is some overlap in the points covered by these references, each reference contributes unique perspectives and details to the discussion, offering a more comprehensive understanding of the status of DCMiTI in Nigeria.

Integration of ICT in Tertiary Education

The benefits of utilizing Information and Communication Technologies (ICTs) in education have been emphasized. Asiyai (2014) emphasizes the advantages of this integration, including improved instructional quality and expanded research opportunities. Technology integration also caters to diverse learning styles and fosters collaborative networking opportunities. However, several barriers hinder the seamless integration of ICTs in educational institutions, including governmental attitudes towards ICT policy, inadequate funding for ICT facilities, and low levels of ICT literacy among students and lecturers. Nonetheless, several TEIs have actively embraced this shift, forming collaborative partnerships with digital resources (Asiyai, 2014), to ensure continuous access to RTC (Resources, Tools and Content).

Individual Skills (IS)

Capacity building efforts and digital literacy are the most popular research topics in Nigeria, with a particular focus on equipping librarians with essential skills to support other TEIs stakeholders with enhancing digital literacies and access to resources(Edewor, 2020; Itsekor and Iwu-james, 2012). Digital literacy, media literacy and communication literacy have all been researched distinctly and while they share some common elements, they serve distinct purposes and empower individuals in various ways: digital literacy enabling technology proficiency, media literacy fostering critical media consumption, and information literacy facilitating effective information management, all contributing to individual skills development (Aduloju, 2019; Uche, 2020).

The development of individual skills empowers tutors and non-academic staff in their mission in teaching, learning, research, and learners with more knowledge, improved communication, access, and global networking and community building. Furthermore, one study reported that librarians with

digital literacy skills experience enhanced job satisfaction and career progression (Itsekor and Iwu-james, 2012).

While the literature emphasizes literacies in the context of librarians (Edewor, 2020), there is a general understanding of the need for skills development among all stakeholders to support them in making informed decisions about digital resources and content creation. Further linking (IS) to Resources, Tools, and Content (RTC); as well as Creation and Innovation (C&I). Overall, training programmes for learners and tutors are essential to ensure the continuous development of digital skills and realise effective digital education in the Nigerian TEI system (Owo & Udoka, 2021).

Some studies have reported accounts where learners possess high levels of digital literacy skills but encounter challenges in utilizing their skills effectively due to limited connectivity, power supply, inadequate resources, poor maintenance of resources among other inhibiting factors(Ogegbo and Tijani, 2023; Adisa et al., 2018).

Learning, Training and Development (LTD)

Training has been reported to improve literacy among librarians in various domains, and enhancing their ability to engage with technology, critically assess media content, and effectively find, evaluate, and use information. Edewor (2020) underscores the significance of these endeavours, highlighting the transformative impact of training programs on librarians. Through targeted initiatives, librarians have undergone a substantial transformation, emerging as proficient navigators of modern technology. This heightened digital literacy extends beyond the library, benefitting the broader community which libraries serve (Itsekor and Iwu-james, 2012).

TEI have developed strategies to encourage learners to engage in self-directed learning, as they uploaded learning materials on messaging groups and the institutions e-learning platforms. However, quality of teaching and assessment is often constrained by irregular power supply, poor internet connection, high data costs and some students' limited digital skills. Recommendations have been made to focus efforts on educational technology training for all stakeholders and enhancing digital education programs to enable the benefits of DC to be fully realised (Ogegbo and Tijani, 2023).

Ogundele (2019) argued that pedagogical approaches by tutors are outdated and not compatible with global innovations and limited digital facilities do not allow for the effective and efficient delivery of digital programmes, suggesting capacity building as a solution and further highlighting the significant relationship between tutors' digital literacy and the quality of digital education provided.

Following the Covid-19 pandemic TEIs in Nigeria came to terms with the possibility of disruptions in face-to-face teaching and focused additional efforts on digital education (Owo and Udoka, 2021), considering the utilisation of online assessments to reap the benefits of monitoring learners progress, and the provision of immediate feedback to the learners (Lu et al., 2023; Yusof et al., 2022). All of which would further develop both the TEI and the learner's capacity to engage in digital education, in view of this, Lu et al. (2023) recommended TEIs should develop workable policies that will encourage the effective use of digital capabilities (Lu et al., 2023).

Omeh explored using innovative pedagogy, namely a combination of context-based learning and problem-based interspersed with live online tools (Google Classroom and Google Meet) and reported learners' academic achievement significantly as well as their self-efficacy (Omeh et al., 2022)

In summary, to achieve effective digital education as well as assessment, government needs to invest more on educational technology and providing adequate ICT facilities in TEIs, as well as offering suitable trainings for tutors (Yusof et al., 2022; Ukwoma et al., 2016; Okidi and Udoh, 2021).

Infrastructure

Infrastructure plays a critical role in ensuring effective digital literacy and education. Adequate internet connectivity, access to ICT facilities, and incentives for educators to utilize digital tools are vital components for successful DCMiTI. Addressing these infrastructure challenges is pivotal for the efficient access to online resources and successful deployment of digital programs (Ternenge and Kashimana, 2019).

Infrastructure limitations also loom large as a substantial hurdle. Adisa et al. (2018) expand on these challenges, citing issues such as restricted access to relevant information, software complexities, and unreliable internet connectivity. Inadequate funding for ICT facilities further exacerbates these concerns, hampering the development of a robust infrastructure for the development of DCMiTI (Ternenge and Kashimana, 2019; Adisa et al., 2018; Okeji and Mayowa-Adebara, 2021).

Government investment in ICT infrastructure is crucial for effective learning, however many TEIs mention government support as a limitation, along with lack of policies promoting digital literacy skill development to ensure that digital skills are not limited to those undertaking specific ICT related courses.

Resources, Tools, and Content (RTC)

Ojeniyi (2016) investigated the impact of skills on resources and found a positive significant relationship between digital literacy and the use of online resources. Many tutors reported high digital literacy skills in General Computer Operation, Internet Browsing, Internet Searching and Computer Appreciation. E-Mail and website were the most often used e-resources among lecturers however, they also reported erratic power supply and poor internet connection as some of the major challenges encountered in the use of e-resources (Ojeniyi and Adetimirin, 2016).

Aduloju (2019) draws attention to incomplete integration of digital skills into the educational curriculum, noting that while there is growing awareness of importance of digital skills, its incorporation into academic programs remains inadequate. While there has been a growing awareness of the importance of digital transformation and the ability to deliver digital education, many TEIs are yet to fully embrace it as an integral part of their programs (Marcel-Okafor and Okafor, 2020).

Studies revealed that many learners and tutors have a high level of awareness regarding the concept of open educational resources (OER) and demonstrate a substantial utilization of various types of OER. However, it was often poor electricity supply, inadequate internet connectivity, and a lack of support that rendered these available resources ineffective (Oseghale, 2023; Wiche and Ogunbodede, 2021). Research further argued that without adequate internet facilities, learners would not be able to fully utilize online resources, tools, or content.

Additionally, learners who possess the skills but lack the necessary resources and tools have increasingly turned to personal mobile devices for both educational and communication purposes. This highlights the current role of mobile devices in accessing academic materials and staying connected (Baro et al., 2019; Edewor, 2020).

Collaboration

Asiyayi (2014) discussed digital education as an opportunity for collaborative networking and collaborative research. Considering collaboration from a slightly different perspective, several Nigerian universities have proactively forged collaborations with virtual book organizations and online repositories. These collaborative efforts have ensured continual access to an extensive repository of digital resources. By partnering with organizations such as SciVerse's ScienceDirect and the Nigerian

Research and Education Network (NgREN), universities have broadened the horizons of access to knowledge and literature (Betiang and Akpan, 2018).

Creation and Innovation (C&I)

Furthermore, digital literacy has been recognized as a catalyst for research publications and the development of policies that encourage content creators to remain at the forefront of digital content creation and innovation (Amuche et al., 2020).

Tertiary Institution

Many researchers have recommended the support DC initiatives with recognition reward schemes to encourage internal stakeholders to engage with LMS and other digital tools and resources (Amuche et al., 2020; Adisa et al., 2018; Betiang and Akpan, 2018). Furthermore, organisational growth has been linked to strong policies and institutional culture (Enakrire, 2021).

To summarise the review of papers included in **RQ4: What is the status of DCMiTI in TEIs in Nigeria -** Learning, Training, Development, and Individual Skills have reflected substantial progress driven by focused efforts within the research and library community. The integration of ICTs in education has further enriched the literature landscape, with the advent of Covid-19 further exasperating the efforts and many researchers offering solutions towards enhancing effective digital education delivery. The solutions have ranged from increased efforts on capacity building, stabilising internet connectivity, varied pedagogical approaches, enhancing digital education programmes, curriculum, and facilities, supporting the efforts with institutional policies and support, recognition reward schemes to encourage and motivate tutors as well as external factors such as erratic power supply and government support. Many of which have reported successful outcomes such as the positive impact of skills development and training on the quality of instruction. However, challenges persist, including infrastructure limitations, curriculum gaps, inconsistent and inadequate funding, and power supply.

All studies included in this review were outcomes of empirical research and although the key research aims of the studies differed, the critical analysis of the results in all studies suggested the existence of the undeniable web of relationships between elements and sub-elements; equivalent to that presented in the results of the other research questions addressed in this review. One element cannot be discussed as a standalone and the elements and sub0elements are always reported in relationship

to one another suggesting that understanding the relationship between elements is a key to proffering a suitable and effective solution.

Furthermore, the review of RQ4 papers concludes that despite the various pockets of elements and sub-elements and solutions recommended, the literature showed no evidence of a holistic solution or structure to supporting DCMiTI in TEI in Nigeria.

3.4.5 Interpretation of Results

Given the aim of the review, in this section I consolidated the body of knowledge built upon evidence from the included literature. I present an interpretation of the data as: the elements contributing to DCM, the relationships between them, and the link between DCM and digital education.

3.4.5.1 Generalisable Knowledge on DCMiTI

The search for 'Digital Capability Maturity' (DCM) in literature indicated that the concept has not been studied as a holistic concept in previous studies. The literature search could not identify a clear and concise definition of that could be used in relation to this study. Farid et al. (2015) argued "… it is still difficult to find a complete and comprehensive definition of e-learning from existing literature". The same applies for DC. However, several terms are used to express the various ideas that make up the concept of Digital Capability, such as digital literacies (Jisc, 2014), digital competence, eLearning among others.

Capability itself is an evolutionary term that applies across various contexts. Capability describes a set of academic and professional practices sanctioned by various, constantly evolving digital technologies (Jisc, 2014). This contextual application of DCM has given rise to different definitions in the context of individual capabilities often referred to in literature as literacies; organisational context (Sandburg, 2014; Killen et al., 2017), teaching and learning (Chowdhury and Chowdhury, 2003; Marshall, 2006) and more specifically e-learning (Marshall, 2006). While *maturity* is the ability to sustain efficient and effective utilisation of those capabilities.

The inconsistent nature of the definitions above justified the construction of a comprehensive definition for Digital Capability that will be referred to in the context of this endeavour. I used an informative technique (W3Consortium, n.d.), to define DCM as stated below.

Digital Capability Maturity in the context of tertiary institutions is defined in this study as:

The ability of an institution to sustain effective and efficient use of digital assets to support teaching, learning, and working, through continuous evaluation, selection and adoption of new technologies and acquiring necessary skills, for full utilisation.

3.4.5.1.1 Elements contributing to DCMiTI

The composition of Digital Capability was identified through an analysis of 140 studies and found to consist of ten key elements : (1) External Factors, (2) Stakeholders, (3) Individual skills, (4) Digital Identity & Wellbeing, (5) Organisation (TEI), (6) Infrastructure, (7) Learning, training & development, (8) Resources, tools & content, (9) Creation & innovation and (10) Collaboration, each with a definition and set of constituting sub-elements Appendix H: Table of elements and supporting literature.

Individually, the elements/ sub-elements that constitute Digital Capability have been researched, and various methods have been employed to develop such elements within the TEI setting. Development of Individual skills is the most common area of research starting with basic tutorials (Pretorius, 2018), workshops and training programmes (Barnard et al., 2019; Cook et al., 2018; Ranieri and Bruni, 2018) aimed at enhancing stakeholders digital skills. Creative problem-solving skills and thinking heuristics to develop creativity have also been adopted (Belski and Belski, 2018). Storytelling (Wei and Hu, 2018), visual analytics and virtual reality (Hammang et al., 2018) have been a prevalent method used to strengthen learners' abilities (Stenliden et al., 2019); as well as the constructive engagement with social media such as Twitter in making positive contributions to teaching (Emeterio et al., 2018; Deaves et al., 2019). Also, various pedagogical approaches (Goforth et al., 2018; Talib, 2018) and strategies have been leveraged to support learners' creativity (Fonseca et al., 2017; García et al., 2018). It is also worth to note the use of gamification has been reported as a popular didactic strategy for the development of digital literacies (Quinde et al., 2018).

I consider the notable absence of Educational Technologists (ET) from DCMiTI stakeholders a gap in the knowledge base upon which the proposed structure will be developed. Given my lived experiences I academic setting where the ET plays an important role in the deployment and support of digital programmes. Therefore, the close this knowledge gap, I will explore this finding in further details in Chapter 4.

However, a limited amount of research is available in which the elements are investigated holistically. To this end, I report my interpretation of the data analysis and knowledge gained as a theoretical concept with a supporting narrative available in Appendix I: Synthesis of RQ2 Data in a narrative.

Furthermore, there may be a knowledge gap in the key roles that contribute the DCMiTI because the results failed to show up educational technologists whom I know from my lived experiences in academia play a significant role in supporting the deployment and maintenance of digital programmes. Therefore, I investigate this finding further in Chapter Four.

3.4.5.1.2 An Ideal Digital Learning Environment

The concept of the Ideal Digital Learning Environment (IDLE) is a theoretical model resulting from the synthesis and meta-analysis of the papers included in the literature review.

Modern-day learning occurs all around us, not only within the classroom; this modern learning space is what the IDLE represents Figure 3-11. A typical IDLE consists of clusters of external environments, with each cluster representing a geographical region. The layers of the environment are porous allowing the transfer of information, knowledge, and skills from one External Environment (EE) to another, between layers of the EE or event between the environment and the pool in which the rest of the world resides, this includes industries, homes etc. The external environment is concerned with social, cultural, socio-economic, and socio-cultural elements that impact learning, as well as public policies on education and the role of the government agencies and ministries. Within this socio-cultural setting resides the TI layer; concerned with institutional norms, organisational structure, size, and facilities. The TI layer also includes corporate strategies, leadership, organisational goals, and practice guidelines. Internal cultural and social values, ethical guidelines, and accountability measures. This also includes division of labour, recognition reward schemes, adoption of best practices, and teaching culture: manageability, sustainability, and financial capacity.

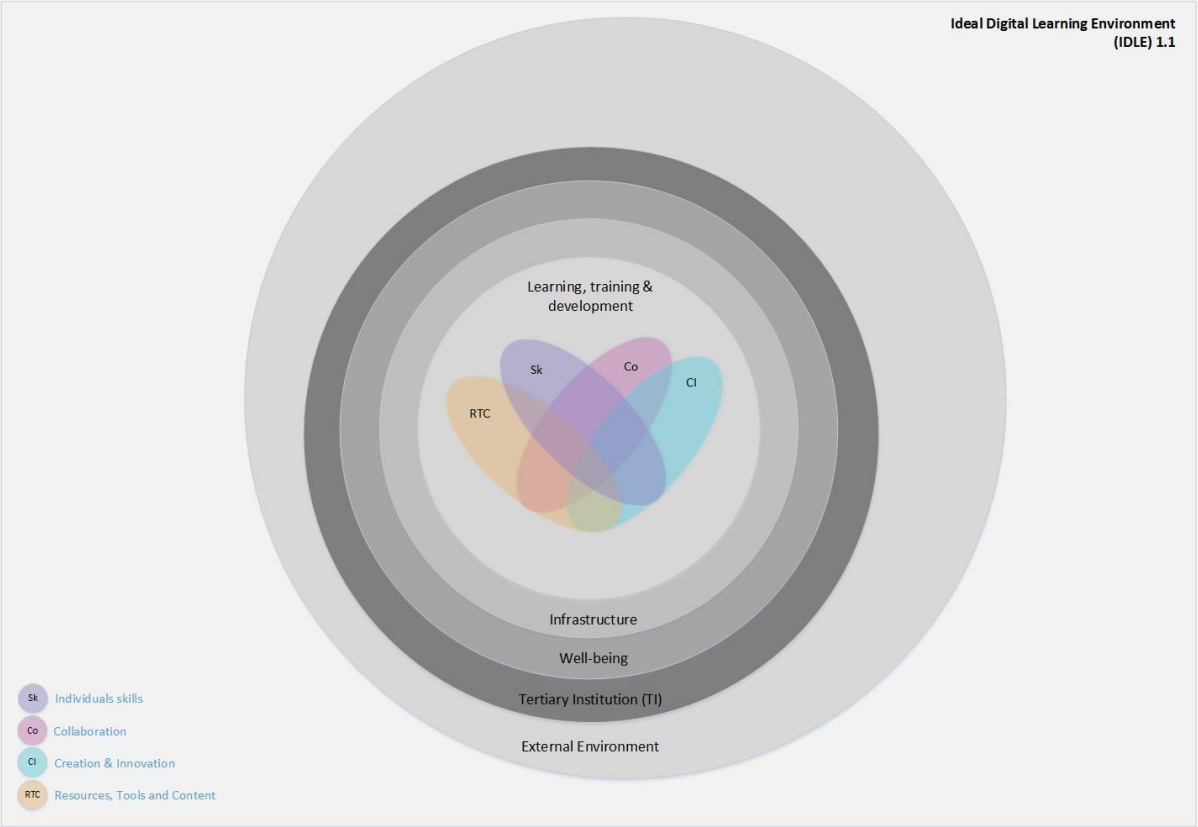

Figure 3-11: An Ideal Digital Learning Environment (IDLE v0.4)

Among the primary concerns of the TI is that of well-being. A learning environment that considers the identity and overall well-being of its members by providing a safe, secure, and comfortable learning space would stimulate learner's involvement and encourage active participation in the learning process. Also, a safety net in the form of technical support would provide the assurance that help is available. It is very much a hierarchy of needs; if an institution takes care of its learners by realising their policies and providing basic needs, then the learners can take care of themselves and achieve their learning goals.

Furthermore, having a digital presence and belonging to a group, for example, as a learner of an institution, you may belong to a social network group for members of the institution. That sense of belonging again fulfils some basic human need and positively impacts the learner's sense of well-being, and by design improves their willingness to contribute to the online collaborative discussion (Gui et al., 2017; Ishkov and Leontiev, 2015; Klampfer and Köhler, 2013). Increasing the likely hood of cocreation of digital content and consequently enhancing collaboration and the quality of such content (Ishkov and Leontiev, 2015). Conversely, an overabundance of technology can lead to lower productivity (Barbas et al., 2014). However, institutions who encourage a culture of best practice can empower leaners to minimise the adverse effects of technology and provide a safe climate for members of learners (Birzina et al., 2012).

Infrastructure is among the responsibilities of the TI although it stands as a layer on its own and is concerned with basic physical structures, network infrastructure, connectivity, hardware, software, and usability supporting the processes that occur with the TI. Furthermore, the TI is responsible for ensuring adequate and productive Infrastructure, providing a fluid environment and minimising potential barriers to successful usage of technology. Infrastructure is inclusive of hardware, software, and communication tools.

Therein lies the primary objective of 'Learning, training and development', this is the core focus of the model, and for that to occur successfully, a secure and fluid infrastructure must be in place. Individuals' skills are the most popular area of research and potentially the most impactful on DCMiTI. However, individual skills and limited by the resources, tools and content that allow learners to access learning materials, collaboration culture that encourages and facilitates collaborative working and learning within the institution.

In summary this IDLE would be the optimal environment in which effective digital education could occur, not only with a single organisation but across multiple organisations, across borders of different External Environments. This concept delivers the vision for TEIs who focus efforts on continuous development of digital capabilities.

3.4.5.1.3 The Relationship between elements

The review indicates the elements and themes contributing to DC are interrelated, and the relationship can be described as a web where none of elements or sub-elements are mutually exclusive. Studies always discuss one element with another element/sub-element, seldom does a study discuss an element in isolation. Given the nature of this relationship, the elements contributing to DCMiTI may be described as an ecological system (Shengquan and Li, 2006).

Shengquan and Li (2006) described ecological systemic change theory as an environment in which significant changes in one element requires at best consideration and in most cases, changes in other elements. Elements contributing to Digital Capability are not mutually exclusive. Division of elements into separate parts without relationships will not necessarily lead to improvement.

In practice, embedding elements of DCM within the context of TEI has already begun. However, successful implementation of such maturity strategies would require a targeted and well-defined supporting structure. This further supports my initial assertion that using the concept of maturity as a lever to guide the development of DCM would yield positive outcome. It would lead institutions to a strategy where the elements and sub-elements are matured in parallel – to result in overall Capability

Maturity. Thus, suggesting that using DCM to achieve more effective impact on digital education, requires implementation of a model that adopts the ecological system perspective.

3.4.5.1.4 Status of research on DCMiTI in Nigeria

The review of DCMiTI in Nigeria did not identify any research efforts to suggest the existence of a multi-variant solution to mitigating the issues associated with technology integration in teaching and learning within TEIs. Nor did the review uncover any holistic research efforts towards DCMiTI, or any similar overarching concepts or solutions.

Similar to the answers to RQ2, the review identified are pockets of research on individual elements as reported in section 3.4.3.2 Review of Included papers for RQ4. In summary, In the realm of Nigerian literature, several noteworthy achievements and developments have come to the fore. A primary accomplishment lies in the concerted efforts towards capacity building and digital literacy. Within this context, the research community, particularly librarians, has dedicated substantial attention to acquiring essential skills that can propel sustainable community development. These endeavours have yielded tangible results, particularly through targeted training programs. Such programs have proven instrumental in elevating Individual Skills.

As a direct consequence of this enhanced Individual Skills, librarians have become proficient in engaging effectively with modern technology. They now possess the competencies required to navigate the digital landscape and leverage digital tools to advance the field of literature. This capability has not only empowered librarians but has also extended the reach of literary resources and services to the broader community.

Furthermore, there is clear recognition of the advantages associated with the integration of Information and Communication Technologies (ICTs) into educational practices. This strategic integration has brought about improvements in the quality of instruction, making it more adaptable to diverse learning styles. In addition, it has facilitated collaborative networking and research opportunities, which are pivotal in advancing the scholarly pursuits within Nigerian literature.

However, challenges persist, including limited skills in many areas and among different disciplines with TEIs, availability of necessary hardware and software, unstable internet connectivity and irregular power supply among other systemic issues (Adisa et al., 2018; Ogegbo and Tijani, 2023; Okeji and Mayowa-Adebara, 2021). Addressing these challenges remains imperative for TEIs to fully harness the potential of digital tools and technologies in advancing education and sustainable development.

The review identified the following elements impacting the development of DCMiTI in Nigeria:

1. Stakeholders assuming their full responsibilities
2. TI management providing explicit support and motivation
3. Adequate infrastructure to aid digital education initiatives
4. Development of individual's skills for learners and tutors
5. Inadequate power supply
6. Appropriate Resources, Tools, and Content
7. Technological acceptances and attitudes toward change
8. Government attitudes towards existing ICT policies
9. Insufficient government investment

The advancements towards integrating technology in teaching and learning in Nigeria are promising and suggest the DC is recognised in Nigeria and continuous efforts are being made to developing capabilities in TEIs with the anticipation of delivering effective digital education.

However, I argue that none of these solutions look at DCMiTI from a holistic perspective as I am proposing in this dissertation, therefore, the elements identified in this review have been grouped into a classification of elements which I will exploit in future studies.

3.4.5.2 The Link between DCM and Digital Education Delivery

The knowledge gained from this review suggests that developing DCM would have a multitude of positive effects on the maturity of a TEI. Taking 'Digital Identity & Well-being' as an example; a TI that considers the identity and overall well-being of its members by providing a safe, secure, and comfortable learning space would stimulate learners' involvement and encourage active participation in the learning process (Diep et al., 2016). Also, a safety net in the form of technical support would provide extra comfort in knowing that if unable to progress, there is help available (Besseah et al., 2017).

In addition, developing DCM would include ensuring stakeholders have a digital presence. This means belonging to a group, for example, as a learner of an TEI, you may belong to a social network group for members of the TEI. That sense of belonging again fulfils some basic human need and positively impacts the learner's sense of well-being, and by design improves their willingness to contribute to online collaborative discussion. Increasing the likely hood of co-creation of digital content and consequently enhancing collaboration and the quality of such content (Gui et al., 2017).

On the other hand, learners who overindulge in digital technology are susceptible to adverse effects, which could result in lower productivity. However, TEI hold the ability to minimise these effects by empowering them with knowledge of best practice, and further supporting that with institutional policies around safeguarding the well-being of their members (Gui et al., 2017; Bertot, 2016; Clarida et al., 2013).

It can be said that a digitally mature institution is a TEIs that focuses on digital capabilities development. Digitally mature institutions stand to provide improved skills development, improved productivity, and better innovation through increased collaboration.

A digitally mature institution would make positive contributions towards increasing learners' interest in a wide range of subjects through technological innovations and consequently achieving improved quality of education and outcomes. The knock-on effects would help address the problem of technological investment without visible returns.

The level of knowledge transfer in a digitally mature institution is far more than that of a TEI where access to digital tools and platform is limited. Therefore, the knowledge gained in such an institution would empower learners with a plethora of skills that can be applied worldwide and provide them with more opportunities to thrive in the modern dynamic economy.

Given the rigorous and systematic consideration of the contributing elements towards DCMiTI, it is evident that developing DCM would greatly contribute to improving the quality of digital Education in many ways, while also maximizing the benefits of already existing technology and tools.

3.4.5.3 Existing Maturity Models in TEIs

With respect to the use of models and/or frameworks that support the improvement of individual elements, frameworks have been used to guide the development of necessary skills and competencies to equip stakeholders with the skills required for the modern world (Alkema et al., 2018; Somabut and Chaijaroen, 2017; Civilcharran and Maharaj, 2018). Some examples are, blended learning frameworks for curriculum design and professional development (Hannaway and Steyn, 2017; Mirriahi et al., 2015).

Digital inclusion policies, institutional e-learning policies, and global education frameworks such as the EU policy framework have been designed to encourage and support digital competencies as a solution closing the digital skills divide (Roushan et al., 2016; Weninger, 2017; Casanueva-Reguart, 2013).

The systematic review uncovered papers reporting on education maturity models where researchers have reviewed and compared the strengths and weaknesses of existing models (Duarte and Martins,

2013; Carvalho et al., 2019), most of which pre-date the inclusion criteria of the SLR reported in this dissertation. Thes earlier models were all based on CMM/CMMI and addressed focus areas such as Information Systems Curriculum (White et al., 2003) , On-line course planning and assessment (Neuhauser, 2004), student learning (Thompson, 2004), computer science teaching (Lutteroth et al., 2007) , HEI management and benchmarking (Dounos and Bohoris, 2007). Among the shortcomings of previous models were focus on a specific entity, many of them are proposed but did not go as far as presenting process areas thus the proposed process areas may not fir the reality in HEIs. The proposed models that focus on teaching did not align with the process of management and administration of the TI and the last criticism is that reference models indicate which attributes an organisation must show; however, they do not indicate how they should be implemented to achieve maturity (Duarte and Martins, 2013; Carvalho et al., 2019).

Table 3-8 summarises maturity models in HEI that were included in the SLR. The Mobile-Learning Evaluation Framework (MLEF) was designed to support HEIs with embedding mobile-learning policies to enhance learning experience for students. The proposed framework included four process areas but did not go as far as suggesting how maturity may be achieved (Murphy and Farley, 2012).

Other models such as the Student Engagement Success Retention Maturity Model (SESR-MM) (Clarke et al., 2013), the Knowledge Management Capability Assessment (KMCA) (Demchig, 2015), the Quality Assurance System (QAS) (Chalaris et al., 2017) and; the Higher Education Institutions Maturity Model (HEI-MM) (Carvalho et al., 2019) are all limited to specific focus areas as shown in Table 3-8 and do not capture the elements that represent the Digital Capability of the institution as a whole; furthermore many of these models are proposed and have not gone as far as suggested process areas.

Table 3-8: summary of existing models in HE found in SLR

Model	Author/year	Focus area	Reference model	Levels of Maturity	Areas
MLEF	(Murphy and Farley, 2012)	Mobile Learning in HEIs	CMM	-	4
SESR-MM	(Clarke et al., 2013)	Student engagement success and retention in HEIs	-	5	Variable number of dimensions per level
eMM	(Marshall, 2013)	e-Learning (Online-courses)	CMM/ CMMI	5	5
KMCA	(Demchig, 2015)	Knowledge management	CMM	4/5	4 areas with varying sub-categories
Jisc	(Killen et al., 2017)	**Digital Capabilities in HEIs**	-	-	6 Elements with variable sub-categories
QAS	(Chalaris et al., 2017)	Quality Assurance Evaluation Procedures in HEIs	CMMI/BPMM	-	7
DCMM	(Kozina and Kirinic, 2018)	**Digital Business transformation management in TEIs**	CMMI	5	6
HEI-MM	(Carvalho et al., 2019)	Information Systems management	-	-	-
Proposed DMFHEI	(Đurek et al., 2019)	**Digital Maturity Framework for HEIs**	CMM	-	7

Marshall and Mitchel presented their initial research on an e-Learning Maturity Model (eMM) that was based on the CMM, in which the affordances of Capability Maturity were used to improve the efficiency of e-Learning processes within Higher Education Institutions to improve the overall quality of e-Learning. Their eMM incorporates the five levels of maturity and it measures them across five process areas: learning, development, coordination and support, evaluation and organisation (Marshall, 2010). Furthermore, the model has been applied in practises to assessment a TEI in New Zealand (Marshall, 2006, 2005). The model is comprehensive and the updated versions which supported the identification of good practice from 2013 were captured in the SLR (Marshall, 2013). However, although the eMM is more comprehensive than other models because it captures process

areas and proposes maturity steps; it is still limited to a specific focus area of online courses/ e-learning and does not adequately represent the concept of DCMiTI that is being addressed.

The Joint Information Systems Committee (Jisc, 2014) designed a digital capabilities framework initially as part of literacies project which extended to include the overall organisational capability. Jisc eloquently defines the DC of an organisation as "the extent to which the culture and infrastructure of an institution enable and motivates digital practices" (Killen et al., 2017). The framework presents six elements of Digital Capability in higher education with limited scholarly research to support the framework or source of process areas used to assess capabilities. While findings from the review add credence to Jisc's model of the digitally capable organisation they do not fully align with the elements of DCMiTI captured in this review. Furthermore, Jisc's model does not represent a pathway to maturity and when asked to comment they were not willing participate in this investigation. This suggested additional investigation was necessary to theoretically underpin the inclusion of elements and explicitly propose a pathway to maturity.

There is a Digital Capability Maturity Model (DCMM) (Kozina and Kirinic, 2018) designed to support digital business transformations, the model consists of 5 maturity levels and attempts to assess 6 areas of business transformation based on a combination of process areas from another model. After reviewing literature on DCMiTI, I suggest the proposed model is heavily focused on business strategy and risk transformation and limited consideration of teaching and learning is made. Furthermore, one of the criticisms this research aims to address is the issues of building model on predecessors without a rigorous review and consideration of the elements required to address the problem domain (Kohlegger et al., 2009).

Lastly, Durek (2019) proposed a Digital Maturity Framework for Higher Education Institutions (DMFHEI) in which he proposes analysing the maturity of ICT in HEIs to determine their readiness for digital engagement; and although the proposal aligns well with the objectives of this research, the proposed framework was not implemented, and the paper concludes with a methodology. This further supports the objectives of this research as other research have also identified the need for such a framework. In further critique of the DMFHEI, it provides little background research and supporting little justification for why the 7 areas suggested are considered appropriate to measure digital capability; although the proposal suggests engaging in qualitative research techniques with appropriate participants to reach a consensus.

In summary, in the realm of Tertiary Education, there is currently a lack of comprehensive research efforts that thoroughly investigate the elements contributing to DCM. Existing endeavours in this area largely build upon previous work and considering the relative newness of the concept of digital

capability, a comprehensive research effort is necessary to fill this gap and provide a comprehensive understanding of DCM in the context of Tertiary Education. Furthermore, there is currently no model available that offers a comprehensive pathway to digital maturity within the context of Tertiary Education.

The limited availability of such results from Nigeria may be attributed to various factors. It could be due to a lack of widespread dissemination of research work in this area, or due to the deliberate design of the study whereby result was restricted to papers published within a specific timeframe, from Scopus; or it could reflect the current state of digital initiatives in the region. Nonetheless, the DCMiTI structure proposed in this thesis, does not exist even outside the scope of Nigeria since the foundation of the research is the elements contributing to DCMiTI as comprehensively investigated and reported in this dissertation.

3.5 Summary of Systematic Literature Review

This chapter reported an extensive systematic review investigating the current body of knowledge on DCM, its composition and impact on digital maturity in TEIs. The review was intended to better understand the status of research in the field and determine the prospects of using the affordances of Capability Maturity as a mechanism for developing institutional maturity in TEI in Nigeria and consequently supporting digital education. The review findings can be summarised as follows:

1. There was limited research effort in DCM between 2012 - 2017, particularly in relation to Higher Education Institutions. However, the review uncovered the composition of DCMiTI, which I aggregated into to a classification of 10 elements.
   Furthermore, the review suggests that all the elements/sub-elements, have a positive effect if addressed adequately and an inverse effect otherwise.
2. The relationship between elements resembles that of an ecological system (Shengquan and Li, 2006) in which elements must be developed in parallel to achieve overall process maturity.
3. Individually, the elements have been researched, and various methods have been employed to develop them within TEIs. There is also considerable knowledge on the positive impact of the presented elements in terms of improving productivity and efficiency in TEIs; as well as evidence on its positive effect on education outcomes, thus providing sound reason to further investigate this area of research.
4. Various models have aimed to develop different aspects of digital maturity, however there was no literature found on DCMiTI, where elements are considered holistically. The only digital

capabilities framework that was available was the Jisc framework, which is largely not an academic undertaking but, moreover, has no emphasis on a clear pathway to maturity.

Among existing eLearning models in education, the eMM was prominently featured in literature. However, the indicators used to assess the eMM were not found to be exhaustive of the domain and there was limited availability to the source of how the existing eMM indicators were selected. More importantly, the eMM indicators were not representative of DCMiTI.

5. As of 2023, the emphasis on elements related to DCMiTI in Nigeria was mainly on developing *Individual Skills*, with literacy being the most popular topic of existing research. DC have been recognised and efforts have been made to integrate technology into education. Some of the inhibiting factors that have thwarted the development of DCMiTI in Nigeria have also been recognised and reported. Research efforts have stemmed mainly from the Southern geopolitical zones, followed by few research efforts in the North Central zones, with limited research attention from the Northern axis of the country. Notably, there was no literature to suggest the existence of a holistic solution or structure to supporting DCMiTI within the TEI landscape in Nigeria.

The evidence gathered in the Systematic review provided sufficient reasons to suggest that developing DCM would yield positive results in overall institutional digital maturity, with knock-on effects on teaching, learning and educational outcomes. Consequently, the prospects for the development of a DCMiTI structure towards this endeavour deserves further investigation. In Chapter 5, I present the continuation of this research journey to substantiate the initial theoretical answers with empirical evidence.

In the next chapter, I explore possible reasons for the absence of Education technologists from this extensive review to remove ambiguity from the body of knowledge upon which the DCMiTI structure will be built.

4. CHAPTER FOUR: INVESTIGATING ROLES CONTRIBUTING TO DCMITI

In this chapter, I investigate a finding from the Systematic Review, which indicated that there is a significant absence of the role of Educational Technologists (ETs) in reported Digital Education programmes. This finding suggests that the reported absence could be impeding success of Digital Education programmes. In this investigation, I explore the key functions of the role of ETs and its impact on implementing digital initiatives in TEIs. The results of this investigation provide further insight to supporting digital education delivery and expands the body of knowledge on stakeholders and their roles. The findings reported in this chapter supplement the answer to Research Question 2 with empirical evidence.

RQ2: How do these elements (Stakeholders) affect Digital Capability Maturity in TEIs?

4.1 Background

The Systematic Literature Review reported in Chapter 3 established elements that contribute to Digital Capability Maturity in Tertiary Institutions (DCMiTI). Several stakeholders and roles were reported in the findings as contributing to the effectiveness of DCMiTI, including lecturers, teachers, instructors, tutors, educators, facilitators, ICT-enabled teachers, training organisers, managers and administrators featured. However, the role of Educational Technologist (ET) was absent from these reported contributors.

My reflections from lived experiences in higher education led me to suggest that ETs should also have been featured as DCMiTI stakeholders because of their pertinent job of facilitating the process of technology adoption and utilisation in the learning environment. An ET is a specialist role that sits at the intersection of two fields: technology and education.

Lorenz et al. (2014) conducted a study on the role of ETs in implementing new technology is schools; ETs were first introduced in Estonian schools in 2005, and given the responsibility of supporting teaching with technology, although there were many arguments about the need for this role given the overlap with existing ICT specialists. By 2012, the positive impact of ETs has schools re-allocating IT Specialist funding to train and employ more ETs (Lorenz et al., 2014).

ETs are trained in the field of educational technology to analyse and evaluate situational processes related to teaching and learning; they also support tutors in using the right tools for their job (Foti, 2005; Lorenz et al., 2014). The Association of Learning technologists also highlighted the role of ETs in enhancing the student experience (Browne and Beetham, 2010).

Given the extensive and systematic nature of the review that uncovered the absence of the ET role in Digital Capability Maturity studies, I posited that if this lack of attention in the literature is a result of a corresponding lack of attention in practice, then this lack of attention and focus, itself, could be an impediment to adoption success in Digital Education programmes. This positioning guided my investigation into the discrepancies between research, anecdotes, and current practice. To this end, I conducted a study of Education Technologists.

4.2 Aim and Objectives

This study aims to establish whether the findings of the systematic review reflect the current state of practice regarding the level of significance given to Education Technologists in TEIs. It also aims to extend the answer to Research Question 2 by adding to the body of knowledge on the impact of stakeholders on the development of DCMiTI.

The following study questions were used to guide the investigation:

1. Is there a misalignment between the role of ETs in theory and practice?
2. What impact does the role have on the implementation of DCMiTI?

4.3 Methods

To better understand how theory aligns with the current state of practice, I conducted a mini-focus group discussion to understand the issue at a deeper level (Nyumba et al., 2018) .

The target participants were purposively selected as ETs working in Tertiary Education.

A random sample of participants were selected through the university directory based on their title and positions.

Participants were recruited via email. A detailed study protocol including sample correspondence is available in Appendix K: Study 2 Protocol, with additional information on how the study was planned.

The study was conducted under protocol number COM/PGR/UH/03493. Below is a summary of the schedule used to guide the discussion:

The schedule started with a 10-minute debrief on the SLR findings, followed a discussion which was guided by the following 6 questions:

Probe question

1. *How would you describe the role of an educational technologist?*

Follow-up questions

2. *How instrumental are Educational Technologists in the effectiveness of Digital Capabilities?*
3. *Are there any other roles in the institution which may be synonymous with that of the Educational Technologist?*
4. *Why might the role of educational technologists be under-represented/absent in published literature?*
5. *What effects may the absence of this role have on the implementation of Digital Capabilities in HEI?*

Exit question – to prompt ending when the limit of 60 minutes is approaching.

6. *Is there anything else you would like to say about the role of Educational Technologists regarding the implementation of digital capabilities in higher education?*

The discussion schedule was piloted amongst a randomly selected sample of participants with knowledge of the study area. These gave me the opportunity to test my moderation skills on how to prompt participants in a way that would keep discussions in line with the study objectives.

The session was audio recorded using a hand-held recording machine. I transcribed the recording verbatim and used the text for content analysis to generate meaningful themes.

4.4 Results and Analysis

In this section, I summarise the results and analysis of the mini-focus group. The analysis was based on a transcription of the discussion which can been in Appendix M: Mini Focus Group Transcript. Below I provide a summary of the study findings.

4.4.1 Summary of Results

There was a 37.5% response rate to invitations, with three out of eight invitations accepted to take part in the study. Some invitees expressed willingness to participate however, their busy schedules made it difficult to find a suitable time. Due to the limited number of ETs available, I extended the invitation to a chief librarian who expressed interest in the study area and works closely with ETs championing digital maturity within the university.

Participants of the focus group comprised two educational technologists and one chief librarian. Participants were mix gendered; (n=2) male and (n=1) female, this representation limited the potential of gender bias in the results. The session took place in a large meeting room and lasted 1 hour and 19 minutes, participants were well engaged in the discussion and all participants offered their opinions based on personal experiences which they contributed to the study.

Table 4-1 presents a summary of the frequency of responses to the six study questions. It shows that 50% of the discussion was held around describing what ETs do. 21.6% of the discussion was about how instrumental ETs are in the effectiveness of DCMiTI. The other four questions had a frequency of 8.1% and below.

Table 4-1: Frequency of comments for each response category

	Research Questions	**No. of comments (n)**	**Frequency (%)**
1	How would you describe the role of an Educational Technologist?	37	50
2	How instrumental are Educational Technologists in the effectiveness of Digital Capabilities?	16	21.6
3	Are there any other roles in the institution which may be synonymous with that of an Educational Technologist?	4	5.4
4	Why might the role of Educational Technologists be under-represented/ absent in published literature?	6	8.1
5	What effects may the absence of this role have on the implementation of Digital Capabilities in HEI?	5	6.8
6	Is there anything else you would like to say about the role of the Educational Technologist regarding the implementation of Digital Capabilities in higher education?	6	8.1

Table 4-2 summarises the list of key responsibilities of ETs in TEIs derived from a content analysis of the mini-focus group transcript. Participants indicated that within their institution, some responsibilities were specific to Localised ETs and others associated with ETs who had wider responsibilities in the University. The list is inclusive of all ET responsibilities mentioned during the discussion; those not assigned to either type of position is because the respondents made no direct indication as to the positioning during the study.

Table 4-2: Key responsibilities of educational technologists in a UK University

	Responsibilities	ETs Positioning with the Institution	
		Centralised	Localised
1	Promoting the best use of technology with regards to student experience	•	•
2	Influencing with comms, 1-to-1s, workshops	•	•
3	Facilitating technological acceptance	•	•
4	Stakeholder or company contact for third-party providers, vendors of tech solutions	•	-
5	Responsible for the procurement of educational technology solutions – slight overlap with IT infrastructure	•	-
6	Some senior ed. techs are involved with budget holding	•	-
7	Elements of project management	•	-
8	Responsible for liaising with 3rd party solutions	•	-
9	Project management skills/ stakeholder management	•	-

10	Model of delivery: first-line IT support, problem fixers, guidance for staff development	•	-
11	Modelling behaviour/ use of technology	•	-
12	Training	•	-
13	Helping staff to provide the best user experience possible to students via a mediated use of technology	-	•
14	Supporting staff to work in a more effective manner, looking at technology and resources available to them	-	•
15	Lifting the ability of staff to not just use tech but to spot the right technological solution for a given scenario		•
16	Bridging the gap between learning and teaching with a bias towards pedagogy	-	•
17	Day-to-day operational element	-	•
18	Project work	-	-
19	Coordinators	-	-
20	Create content digitally	-	-
21	Communicate digitally	-	-
22	Collaborate of projects digitally	-	-
23	Often influencing other staff	-	-
24	Resource procurement	-	-
25	Basic digital literacy and development	-	-
26	Operational (Use technology to produce outcomes) – depending on their ability	-	-
27	Generalists	-	-
28	Experts in pedagogy, bridging the gap with technology	-	-
29	Spot the right solution for a given scenario	-	-
30	Coordinators	-	-
31	Mediate staff/ influence communication either 1-on-1 or through workshops	-	-
32	Consultancy	-	-
33	Development	-	-

In the next section, I provide a deeper analysis of what these results mean for the development of DCMiTI.

4.4.2 Interpretation of results

A detailed analysis of the discussion showed that participants made comments on a range of issues. Below I provide an interpretation of the results based on the study questions I used to guide the FGD:

4.4.2.1 How would you describe the role of the Educational Technologist?

Table 4-1 indicates that half of the discussion was about the roles and responsibilities of ETs in TEIs because it had the highest frequency of responses. Table 4-2 provides a summary of those responsibilities that participants suggested make up the role of an ET. Participants suggested that ETs consider themselves experts in pedagogy. ETs influence communications and support staff to work more effectively through one-to-one sessions or group workshops, finding innovative technological solutions to complex problems. ETs are also responsible for promoting technology and facilitating staff in offering a good student experience via mediated use of communications and modelling best practice. As one participant stated:

> *"Looking back historically… the ET would be an expert in pedagogy ultimately and the technology would be a kind of means of implementing that…"*

These roles vary depending on whether the ET is centrally positioned within the institution, in which case their responsibilities lean more towards project management, procurement and in some instances even budget holding. Embedded ETs are those who have been localised to a particular school or department within the institution and typically their day-to-day responsibilities involve mediating staff one-on-one or via workshops, modelling best practise, communicating, collaborating digitally, and promoting the best use of technology with regards to the student experience.

The extensive list of responsibilities in Table 4-2 further indicates that these ETs are generalists, in the sense that they have a wide range of responsibilities. Participants stated that in their institution there are two models of how educational technologists function within an institution, the first is the do-it-for-you model and is often used in cases where staff have weaker digital literacy skills; the second model is the self-help model which is better suited to more digitally capable staff where they are provided with better learning resources to help them achieve tasks more efficiently.

> *"I add most value not where I'm just teaching where a button is in a UI it's where I'm modelling how to approach and create a digital project even, or how to approach a project where you involve technology to some degree as a solution."*

4.4.2.2 How instrumental are Educational Technologists in the effectiveness of Digital Capabilities?

The role of ETs as described above is pivotal to the effective implementation of Digital Capability initiatives in tertiary institutions.

> *"I just think it's really interesting that this role of the educational technologist has obviously morphed out of a requirement otherwise it wouldn't exist, so somewhere along the line, some you know not just one person but a whole raft of factors have come together to say we need this type of role because this type of role is missing."*

ETs themselves recognise that they must be 'forward-looking' because when it comes to digital capabilities, a person who is considered digitally capable today, if they do not keep up with emerging trends and horizon scanning, they may not be digitally capable tomorrow.

Participants agreed with one suggestion that:

> *"… actually, the role of the ET should be represented in some of those more strategic planning decisions so that you can see something, and you understand what the impacts are for supporting it and costs are."*

Considering the notion of modelling best practise, ETs help to create that culture of good practice:

> *"… helping staff to model best practice towards their students, so in that respect, I'd say it's certainly influential in that kind of setting."*

4.4.2.3 Are there any other roles in the institution which may be synonymous to that of Educational Technologist?

Considering the range of responsibilities that ETs entail, it is inevitable that certain aspects of the role overlap with that of project managers, technicians, librarians, and procurements officers. Table 4-3 presents a list of roles that may be considered synonymous.

Table 4-3: roles synonymous or which overlap with ETs in TEIs

1	Digital champions
2	IT service staff
3	Curriculum team
4	Instructional designer
5	Digital Specialist
6	Staff development teams
7	Librarians

4.4.2.4 Why might the role of Educational Technologists be under-represented/absent in published literature?

Findings from the FGD suggest that the role itself is so multi-faceted that it is sometimes represented in different ways and the term 'Educational technologist' may not be the common terms across all institutions. There is also a general feeling among ETs that their role is invisible in academic research because it is so multifaceted and quite subtle there is no definitive link to any particular area and their involvement is often overlooked.

According to participants, because their work supports many disciplines, it may not always emerge as its own discipline and therefore makes little appearance in mainstream literature. They also indicated the existence of a community of practice where discipline-specific literature is published regarding technology enhanced learning roles. The Association of Learning Technologists (ALT) have an extensive catalogue of articles in relation to ETs and other Technology Enhanced Learning roles, however, it may not prominently appear in literature searches unless the exact search term is being used. For example, despite the pivotal role they play in developing DC, the role was not proximately featured in my systematic review of 140 articles reporting on various elements and themes of DCMiTI because the search term did not include the words 'educational technologist'.

"So, we have a very active ALT but again they're a community of practice, so it's almost that the literature would reside with the communities of practice."

4.4.2.5 What effects may the absence of this role have on the implementation of Digital Capabilities in HEI?

The Chief librarian confirmed during the FGD that ETs are very influential within Tertiary Institutions in terms of what they do, which is influencing pedagogy via mediated use of technology. Efforts to develop DC without ETs would not be as efficient. The chief librarian among the participants commented:

"… I think they have been very influential and will continue to be influential in terms of what they do."

"I don't think it would go as quick… I don't think we would have even got this far without them…"

Particularly as new technology is introduced into TEIs, ETs are instrumental in sharing good practice through annual events such as Learning, and Teaching Conference and all stakeholders can learn from across the different schools. Through such collaborative events the evidence base is growing that ETs do have impact and influence.

Another respondent's opinion was that most of the functions would happen even in the absence of the ET. However, the richness would be missing; you would lack having that role which spans different disciplines truly understanding the requirements from both the pedagogical and the technical aspect.

"… No one is going to understand the requirements as well as an ed. tech who knows the pedagogy side and the institution and also knows most of the tech…"

This is where the ET adds value, and if they are missed then that understanding of what is required is dependent on communication between tutors, technicians, and other roles.

"I've seen it go wrong more than I've seen it go right. Having someone who already spans the gap is invaluable!"

The richness and innovativeness that comes as part of the role of ETs itself are a declaration of priority in terms of title and in the context of the whole organisation. It is a specialisation, bringing together the broader perspective of what is happening in terms of technological developments. Thus, part of the role is looking to the external environment to keep the innovation fresh and bring new ideas back into the organisation because due to other pressures many academics are not given the time and the space to allow practice to inform their teaching and learning.

"Unless you have an ET, it won't entirely be the day job of any other discipline to make sure that the execution of good educational technology practices and systems is there. It will be an extra thing on someone's desk…"

4.5 Summary of Chapter 4

In this chapter, I reported on a study investigating whether findings from the literature review reflect current state of practice regarding the level of significance given to Educational Technologists and their impact on DCMiTI.

I suggested that given the extensive and systematic nature of the review that uncovered the absence of the ET role in Digital Capability Maturity studies, it may be possible that this lack of attention in the literature is a result of a corresponding lack of attention in practice. I further suggested that this lack of attention and focus, itself, could be an impediment to adoption success in Digital Education programmes. This positioning guided my investigation into the discrepancies between research, anecdotes, and current practice.

The study confirmed that there is a misalignment of how literature reports the role of ETs and how ETs operate in Digital Education programmes in practice, it also suggested reasons why educational technologists were not featured in the systematic review in Chapter 2. The study also reported the significance of ET's impact on the implementation of DCMiTI. The study findings provide further depth to the answers to Research Question 2.

RQ2: How do these elements affect Digital Capability Maturity in TEIs?

4.5.1 Key findings supporting RQ2

The study highlighted a number of inconsistencies between theory and practice around the role of ETs who are primarily seen as experts in pedagogy and pivotal to the success of digital education. It presents these findings as an absence statement and impact statement below.

4.5.1.1 Absence statement

(1) The role of the Educational Technologist was under-represented in mainstream academic literature but there is a community of practice within which a vast amount of information resides. Within this community are a group of people who have knowledge of DCMiTI and have made valuable input into the research.

(2) The ambiguity associated with ETs and other technology-enhanced learning roles means it could have been featured under a different title. TEL roles in TEIs use many synonymous titles within TEIs, all whose responsibilities evolve with the continuous development of technology (Foti, 2005; Browne and Beetham, 2010).

4.5.1.2 Effect on the development of DCMiTI

The existence of an internal stakeholder whose role is to bridge the gap between technology and pedagogy is of great significance. The ambiguity associated with Technology-Enhanced learning roles makes it difficult to pin a specific title to the success of digital education, so it is far more useful to emphasise the effect of the role or responsibility on the development of DCMiTI. The absence of such a role would mean that there are no persons dedicated to providing change leadership (Aslan and Reigeluth, 2013) and supporting pedagogical practices via mediated use of technology. This supports the findings from Kozine (2007) who suggested, someone needs to be responsible for carefully exploring and analysing the possible use and benefits of new technologies as they emerge (Kozina, 2007); it is essential for the success of any digital learning environment (O Arsenijević et al., 2018). Consequently, such a role would be critical to the successful planning, deployment, and maintenance of digital education.

4.5.2 Confirmatory findings from ALT-C

I disseminated the findings from this study at the Association of Learning Technologists Conference (ALT-C 2019) where a wide range of ETs in practice among other TEI roles were present (Bello et al., 2019a). My research findings aligned with the views and experiences of the conference attendees.

I have not further investigated additional findings because the results provided sufficient useful input allowing me to proceed with the research objectives and because of the limited resource of the PhD programme.

In this chapter, I have extended the body of knowledge on one element - that of the effect of stakeholders on DCMITI. The next two chapters report further empirical studies that investigate other elements that contribute to DCMiTI.

5. CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK

In this chapter, I report the findings of an exploratory study investigating the elements of DCMiTI in the UK. The study was intended firstly to gain a deeper insight into the relationship between elements and additionally to explore investigation techniques to be used for the larger case study which I present in the next chapter. The findings reported in this study substantiate the literature findings and provides empirical evidence to support the answers to Research Questions 1 and 2 of this dissertation.

RQ1: What elements contribute to Digital Capability Maturity?

RQ2: How do these elements affect the Digital Capability Maturity of tertiary institutions?

5.1 Background

My study of existing literature reported in Chapter 3, identified ten candidate elements contributing to DCMITI, each comprising of several sub-elements as shown in Table 3-5. The literature also suggested the positive impact of the candidate elements listed in the classification; and this evidence led me to suggest the consequential knock-on effect on digital capabilities.

However, the analysis was limited to theory and therefore difficult to get an in-depth understanding of the intricacies of the relationships between elements; and which specific elements impact one another; and more specifically 'how?'.

Towards the development of a DCMiTI support structure, there was a need to further investigate the elements and their relationships. Therefore, I designed this investigation with the objectives listed below.

5.2 Aims and Objectives

The aim of the study was to explore and substantiate the proposed classification of elements and gain a better understanding of the relationship between the elements; subsequently, informing the construction of the proposed DCMiTI development structure.

The following objectives were set out to guide the investigation:

a. Ratify the results of RQ1: What elements impact Digital Capability Maturity?
b. Ratify the results of RQ2: How do these elements affect DCMiTI?
c. Rank the elements listed from the literature review in order of significance of their impact on DCMiTI.

With the view of investigating DCMiTI in North-West Nigeria, this study served as a preliminary exploratory study allowing me to explore and gain experience in using different methods and analysis techniques that will be utilised in the subsequent Chapter of this dissertation.

5.3 Methods

The study investigated DCMiTI in two sequential phases. The first phase collected and analysed quantitative data ratifying the outcomes of RQ1 and part of RQ2 as reported in CHAPTER THREE: SYSTEMATIC LITERATURE REVIEW. The second qualitative phase of the study supplemented the first phase with in-depth explanations that would otherwise not have been extracted from the initial phase and further addressed RQ2. Table 5-1 summarises the purpose of each phase of the study.

Table 5-1: Design rationale

RQ addressed	Study Phase	Data type	Purpose
RQ1, RQ2	Phase I	Quantitative	- Ratify the results of RQ1 before proceeding to use this data to inform the model development - Ratify the positive effect of elements (RQ2)
RQ2	Phase II	Qualitative	Builds on RQ2 with in-depth explanation of 'how' elements impact on DCMiTI

The study was conducted under protocol number COM/PGR/UH/03737. Appendix R: Protocol for Study provides detail of how the study was planned. Below I summarise the methods used to conduct the investigation.

5.3.1 Phase I: Quantitative methods

5.3.1.1 Tools

A structured questionnaire was administered using an online survey tool at the time known as 'onlinesurvey.com', later acquired by Jisc (Jisc, 2023). The survey was administered using dedicated tablets solely for the purpose of this study. The full questionnaire can be seen in Screenshots of Online Questionnaire under Appendix R. Below, I explain the structure of the questions below.

The questionnaire consisted of 20 questions that used a 7-point Likert scale to gather participants agreements on the following statements, for each of the 10 elements in the classification:

1. The elements listed from the literature review are elements of Digital Capability Maturity.

2. The elements listed from the literature review have a positive contribution to DCMiTI.

The next 10 questions used a 10-point ranking scale to measure the order of significance of each element.

3. Rank the elements listed from the literature review in order of significance of their impact on DCMiTI.

The last question was an open-ended question used to collect data that may not have otherwise been captured in the survey.

5.3.1.2 Participants

Participants for this phase included tutors, learners, administrators, and other technical staff. All participants volunteered to take part in the study and gave full consent. Participants were of varying ages and genders (see results section for full demographic data and section 5.4.3.1 An analysis of demographic data for my interpretation of the data).

5.3.1.3 Pilot study

A short pilot study was conducted to test and refine the questionnaire before undertaking the full study. No significant changes were made apart from ensuring the fields were all compulsory, so the participants must answer all 30 questions before moving on, since the Likert scale provided an option for the respondent to declare no opinion this was deemed a suitable validation step to ensure all questionnaires were completed in full to avoid the complexities of dealing with missing data.

5.3.1.4 Sampling

The target population for this study was a UK university that was purposively selected due to ease of access (Etikan, 2017). Participants were selected using probability sampling, whereby it is assumed all members of the population had an equal calculable chance of being selected.

5.3.1.5 Recruitment

Study participants were recruited at from various locations around the University campus; they were briefed on the purpose of the study through participant information sheets and each participant signed consent before participating in the study. Data collection was undertaken over a 7-week period.

5.3.1.6 Statistical Analysis

Data analysis was done using SPSS and involved descriptive analysis through which different items were calculated including frequencies and percentages, as well as measurements of central tendency (Sanai et al., 2019; Delaney, 2010). I report the results of this analysis in section 5.4.1 Results from Study Phase I (Quantitative).

5.3.2 Phase II: Qualitative methods

The second phase of the study involved semi-structured interviews (Morse, 1991), designed to explore more comprehensive explanation of the effects that the elements have on DCMiTI; and further to inform the development of a supporting structure.

5.3.2.1 Tools

A semi-structured interview schedule was used to gather data required to answer the questions (see Appendix: Interview Schedule). All questions were open-ended and Table 5-2 gives a snapshot of the questions used to guide the interviews.

Table 5-2: Questions used in interview schedule

Q1	*What elements contribute to Digital Capability?*
Q2	*How do these elements impact DCMiTI?*
Q3	*Which specific elements have the most impact on learning and why?*
Q4	*Are there any other opinions you wish to share in relation to DCMiTI?*

5.3.2.2 Participants

The study engaged the views of TEI management members from various departments within the university Participants were of mixed ages and genders (see section 5.4 Results and Analysis for full demographic data).

5.3.2.3 Pilot study

A short pilot study was conducted before the main study was undertaken to pilot the questions, interview techniques and analysis techniques. As a result of this pilot, facilitation prompts were added to the interview schedule to avoid leading participants (Ismail et al., 2017).

5.3.2.4 Sampling

The target population was the same for the second phase of the study, a UK university purposively selected due to ease of access. Participants were also purposively selected based on their knowledge and experiences of working within the Tertiary Institution setting (Etikan, 2017).

5.3.2.5 Recruitment

Study participants were selected based on their job roles and through professional recommendations from other TEI staff and enlisted through email communication.

5.3.2.6 Content analysis

Therefore, the interview recordings were each transcribed and imported into Nvivo for a 3-step deductive analysis as detailed below.

I employed the pre-defined DCMiTI classification from (Chapter 3) as a frame for analysing the data. Theoretically rooted constructs and theories from the classification guided the data analysis and coding (Hsieh and Shannon, 2005).

5.3.2.6.1 Preparation

- The preparation phase involved selecting units of analysis which were the 10 pre-defined elements contributing to DCM. Mayring (2008) suggests that units of analysis should neither be too narrow nor too wide and must be in accordance with the research objective, therefore I used elements and sub-elements as units of analysis and kept the descriptions to one side.

- Next information associated with each unit of analysis was extracted and put into a second structure determined by a single structuring dimension. In this study, the structure was determined by the research question; '*RQ2: How do these elements impact the DCMiTI?*' – the aim being to enrich our understanding of the statistical data and further expand relationships between elements and classify them as **antecedent and consequent** to better inform the model construction.

  The preparation phase ended with a description of the categories which was also extracted from the classification and inserted into the new structure.

5.3.2.6.2 Coding

- The next stage was to work through the data, organising it for the first time. I adopted an iterative approach that permits the re-working of the category system as new categories may arise (Mayring, 2015). Despite the general approach being deductive, this inductive step reduces the possibility of missing any new findings that may have been introduced during the qualitative part of the study.
- The data was worked through three times, and the findings were marked with codes. Each time the number of codes reduced because with each iteration there was a greater level of familiarisation with the data and the codes were organised as main codes (elements) and sub-codes (sub-elements). There were a few codes that did not comfortably fit into the existing structure, and they were recorded at the end of the codebook. After each iteration the description of each code/ sub-code was then reviewed.

5.3.2.6.3 Reporting

- Finally, the codes were condensed and reported as codes, sub-codes, and descriptions in the form of a codebook. The relationship between the codes/sub-codes was presented in the form of a concept map, along with the bi-directional relationships. The detailed results of the content analysis are reported in section 5.4.2 Results from Study Phase II (Qualitative).

5.4 Results and Analysis

In this section, I present the detailed results for both phases of the study (qualitative and quantitative). The results are presented sequentially, clearly indicating which data was derived from which study. I provide an interpretation of the results and their implication towards the development of a DCMiTI support structure.

5.4.1 Results from Study Phase I (Quantitative)

A total of (n=85) respondents from 16 different departments across the university participated in the study. Table 5.3 shows, (36.5%) of participants were female, (61.2%) were male, while the remaining (2.4%) preferred not to disclose their gender.

Table 5-3: Gender of respondents from Phase I of Investigating DCMiTI - UK

Gender	n	%
Female	31	36.5
Male	52	61.2
Prefer not to say	2	2.4

The highest number of respondents were digital natives (Thomas, 2011) between the ages of 18-24 (56.5%) and 25-34 (28.2%), the remaining age group had (n <=7) respondents. Generally, the data shows that the number of respondents decreased as their age group increased.

Table 5-4: Age groups of respondents from Investigating DCMiTI - UK

Age group	N	%
18-24	48	56.5
25-34	24	28.2
35-44	5	5.9
45-54	6	7.1
55-64	2	2.4
65+	0	0

Table 5-5 shows that most of the respondents (83.5%, n=71) were learners, and only a small percentage of tutors (5.9%, n= 5) took part in the study. The rest of the stakeholder groups each had less than

5% of respondents who participated. Therefore, the data could not be analysed in terms of responses from different stakeholder groups.

Table 5-5: Stakeholder groups from Investigating DCMiTI - UK

Stakeholder group	n	%
Management	2	2.4
Tutors	5	5.9
Learners	71	83.5
Administrators	3	3.5
Other technical staff	4	4.7

5.4.1.1 The elements found in the literature review are the elements that contribute to Digital Capability (RQ1)

Table 5-6 presents a summary of the results for the first question in the survey, showing the number of respondents that selected each value on the Likert scale; and the median rank values for each theme.

Table 5-6: Summary of agreement levels for RQ1 and median rank values

Likert values	1	2	3	4	5	6	7	
Element	No. of respondents							Median
Stakeholders	1	0	3	9	19	26	27	6
EE	2	1	8	16	23	21	14	5
TI	0	4	4	15	21	18	23	5
Infrastructure	1	1	3	13	16	21	30	6
Individual skills	0	3	4	10	24	23	21	6
DI&W	1	4	6	10	19	25	20	6
RTC	1	1	2	6	18	27	30	6
LTD	1	0	2	11	19	26	26	6
Co	0	2	6	14	19	28	16	6
C&I	0	3	1	11	18	24	28	6

The general response, through the majority of respondents' agreement scores, confirms that the elements found in the literature search are important elements contributing to DC. Figure 5-1 shows the distribution of agreement levels across the 10 elements, indicating the highest level of strong agreements are for Infrastructure, resources, tools & content and creation & innovation, stakeholders and learning training and development. Additional graphical representation can be seen in Figure 5-2.

There is a similar pattern of agreement between Individual skills, where (n=68) respondents agreed that it is an element of DC, and DI&W (n=64). These elements also presented the same number of respondents (n=10) who indicated their perceptions as neutral.

The middle point of the 7-point Likert scale indicates a neutral opinion where respondents neither agree nor disagree with the statement. The data in Figure 5-3 shows that respondents indicated a notable frequency of neutral opinions with regards to External Environment, Tertiary Institution, Collaboration, and infrastructure notwithstanding the general agreement that the elements do contribute to digital capabilities.

Disagreement levels appeared relatively low for all elements with External Environment and Digitally identity & well-being both presenting (n=11, 12.9%) of respondents who did not agree that these elements contributed to DC. All other elements presented less than (10%) of respondents who disagreed. Despite some disagreement the analysis indicates that responses are not because the majority of respondents have a general agreement that all ten elements do contribute to DC.

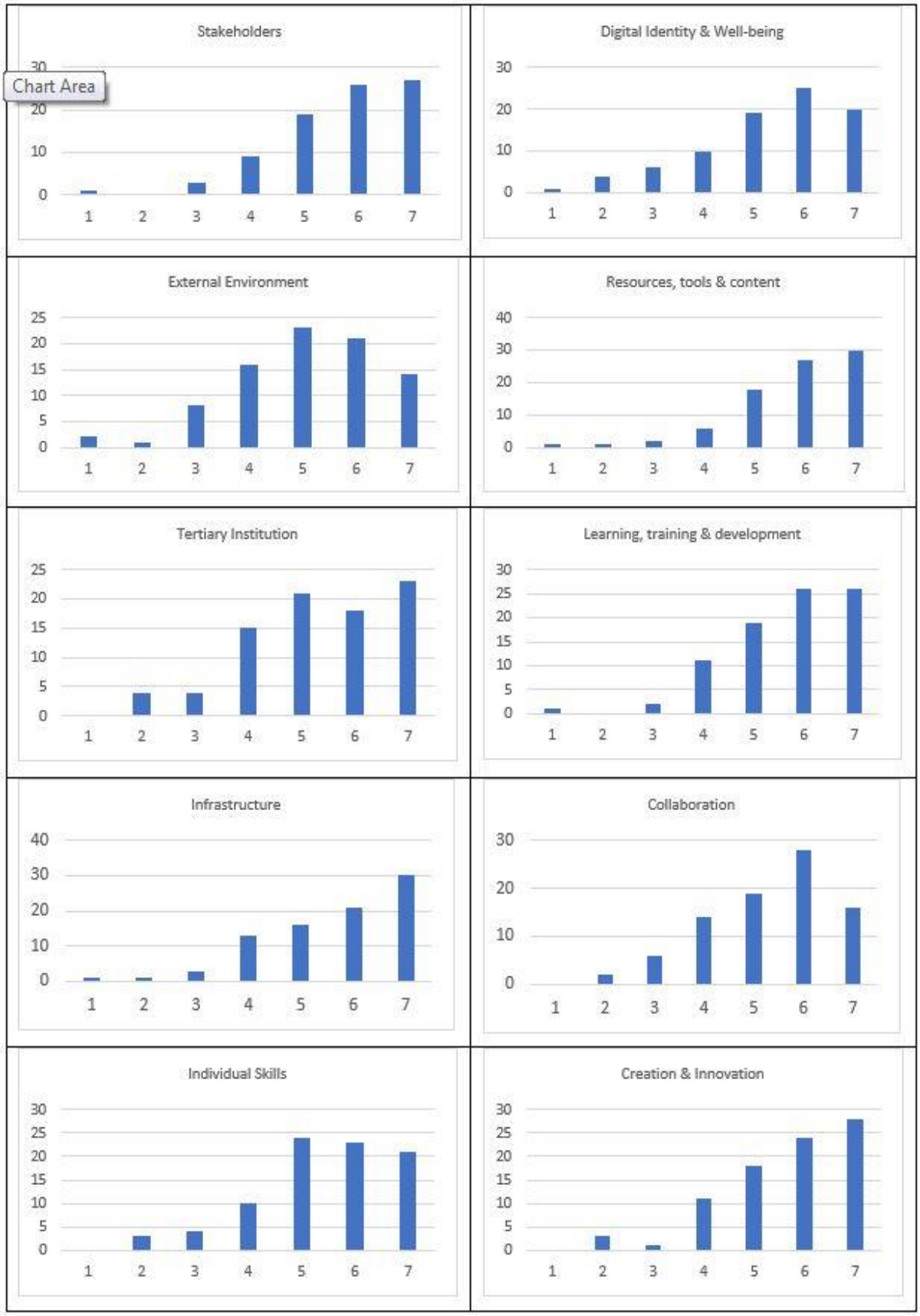

Figure 5-1: Differences in level of agreement that elements found in literature are elements of Digital Capability (RQ1)

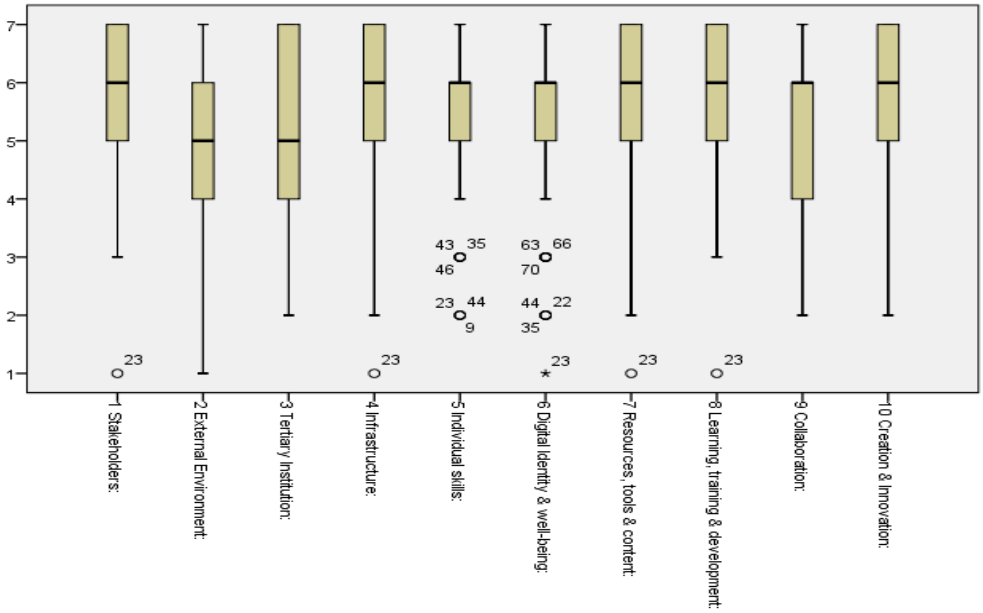

Figure 5-2: Boxplot for respondent's agreements to RQ1

5.4.1.2 The elements found in the literature review have a positive contribution to DCMiTI (RQ2)

Table 5-7 presents a summary of respondents' agreement levels for each value on the Likert scale, and a calculation of the median rank values for each element.

Table 5-7: Summary of agreement levels for RQ2 and median rank values

Likert values	1	2	3	4	5	6	7	
Element	No. of respondents							Median
Stakeholders	0	2	5	11	10	23	26	6
EE	3	2	4	21	22	17	16	5
TI	1	3	2	11	28	21	19	5
Infrastructure	1	1	3	14	20	22	24	6
Individual skills	0	1	2	14	20	28	20	6
DI&W	0	2	4	11	22	28	18	6
RTC	1	1	2	8	13	23	37	6
LTD	0	1	3	9	15	29	28	6
Co	0	3	4	18	14	19	27	6
C&I	2	1	2	9	15	22	34	6

The data presented in Figure 5-3 indicates that respondents had a general agreement on the positive impact of all 10 elements on DCMiTI. The analysis indicates that Stakeholders, Resources, tools & content, Learning, training & development, collaboration, and creation & innovation have the highest number of respondents (n > 25) who strongly agree that these elements have a positive effect on DCMiTI. Individual skills, digital identity & well-being, LTD, Infrastructure and TI also had many respondents (n >20) for each, who agreed (6 on the 7-point Likert scale) that these elements had a

positive contribution to DCMiTI. Respondents (n>25) agreed that Digital identity & wellbeing has a positive effect on institutional maturity.

Notably, the pattern for individual skills is very similar to that of identity & well-being with (n=25) respondents agreeing that individual's skills are also considerably important and only (n=3) respondents indicating disagreement.

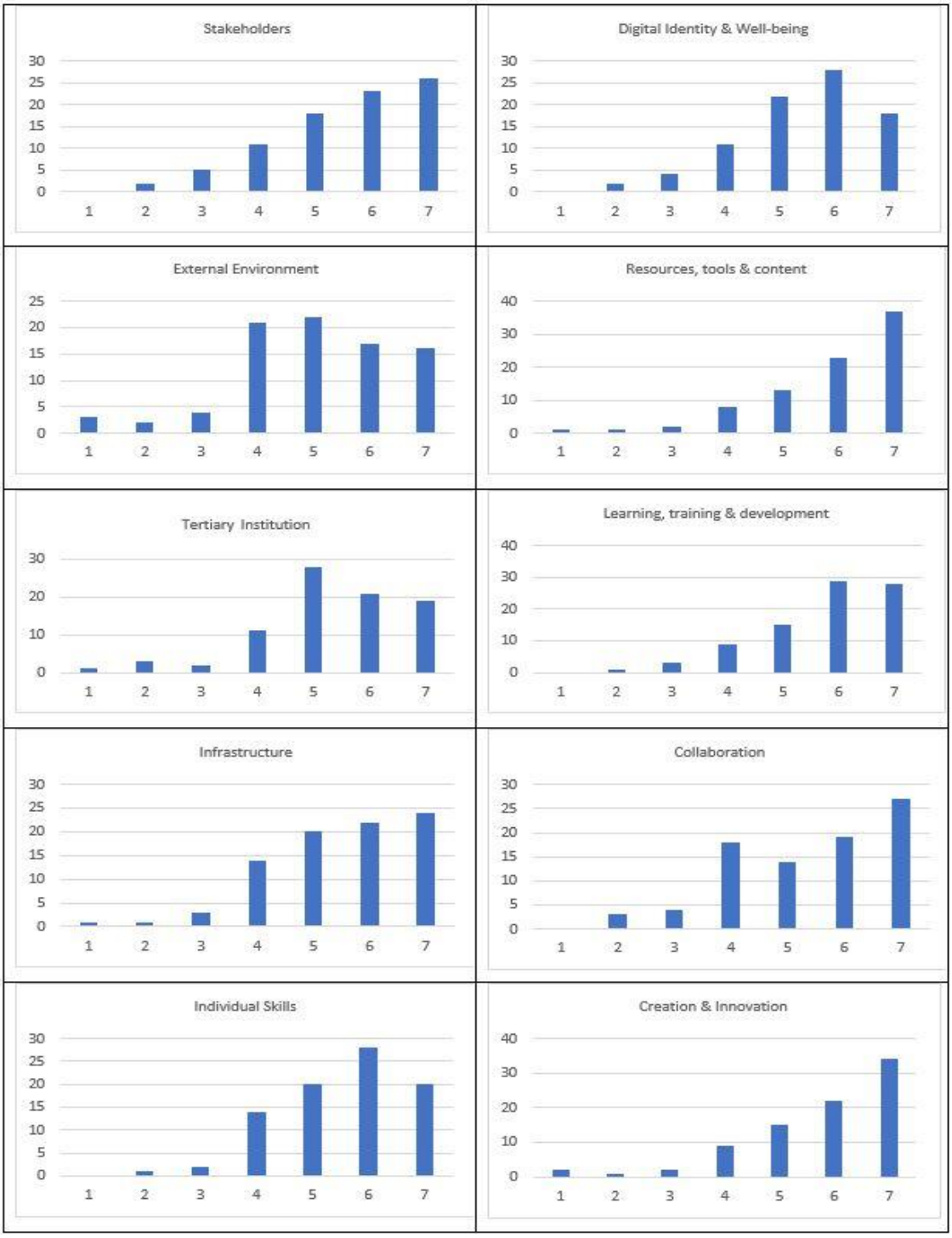

Figure 5-3: Differences in level of agreement that the elements found in literature have a positive contribution to DC (RQ2)

Figure 5-4 provides a more visual representation of this data where the range of the values are represented by the whiskers (black lines), and the concentration of the values are shown by the boxes.

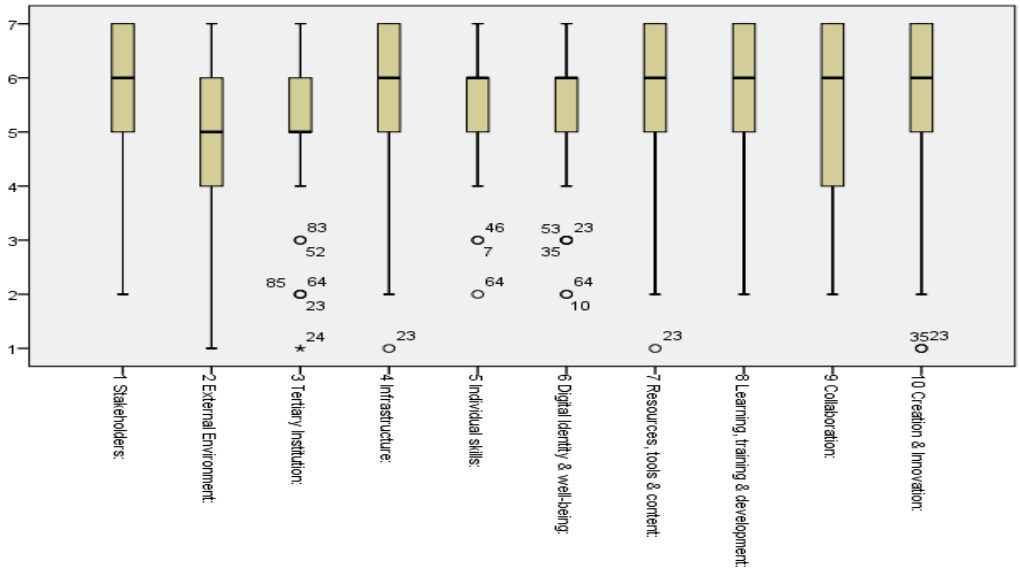

Figure 5-4: Boxplot for respondent's agreement to RQ2

The general pattern indicates low levels of disagreement across all elements; with external environment having the most respondents (n=9) who disagree that the external environmental factors have a positive effect on DCMiTI. Also (n>20) respondents neither agreed no disagreed on the positive effects on this element, generally indicated some uncertainty from respondents around the impact of the external environment, although the differences in agreement levels still weighed heavily towards agreeing to a positive contribution. Furthermore, respondents also indicated uncertainty on the positive effects of collaboration (n>15) and infrastructure, individual skills and tertiary institution environment all showed (n >10) respondents who were neutral on this element.

5.4.1.3 Ranking elements

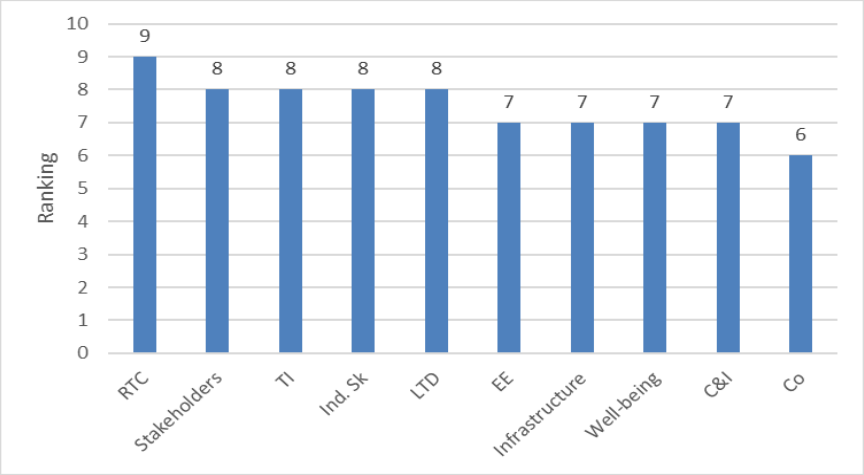

Figure 5-5: Median rank values for each element

Figure 5-5 presents the results of the third question in the survey where respondents were asked to rank elements in order of impact on DCMiTI from 1 to 10, where 1 is least impactful and 10 is most impactful. The rank values indicate that RTC has the most significant impact of DCMiTI with a median rank of 9. Stakeholders, tertiary institution, Individual's skills and learning, training and development all ranked (median=8), suggesting they all have equal significance in terms of their impact on DCMiTI. While external environment, infrastructure, digital identity & well-being are also perceived as equally impactful with a ranking of (median=7). Respondents ranked collaboration as the least impactful, element with a ranking of (median=6).

The purpose of the ranking question was to understand the level of significance of each element however as seen in Figure 5-5, there is very little variation in the ranking between elements therefore a number of different methods were used to interpret the data in section 5.4.3.3 The Order of Significance of elements towards developing DCMiTI.

5.4.2 Results from Study Phase II (Qualitative)

The response rate for interview participation was 60%. A total of (n=3) members of management from various departments within the university participated in the phase of the study. Participants were of mixed ages and genders (n=2) female and (n=1) male.

The interview transcripts were coded and Table 5-8 shows the frequency of appearance of each element referred to during the interviews (see Appendix S: Transcripts from). A detailed list of each element/sub-element found, and its description in the context of this research can be seen in Appendix T: Content Analysis Codebook.

The files refer to the number of transcripts analysed, and the references indicate the number of times a reference was made to each theme. The data in Table 5-8 indicates that Individual skills was the most frequently referenced with (n=39) references, closely followed by the Tertiary Institution with (n=33) references. Infrastructure was the third most frequently mentioned theme (n=27) references, and LTD with (n=25). With then a significant gap followed Wellbeing (n=13) and Resources, tools, and content (n=11). Little reference was made to creation and innovation (n=4) and even less for External Environment (n=1). Lastly there was no mention of Collaboration (n=0) during the interviews. I discuss the interpretation of these findings in section 5.4.3 Interpretation of Results.

Table 5-8: References made to each element during interviews

Themes	Category	Files	References	
External Environment	CSF	1	1	8
Tertiary Institution	CSF	3	33	2
Individual skills	CSF	3	39	1
Infrastructure	CSF	3	27	3
Wellbeing	Element	3	13	5
Resources, tools, and content	CSF	2	11	6
Learning, training & development	CSF	3	25	4
Collaboration	Element/ product	0	0	9
Creation & Innovation	Element/ product	2	4	7
	Total	**3**	**153**	

5.4.2.1 Interdependencies between elements and sub-elements

Table 5-9 summarises the relationships identified during this phase of the study. The arrows (<, >) indicate the direction and show that the nature of these relationships is such that two or more elements are dependent on one another. For example, **(Wb < > TI)**: this means Wellbeing is dependent on many sub-elements of the Tertiary Institutions (such as the provision of adequate policies to support a health work-life-balance, the provision of occupational health facilities etc.); however, there are also aspects of TI that are determined by wellbeing (such as learners use of media platforms, managing digital footprints etc.). In addition **(Wb < IS)**: sub-elements of wellbeing are dependent on Individual skills such as the awareness of wellbeing and consideration of society as whole.

These bi-directional relationships indicate the existence of interdependencies between elements (Haffar et al., 2020). An interpretation of these findings is offered in the next section, and I address these relationships further in section 10.6 Future Work.

Table 5-9: bi-directional relationships between elements

Element/ Sub-element	Relationship
Wellbeing (Wb)	Wb < policies
	Wb > Work life balance
	Wb < > ethical use of media platforms
	Wb > awareness of society as a whole
	Wb > digital footprint
	Wb > health risks
	Health risks > mental health
	Health risks > physical health
	Health risks > occupational health
	Wb <> TI
Tertiary Institution (TI)	TI > Policies > occupational health
	TI > Occupational health
	TI > Institutional guidelines Institutional guidelines > Email etiquette Institutional guidelines > Staff training Institutional guidelines > Social media usage
	TI > Strategic planning
	TI > Structure
	TI > Financial commitment
	TI > Commitment to TEL
	Commitment to TEL > Financial commitment
	Commitment to TEL > Investing in Technology
	Financial commitment > Investing in Technology Investing in Technology > Keeping-up-to-date
	Commitment to TEL > RTC
	TI < > Feedback
	TI <> Keeping up-to-date
	TI > Learning culture
	TI > Institutional culture Institutional culture > Learning culture Learning culture > Own-sense-of-development Own-sense-of-development < IS Institutional culture > Digitally capable culture Digitally capable culture > confidence Confidence < IS
	TI < Data visualisation
	TI < > CI
	TI <> ISk
	TI < DCM
Resources, Tools & Content (RTC)	RTC < Commitment to TEL
	RTC > Guided learner journey
	RTC > VLE
	RTC < Keeping-up-to-date
	RTC < Consulting stakeholders
Commitment to TEL	CtoTEL > Feedback > Learner experience
	CtoTEL > Investing in Technology
	CtoTEL > Communication
	CtoTEL < > Inf.
	CtoTEL < TI
Learning, Training & Development	LTD > Modes of learning
	LTD > Professional development
	LTD <> RTC
Infrastructure (Inf.)	Inf. > Support
	Inf. > Technology (assets)
	Inf. < Data visualisation
	Inf. < CI
Creation & Innovation	CI > Skills to create
	CI <> TI
Individual Skills (ISk)	ISk > skills to create
	ISk > Understanding of wellbeing (Wb)
	ISk > ICT Literacy
	ISk > Pedagogical skills
	ISk > ICT Proficiency
	ISk > Information literacy
	ISk > Technical knowledge
	ISk > Digital skills
	Digital skills > skills to create
	ISk > Digital analytics
	Digital analytics > Data analysis
	Digital analytics < Data visualisation
	ISk > Learner experience
	ISk <> DCM
External Environment (EE)	**EE <> TI**
	EE <> ISk

5.4.2.2 The Cross-sectional relationship between elements

In additional analysis, Figure 5-6 presents a concept map representing the contents of the codebook and knowledge gained from its construction. This concept map captures only some of the interdependencies between elements (Novak, 2008), however it clearly shows the existence of several cross-sectional relationships indicating that at any given point in time there are multiple elements affecting the Digital Capability of a TEI, and all these elements are interdependent. I discuss the implication of this findings further in 5.4.3.4 Summary of Key findings emerged from Phase II of this study.

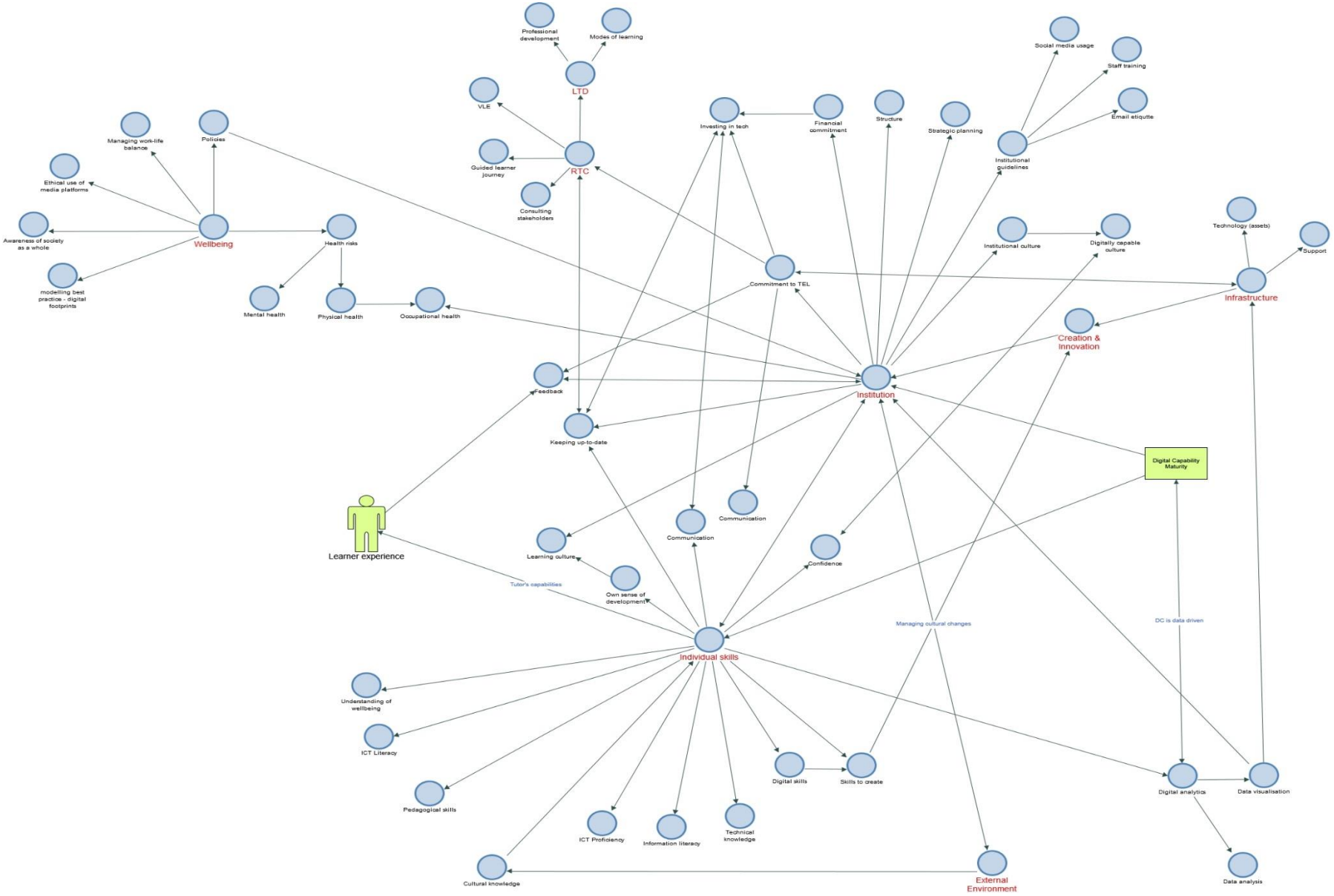

Figure 5-6: Concept map of the interrelationships between elements/ sub-elements

5.4.3 Interpretation of Results

In this section, I present my interpretation of the results on Investigating DCMiTI in the UK to substantiate the proposed candidate elements and gain a deeper understanding of their effects on developing DCMiTI.

5.4.3.1 An analysis of demographic data

The results indicated the majority of respondents were learners and less than 6% of respondents were from the other stakeholder groups. Therefore, the data could not be analysed in terms of responses from different stakeholder groups. This limited participation could be because of a general unwillingness to participate, or because the study was conducted during a busy time of the academic year for staff.

The findings revealed a negative relationship between age group and participation. While there is a prevailing notion, supported by the systematic literature review (SLR), that younger age groups, often referred to as 'digital natives,' tend to have greater familiarity with digital matters and are more inclined to engage in discussions about digital capabilities, it is important to acknowledge the presence of selection bias in the sample population. Given that the majority of the TEI population consists of students, it is expected that a larger proportion of the results would stem from this demographic.

Another interpretation could be because most managers and tutors do not belong to the age group that are considered ‘digital natives’ and therefore are not particularly comfortable with participating in a study about DC. Furthermore, it can also be interpreted that because the university population is mostly comprised of digital natives, we can expect a higher response rate from this particular age group against other age groups comprised of Management, Tutors, administrators, and other technical staff who represent a much smaller percentage of the university population.

In the end, the findings from this study reflect the opinion of learners and management stakeholders.

5.4.3.2 Corroborated SLR Findings

In this section, I discuss the findings from Phase I of the study where I collected stakeholders’ opinions on the candidate elements and their Impact on DCMiTI. The majority of responses corroborated the findings from the systematic review.

5.4.3.2.1 Confirming the elements that contribute to Digital Capability (RQ1)

The results presented high agreements levels that elements listed in the classification all contribute to DCM and presented comparatively low disagreements. It can be said the disagreements are confirmation that the strong positive agreements are not by chance.

5.4.3.2.2 Confirming elements positive contribution to DCMiTI (RQ2)

Findings from this study showed a high level of agreements that all elements have a positive contribution to DCMITI with comparatively low disagreements. Again, the disagreements serve as a sanity check that the confirmations were not by chance.

There was a notable similarity in the pattern of results from Individual Skills and DI&W. Considering the nuances around the divide between digital identity & well-being forming part of individual skills; this data supports the assertion that there are some aspects of Digital Identity and wellbeing that are considered as individual skills. Discussed further in 5.4.3.4.

5.4.3.3 The Order of Significance of elements towards developing DCMiTI

The purpose of the ranking question was to understand the relative level of significance of each element towards the construction of a DCMiTI development structure.

5.4.3.3.1 Different ranking methods

Figure 5-5 showed little variation in the ranking using the median rank values. Therefore, I interpreted the data using several different ranking methods as shown in Table 5-10.

Table 5-10: Variation in ranking Methods

	Themes	Stakeholders	External Environment	Tertiary Institution	Infrastructure	Individual Skills	Well-being	Resources tools & content	Learning training & Development	Collaboration	Creation & Innovation
Methods	Median	8	8	8	7	8	7	9	8	6	7
	Aggregate	429	376	437	416	418	395	493	468	378	426
	mean	7.15	6.37	7.29	7.06	6.97	6.69	8.22	7.80	6.41	7.1
	Ranking by aggregate	**4**	**10**	**3**	**7**	**6**	**8**	**1**	**2**	**9**	**5**

Table 5-10 shows median, mean, and aggregate values as the total of participant rankings. The aggregate values showed the most distinction between elements; therefore, I used the method of ranking by aggregates to suggest the relative level of significance of elements.

5.4.3.3.2 Relative significance of elements

Table 5-11 shows the relative importance of elements in the classification, where 1 is the most significant (Resources, tools & content) and 10 is the least significant (External Environment).

Table 5-11: Level of agreements in order of weighting majority responses (RQ2)

Rank Order	Themes	Strongly agree	Agree	Agree slightly	Neutral	Total agreements	%
1	Resources, tools & content	(37)	23	13	8	73	85.9
2	Learning, training & development	28	(29)	15	9	72	84.7
3	Creation & Innovation	(34)	22	15	9	71	83.5
4	Well-being	18	(28)	22	11	68	80.0
5	Individual skills	20	(28)	20	14	68	80.0
6	Tertiary Institution	19	21	(28)	11	68	80.0
7	Stakeholders	(26)	23	10	11	67	78.8
8	Infrastructure	(24)	22	20	14	66	77.6
9	Collaboration	(27)	19	14	18	60	70.6
10	External Environment	16	17	(22)	21	55	64.7

5.4.3.3.3 Derived significance based on RQ2 responses

Furthermore, Table 5-11 extends the analysis by presenting the levels of agreement to RQ2 in order of majority responses. Assuming the level of agreements indicates the level of significance, then the values under 'total agreements' indicate a derived order of importance given to each element in the survey of RQ2.

5.4.3.3.4 Derived significance based on RQ2 a calculation of strongest agreements

Table 5-11 also shows the levels of uncertainty associated with each theme, so for example Digital identity & well-being, Individual skills and Tertiary Institution all had equal values of (80%) for total agreement. In this case the number of strongest agreements were considered in relation to the number of neutral opinions with regards to the theme to determine the derived rank order. Both Digital Identity & Well-being and individual skills had the largest weight on agreements with (n=28) respondents agreeing on the positive impact on this theme. However, DI&W has (n=11) neutral opinions in comparison to individual skills which had (n=14) neutral opinion and therefore DI&W ranked higher. TI has the strongest agreements on 'slightly agree' with (n=28) respondents slightly agreeing on its positive contribution to DCMiTI and (n=11) respondents with neutral opinions and there ranked the lowest of the three elements with the same total agreement.

5.4.3.3.5 Summary of Order of Significance

After ranking the elements using three different evaluative methods, first based on median rank values of stakeholder's agreements, then based on the derived level of significance from stakeholder's agreements, and lastly by taking only values of agreement into consideration (points 7, 6 and 5 on the Likert scale), I found slight variation in the rank ordering for each of these evaluation methods. Therefore, I used a correlation coefficient test was used to measure the degree of concordance between rank orders of the various evaluation methods. **Spearman's rank correlation indicates strong positive and significant correlations to conclude a significant linear relationship between all rankings as shown in Table 5-12** (Zar, 2014)**.** This suggests that the rank orders used in either of these methods is sufficiently accurate.

Table 5-12: Ranked Aggregates and Spearman's Rank Correlation data

	Ranking and R1	**Ranking and R2**	**R1 and R2**
Coefficient	0.830303	0.733333	0.90303
N:	10	10	10
T Statistic	4.2138888	3.050851	5.945747
DF	8	8	8
p value	0.0029402	0.015801	0.000344

5.4.3.4 Summary of Key findings emerged from Phase II of this study

Most of the findings from the second phase of the study corroborated previous findings. However, seven new findings emerged from to this study which have not previously been captured in this dissertation. Table 5-13 summarises the key findings and how the information has been used to inform this research work.

Table 5-13: Summary of key findings from interviews with management stakeholder in a UK University

	Description	**Implication on research**
Finding 1	Wellbeing is often considered as an individual skill closely linked to the broader theme of wellbeing. While digital identity is also an individual skill referring to the awareness and understanding of the importance of an individual's digital footprint.	The original classification of DCMiTI placed Digital Identity & Wellbeing as one element. However, this finding suggests: a. 'Digital Identity' is an individual skill b. Different aspects of wellbeing are dotted across different elements c. Nonetheless, wellbeing should be included in the classification as an element in its own right – for this reason the concept of wellbeing may appear repetitious in various areas of the development structure.
Finding 2	Institutional policies should make consideration for wellbeing, some adverse effects of poor wellbeing are physical health risks which are linked with the	Consideration of wellbeing in institutional policies is a requirement for higher levels of maturity.

	element of occupational health covered by institutional policies.	
Finding 3	Own sense of self development is another individual skill that can be developed and further supported through organisational initiatives that promote a culture around learning as a life-long skill.	Theoretical findings indicated personal development as an element/sub-element. This finding extends this to discuss 'an individual's own sense of self-development' as an important element that must be captured in developing DCMiTI. This will be represented in the DCMiTI classification through: a. Individual's *own sense of self-development* is a sub-element of individuals skills. b. *Learning as a life-long skill* will also be captured under individual skills. c. Training learners to understand the significance of personal development and advantages of digital skills will be captured under the element of LTD. d. *Organisational support* to promote self-development activities will be captured under the element of Tertiary Institution.
Finding 4	Creation is often considered as an individual skill that supports innovation. Creation also requires necessary tools and platforms (infrastructure) to support the process.	Creation and Innovation was included in the original classification from literature; however, this finding extends that knowledge and suggests: a. Creation is the individual skills that results in learners being able to innovate. Innovation is the product of creativity. b. Creation requires the necessary RTC to support the learner's creativity c. Higher levels of maturity will require adequate infrastructure to support the process.
Finding 5	Interplay between elements indicates strong levels of interdependencies and a network of cross-sectional relationships	Literature findings indicated the relationship between elements as a web. This finding extends this information to provide further details of relationships between each element and supports this with a graphical representation in the form of a concept map (Figure 5-6). This finding suggests that to fully capture DCMiTI, the interdependencies and cross-sectional relationships must be fully represented.
Finding 6	Floating elements which cut across multiple areas of capability	The initial concept of DCMiTI and the classification of elements is two-dimensional. These floating elements suggest there is need to consider alternate representation of the concept of DCMiTI beyond the two-dimensional model.
Finding 7	The emergence of data analytics and data visualisation	This has not previously been captured this research work. This finding suggests that the concept of DCMiTI is data driven. Therefore, any development structure must consider the role of data in driving maturity.

5.4.3.4.1 The Elements

An in-depth content analysis of the study data suggests that the concept of DCMiTI can be divided into two main areas: (1) the skill set of individual learners and tutors within the institutions and (2) the organisational structure and culture of the institution. The two areas that impact capability are interdependent; In effect, for many expectations of a digitally capable institution there is a set of responsibilities; one for the institution and one for the individual, leading to the assertion that, *as individuals develop their capacity, the institution grows in capability*. Therefore, a tutor with high level capabilities will have a positive effect on the learner experience.

There are a few floating elements that contribute to DCMiTI, which cut across multiple elements, such as, *wellbeing*, *innovation,* and Interactivity. *Wellbeing* is mentioned in the context of individuals understanding and ability to manage it and again in the context of the institutions ability to support and maintain the wellbeing of all the various individuals within.
Similarly, *innovation* is mentioned as the individual skill to be able to create and innovate material and content. However, there is also the concept of *innovation* as a culture within a digitally capable and mature institution.
Lastly *Interactivity*, a powerful sub-element under *Learning, training, and development (LTD)* that is enabled by technology. Management participants suggested *interactivity* enables tutors to recognise that learning is a dialogue. However, further thought needs to be given to how *Interactivity* could be defined and measured towards the development of a maturity structure.

These floating elements suggest there is need to consider alternate representation of the concept of DCMiTI beyond the two-dimensional model. I address this matter further in the section 10.6 Future Work.

5.4.3.4.2 The interplay between elements (multidimensional dynamic)

(1) There are strong interdependencies between the elements and sub-elements that contribute to DCMiTI. This is represented in Table 5-9.

(2) There is a cross-sectional relationship between elements represented in Figure 5-6, which must be captured if maturity is the to fully represented.

5.4.3.4.3 The emergence of the data analytics

The emergence of data analytics from the content analysis of interviews suggests the idea that DC is data-driven, leading to the assertion that DCMiTI may also be data-driven. This links in with the

important element of learner experience and the idea of using learner feedback as a measure of what is being done right or what could be done differently in terms of teaching and learning. This interactive feedback loop is itself data-driven and the concept of data analysis and visualisation is particularly important to note for assigning meaningful values to elements towards the development of the DCMiTI structure.

5.5 Summary of Exploring DCMiTI in a UK University

In this chapter, I report an exploratory study investigating the elements contributing to DCMiTI and the relationship between them. In summary, most of the findings from this study corroborated the findings from previous studies giving more empirical weight to the outcome of the systematic review and providing further insight into the complex relationships between the elements that contribute to DCMiTI. The study also revealed a wealth of new findings which proved to be invaluable to the overall research work.

This chapter substantiates the answers to Research Questions 1 and 2 with empirical evidence.

RQ1: What elements contribute to DCM?

This study confirmed that all 10 elements identified in the literature search are elements that contribute to Digital Capabilities. Participant agreements presented in this chapter provide sufficient empirical evidence to confirm the proposed classification of elements and substantiate the theoretical answer to RQ1.

RQ2: How do these elements affect the Digital Capability Maturity of Tertiary Institutions?

This study also confirmed that all elements have a positive effect on DCMiTI when developed. However, to ensure development efforts results in overall maturity, elements should be matured in parallel.

In summary, the new knowledge gained in this study chapter suggests that DCMiTI may be seen as a combination of individual capability (learner and/or tutor), the institutions commitment to digital education, and the resources, tools, and content available to support the learning process. Furthermore, sustainability of DCMiTI may then be assessed using analytics from the learner experience and how well an institution is able to utilise that data for best effect with regards to individual institutional objectives.

The knowledge gained in this chapter was used to revise the classification of elements contributing to DCMiTI. Furthermore, the key take-away points that will inform the development of a proposed DCMiTI structure can be summarised as follows:

1. Consideration of wellbeing in institutional policies is a requirement for higher levels of maturity.
2. Higher levels of maturity will require adequate infrastructure to support the process.
3. Any structure for improvement should capture the interdependencies and cross-sectional relationships between elements to fully represent DCMiTI.
4. DCMiTI is multi-dimensional concept and future work is necessary towards representing it as such.
5. The results suggest that DC is data-driven and therefore any models of DC maturity and improvement must consider the role of data in driving maturity.

The exploratory study presented in this chapter yielded fruitful results therefore, In the next chapter of this dissertation, I replicated the exploration techniques to survey a case study of TEIs in Northwest Nigeria.

6. CHAPTER SIX: INVESTIGATING DCMiTI IN A CASE STUDY OF NORTHWEST NIGERIA

In this chapter, I report on a study designed to extend my investigation of DCMiTI to the Nigerian Tertiary Education landscape. The study contextualised the concept of DCMiTI to a case study of four different types of TEIs in Northwest Nigeria providing further insight into the relationships between elements. The findings from the investigation also brought to light certain considerations specific to the case study area which informed the model construction. The results from this study substantiate the answers to RQ1, RQ2 and RQ4.

RQ1: What elements contribute to DCM?

RQ2: How do these elements affect the Digital Capability Maturity of Tertiary Institution?

RQ4: What is the status of DCMiTI in Nigeria?

6.1 Background

An initial knowledge base was proposed grounded by theory from CHAPTER THREE: SYSTEMATIC LITERATURE REVIEW, which identified candidate elements contributing to DCMiTI and suggested that all elements have a positive effect on an institutional maturity, if developed. Then, the preliminary investigation reported in CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK confirmed the review findings and extended the knowledge base on DCMiTI.

Drawing back to the research problem of *TEIs in Nigeria showing limitations in their ability to deliver digital education effectively*, as stated in chapter 1, and my proposed solution of developing a structure to support the development of DCMiTI in Nigeria; the study reported in this chapter was designed to contextualise the initial knowledge base to Northwest Nigeria.

Furthermore, CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK findings indicated that TEIs have different sets of priorities, and the order of significance of elements/sub-elements will vary between different TEIs and different External environments. These findings suggested that any support structure must be calibrated for use by ensuring the elements/sub-elements align with the institutional goals, as well as the external environment.

Therefore, the purpose of contextualising DCMiTI in this case study is to proffer a solution suitable to the Nigerian education landscape. Thus, I conducted the investigation reported in this chapter, with the objectives listed below.

6.2 Aims and Objectives

The objective of this study was to substantiate the proposed classification of DCMiTI in Nigeria and further contextualise the knowledge of DCMiTI to the Nigerian TEI landscape with the goal of informing the construction of a DCMiTI development structure.

The following study questions were set out to guide the investigation:

1. Study Question 1: What elements impact Digital Capability Maturity?
2. Study Question 2: How do these elements affect DCMiTI?
3. Study Question 3: Rank the elements listed from the literature review in order of significance of their impact on DCMiTI.
4. Study Question 4: Report of the status of DCMiTI in Northwest Nigeria.

6.3 Methods

To answer the Study Questions listed above, I replicated most of the methods used in (CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK) of this dissertation as shown in Table 6-1.

Table 6-1: study design rationale

Study Phase	Type	Purpose
Phase I	Quantitative	▪ Ratify the results of RQ1 before proceeding to use this data to inform the model development ▪ Ratify the positive effect of elements on DCMiTI (RQ2)
Phase II	Qualitative	▪ Builds on RQ2 with in-depth explanation of 'how' elements impact on DCMiTI ▪ Report on the status of DCMiTI in TEIs in Northwest Nigeria

The study was conducted under ethics protocol number ECS/PGR/UH/03871. Appendix V: Protocol for Study 4 details how I planned the investigation.

6.3.1 Phase I: Quantitative Methods

6.3.1.1 Tools (I)

This study used the same structured questionnaire as CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK, to collect participants' agreements with elements in the classification and their effect on DCMiTI. However, in this study the questionnaire was administered using pen-to-paper questionnaires as shown in Appendix: Pen-to-paper Questionnaire) as opposed to electronically. This was primarily due to limitations of internet connectivity in the case study area and because the target sample size was much larger and only a limited number of tablets were available.

6.3.1.2 Participants (I)

Participants targeted for this phase of the study included all stakeholder groups identified in the classification of DCMiTI: learners, tutors, TEI management, administrative staff, and technical staff.

6.3.1.3 Pilot (I)

Considerations were made to use a portable Wi-Fi solution and the digital survey, however after piloting this administration method, the connection was too slow, and data was lost due to unstable connectivity, and it was not time efficient considering the target sample size. Therefore, the decision was made to print off the questionnaire and administer it using pen-to-paper. Furthermore, the entire recruitment process presented challenges in that many participants requested further explanation on the purpose of study; despite being given participant information sheets. The issue with repeated explanations is that using different terms introduces the potential of bias and takes double the time; as a result, I approached academic staff and requested to address learners in clusters after scheduled classes so I could introduce myself and the purpose of the study to clusters of participants at once. This method proved to be more effective.

6.3.1.4 Sampling (I)

Purposive sampling is a type of non-probability sampling in which some reasoning is used to select institutions to participate in the research. I used this technique to select four institutions from the Northwest geo-political zones of Nigeria based on their types and willingness of the institutions management to participate in the research. A cross-section of the different types of TEIs were selected: A University, a Polytechnic, a Federal College of Education, and a National Teaching Institute (formerly referred to as a monotechnic).

Based on Krejcie and Morgan (1970) sample size table, a data sample of 384 respondents is considered sufficient to represent the population of 82826**.** Table 6-2 shows the proportional sample size for each institution.

Table 6-2: proportional sample size of four TEIs

	Institution	Tutors	Learners	Total	Sample size proportion
1	University	6400	35000	41400	192
2	Polytechnic	2963	25000	27963	129
3	Federal College of Education (Technical)	557	10590	11147	52
4	A National Institute (Monotechnic)	816	1500	2316	11
				82826	384

Data source: Intuitions MIS Units (2019)

Table 6-3 shows a further breakdown of the distribution of questionnaire proportional the population. Therefore, the target sample size was to recruit 51 tutors and 333 learners to participate in the investigation. I report the participation rates in the results section 6.4.1.2 Results included in Analysis

Table 6-3: distribution of questionnaires proportional to the study population

	Institution name	Sample size	tutor proportions	learner proportions
1	University	192	30	162
2	Polytechnic	129	14	115
3	Federal College of Education (Technical)	52	3	49
4	A National Institute (Monotechnic)	11	4	7
		384	**51**	**333**

6.3.1.5 Recruitment (I)

After receiving written consent for each of the TEIs selected for the study, participants were recruited at convenience from various departments around the TEI campuses. I approached tutors for permission to address learners after scheduled lectures to introduce myself and debrief them on the purpose of my investigation. For those willing to participate, I then handed out the study tool which included a copy of the participant information sheet and consent form.

Data collection was scheduled to be undertaken over an 8-week period; however, this was cut short due to the outbreak of the COVID-19 pandemic. Therefore, the data collection period lasted only 2 weeks.

6.3.1.6 Statistical Analysis

The questionnaire data was manually input into an excel spreadsheet and exported into SPSS. Unlike the electronic questionnaire, the data collected in the pen-to-paper questionnaires were subject to missing data and several incomplete questionnaires. Therefore, an extensive data cleaning process was undertaken to arrive at the final dataset used for analysis. I report the data cleaning process as part of the results in Section 6.4.1.1 Data Cleaning. I then used descriptive statistics to analyse frequencies, percentages, and measurements of central tendency (medians); which I report under section 6.4.1.2 Results included in Analysis.

6.3.2 Phase II: Qualitative Methods

The second phase of the study again employed the same methods used to explore the opinion of management stakeholders in Chapter 5, Section 5.3 Methods to further inform the development of a support structure for DCMiTI. However, in this study, there was an added objective to contextualise DCMiTI to the Nigerian TEI landscape and report on the status of DCMiTI in the case study area.

6.3.2.1 Tools (II)

A semi-structured Interview Schedule was used to guide interviews with participants to gather the data required to answer the research questions. Table 6-4 summarises the justification of the questions used in the interview schedule.

Table 6-4: justification of interview questions

Research Question	**Interview Question**
RQ2: How do these elements affect the Digital Capability Maturity of Tertiary Institution?	. What elements contribute to DC? . How do these elements affect Maturity?
RQ3: What is the status of research on Digital Capability Maturity in Tertiary Institutions?	. Which specific elements have the most impact on learning and why?
RQ4: What is the status of Digital Capability Maturity in Tertiary Institutions in Nigeria?	Drive research process

6.3.2.2 Participants (II)

Participants for this phase of the study included TEI management members from various departments within the case study institutions.

6.3.2.3 Pilot (II)

This phase of the study was not piloted due to COVID-19 and the time limitations of having to cut the data collection period shorter than planned; furthermore, I had already piloted and undertaken the same study in the UK, therefore, no changes were made to the interview schedule.

6.3.2.4 Sampling (II)

Phase II of the study surveyed the same sample pool reported in Phase I: section 6.3.1.4 Sampling.

6.3.2.5 Recruitment (II)

Study participants were recruited at random based on their job roles and through professional recommendations from Institutional management and the department of Human Resources. Invitations were sent out via email with participant information sheets and consent forms for those willing to participate. I report total participants and response rates in the results section.

Interviews were scheduled and undertaken in pre-booked meeting rooms on the respective TEI campuses.

6.3.2.6 Content Analysis

All interviews were audio recorded and transcribed verbatim. I imported the transcriptions to Nvivo and undertook a content analysis which I report on in section 6.4.2 Results from Study Phase II (Qualitative).

6.4 Results and Analysis

6.4.1 Results from Study Phase I (Quantitative)

Table 6-5 summarises the total number of questionnaires collected from the study population and shows that the sample collected from the University, the FCE-T and the National Institute all exceeded the target sample size by 104%, 278% and 1,290% respectively. I collected sample sizes larger than the target in anticipation of incomplete questionnaires that may need to be excluded from the analysis. However, the data collected from the polytechnic fell short of the sample size required to adequately represent the polytechnic with only 72 questionnaires out of 129 required. This was solely due to the need to end data collection early because of restrictions of the pandemic, otherwise target participants generally expressed willingness to participate.

Table 6-5: summary of data collected from each TEI in the case study

Institution name	**Sample size**		**Staff proportions**		**Student proportions**		**Total Sample**
	target		target		target		
University	192		30		162		**301**
Polytechnic	129		14		115		**72**
Federal College of Education – Technical (FCE-T)	52		3		49		**142**
A National Institute/Monotechnic (NI)	11		4		7		**150**
TOTAL	384		51		333		**665**

Notwithstanding, the total sample size collected for the population was 556 which was greater than the 384 surveys needed to represent TEIs in Northwest Nigeria. The survey data collected was subject to cleaning before arriving at a final data set for analysis.

6.4.1.1 Data Cleaning

A total of (n=121) cases were affected by the issue of missing data. I considered excluding all cases with missing data however, this would have increased the likelihood of introducing bias; moreover, best practise would argue that it is best to keep as much of the data collected, if possible(Mirzaei et al., 2022; Peng et al., 2022). Therefore, a brief exploratory analysis was performed on the data collected to determine the nature of the missingness (Brick and Kalton, 1996).

A 2-step data cleaning was undertaken to arrive at the final data sets to be used for analysis. The same steps were followed cleaning the questionnaire data for all four institutions. Table 6-6 shows the figures for the omitted data and final data sets used for analysis. Below I explain how I arrived at these figures.

6.4.1.1.1 Exploring the nature of missingness

Table 6-6: summary of missing data points

	FCE	Polytechnic	Monotechnic	University
Original dataset (raw data)	**142**	**72**	**150**	**301**
Missing datapoints in raw data	307	116	157	233
No. of Multiple responses instances/ cases	13	14	51	67
Step 2 Omit sets with >10% missingness	29	18	28	46
a. Whole question unanswered	6	3	2	4
b. More than 10% missingness per question	23	15	26	42
Missing datapoints in cleaned data	50	38	49	112
Datasets omitted	29	18	28	46
Final dataset for analysis	**113**	**54**	**122**	**255**

Missing data often introduces problems that affect the data analysis (Mirzaei et al., 2022). There are three main concerns; the first is that missing data reduces statistical power (Mirzaei et al., 2022; Peng et al., 2022); in this case there was a sufficient data sample, therefore this was not the major concern in this study. The second issue is that missing data can bias the results and lastly excluding problematic cases can reduce the representativeness of the data sample (Peng et al., 2022). The issue of lost data biasing the results only becomes a concern if imputation methods are being used to replace missing values. I performed Little's MCAR (Missing Completely at Random) test to determine whether the values were missing in a random, or non-random way meaning the pattern may be dependent on the data values themselves (Little, 1988). **The results from running Littles MCAR test, were Chi-Square = 1452.405, DF=1256, Sig.000. Since the value is statistically significant (less than 0.05)**, I thus concluded that the data were Missing Not Completely at Random (MNCAR) and there was a high probability that the missingness was related to the value of the item itself; or the value of other item(s) in the data set. Therefore, eliminating the option of using any imputation methods to estimate missing values.

Lastly, I addressed the issue of preserving representativeness while excluding selected cases of missing data; this was the main concern in this survey. The goal was to retain as much data as possible without reducing the representativeness of the data sample.

I performed a brief analysis exploring the missingness across the different elements and then again across the different questions to determine whether a particular element, or survey question was the source of the missing data. The exploration revealed all elements presented similar amounts of missing data as shown in Figure 6-1, and likewise no specific question presented more missingness than the others, eliminating the possibility of missingness being associated with any issue with the study question or understandability of a particular element.

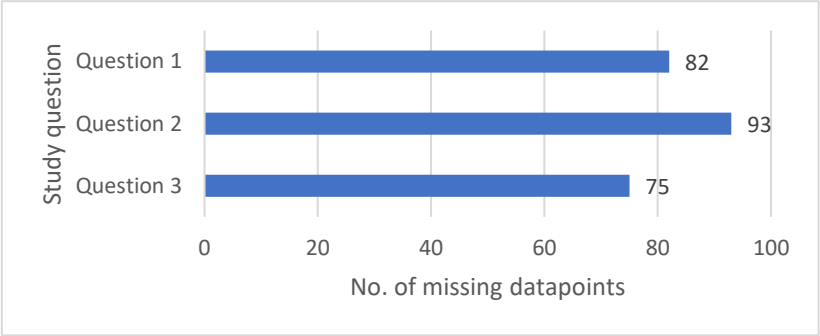

Figure 6-1: missingness per question

6.4.1.1.2 Handling missing data

In pursuit of a sound, scientific and reliable analysis, I applied a 10% missingness tolerance (Dong and Peng, 2013). This meant that any responses where a dataset is missing more than 10% of the responses from one question, or from a particular respondent; then that variable or respondent may be considered problematic and therefore excluded from the result set.

Using this mechanism, resulted in excluding 20.5% of the data collected. However, because I had collected data in excess of the target to compensate for any issues of incomplete questionnaires; despite the omissions, the remaining dataset included (n=544) surveys, which was large enough for sufficient statistical power and meaningful analysis that was representative of the case study area.

In terms of the elements, missing data points ranged from 1-8 out of a possible 339 data points per element. IS presented the highest number of missing data points with 8/339 (2.359%) missingness, closely followed by DI&W, RTC and TI which all had 2.064% missingness. EE (1.769%), Co (1.179%) and the remaining elements all presented less than 1% of missing data. Again, this indicates that no one element presented problems in the questionnaire.

In the next section, I present the respondents' demographics followed by results and preliminary analysis of the final data set, addressing each of the study questions.

6.4.1.2 Results included in Analysis

6.4.1.2.1 Summary of demographic data

I investigated DCMiTI in a case study of four TEIs within the North-West Zones of Nigeria to substantiate the proposed classification and findings from the literature review. A total of 544 questionnaires were included in the analysis of Phase I. The largest portion of respondents were from the university with 46.9%. 22.4% of the survey data was from the NI and 20.8% from the FCE-T. The fewest questionnaires were collected from the polytechnic (9.9%). The low response rate from the polytechnic was due to cutting the data collection period short because of restrictions related to the pandemic. Notwithstanding, the total sample size collected for the population was sufficient to represent TEIs in Northwest Nigeria.

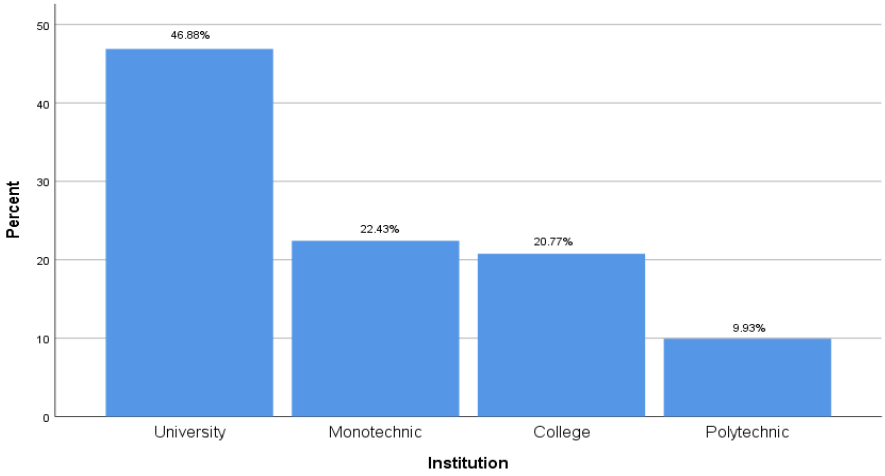

Figure 6-2: distribution of respondents across the four institutions

The majority of respondents were learners (93%) with relatively small proportions from the other stakeholder groups as seen in Figure 6-3. Learners were much more willing to take part in the study than tutors, administrators, and technical staff.

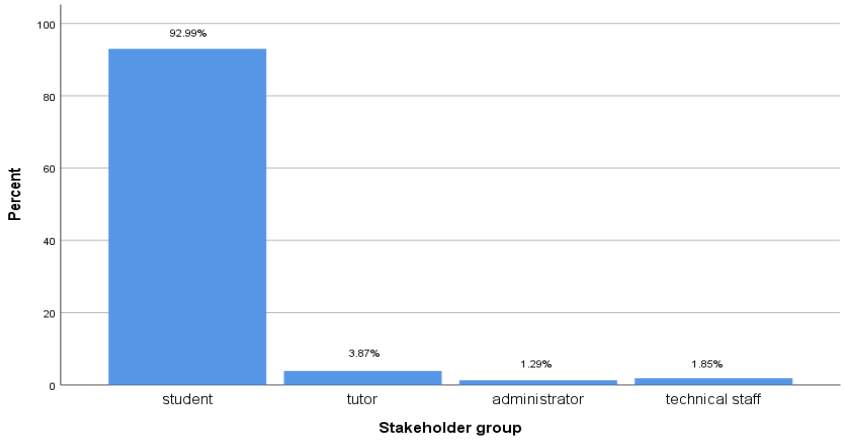

Figure 6-3: distribution of respondents across stakeholder groups

Most of the respondents were between the ages of 18-24 (72.1%). 19.4% were between the ages of 25-34, and the other age groups presented even smaller proportions as shown in Figure 6-4. There were no respondents above the age of 55.

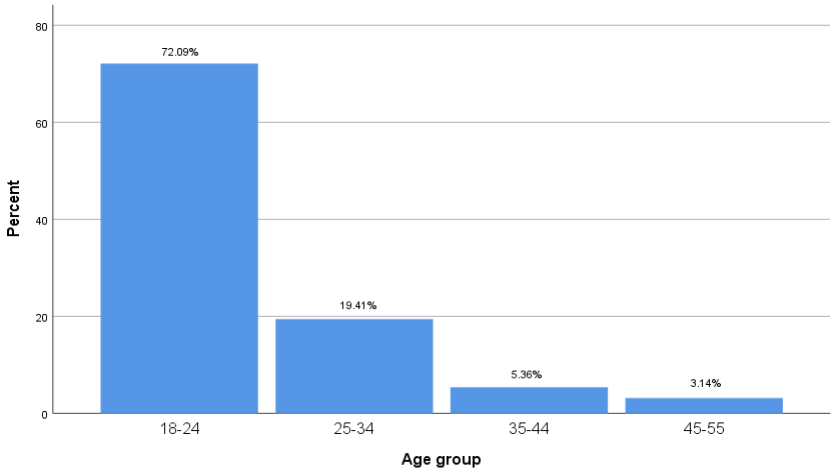

Figure 6-4: distribution of respondents across age groups

65.8% of respondents identified as male, and 33.5% as female, while 0.7% preferred not the disclose their gender.

Considering the survey was conducted across four different types of tertiary level institutions, the qualification types varied. Figure 6-5 shows 35.4% of respondents were pursuing a bachelor's degree, 33.0% were diploma/HND students and 20.6% were pre-NCE students (a course only offered in the Colleges). Only a small proportion of participants were postgraduates: master's degree students (7.8%) and doctoral candidates (3.2%). Figure 6-5 also demonstrates that the data included some representation of the various degree type offered in TEIs, with the most representation from bachelor's and diploma learners. Furthermore, participants were undertaking a range of different courses from different disciplines across the different institutions.

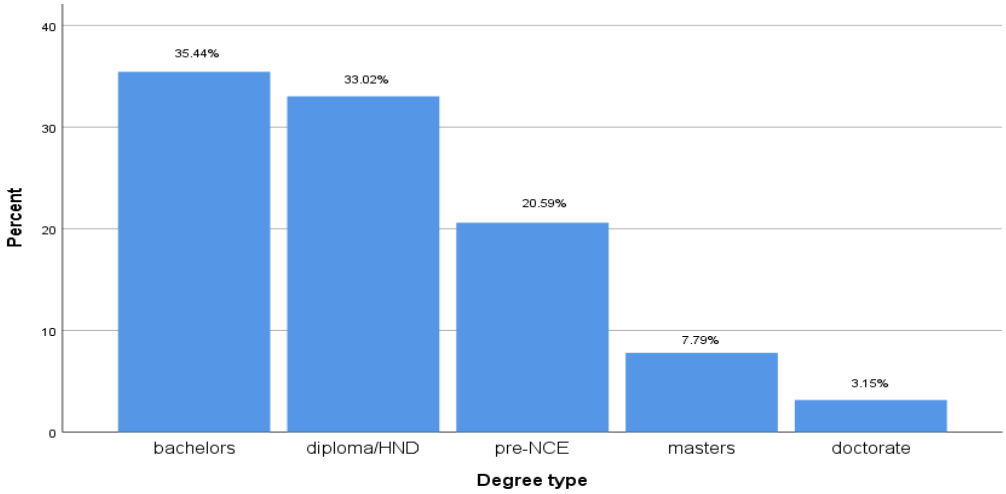

Figure 6-5: distribution of respondents across degree types

6.4.1.2.2 Results and Analysis

The overall results of the investigation yielded a strong and consistent pattern of high agreements and low disagreements, combined with a small portion of uncertainty across the four institutions. Table 6-7 presents a summary of the agreement strengths for Study Questions 1 and 2.

In presenting the results I have simplified the data for ease of analysis by consolidating the values on the Likert Scale into three simple categories. The first combines all agreements (values 7= strongly agree, 6= agree and 5= slightly agree) in overall agreements. The second category combines all disagreements (values 1= strongly disagree, 2= disagree, 3= slightly disagree) into overall disagreements. The last category looked at value 4 on the Likert Scale (value 4= neither agree not disagree), highlighting the portion of responses that neither agreed nor disagreed with the statement that elements in the classification contribute to DCM.

Table 6-7: Summary of results from Question 1 and Question 2 of the Case study

	Strength of agreements (%)		
Likert Scale values	overall agreements	Overall disagreements	Neither agree nor disagree
Question 1	> 58.2%	<=33.3 %	<= 16.3 %
Question 2	>= 58.4 %	<= 11.5 %	<= 15.7%

Note: In this table I have summarised the 7-point Likert Scale used to collect the data by referring to points 1, 2 and 3 of the scale as disagreements; points 5, 6, 7 as disagreement and point 4 is neither agree nor disagree.

The data summarised in Table 6-7 indicates the following:

- The majority of stakeholders from the case study agreed that the elements uncovered in the SLR are elements that contribute to DCM.
- The majority of stakeholders from the case study also agreed that these ten elements have a positive effect on the DCMiTI.
- A small but acceptable portion of the study population did not have an opinion.

Next, I present a further breakdown of the results, looking at the pattern of agreements from each institution; presented in order of Study Question 1, followed by Study Question 2.

6.4.1.2.2.1 The elements found in the literature review are the elements that contribute to Digital Capability (RQ1)

Participants from the four institutions were asked to score their level of agreement against elements 1-10 listed in the questionnaire.

> **Study Question 1**: On a 7-point scale, rate how strongly you agree or disagree that the elements (1-10) are elements of Digital Capability (where 1 = strongly agree and 7 = strongly disagree).

The graphs in *Figure 6-6* to *Figure 6-9* on pg130, show the distribution of responses from each of the four TEIs surveyed in the case study. Table 6-8 provides a summary of the results obtained.

Table 6-8: range of agreements across the four institutions

	Strength of agreements (%)		
Tertiary Institution	Overall agreements	Overall disagreements	Neither agree not disagree
University	>= 75.2	<= 19.4	<= 6.4
National Institute (NI)	>= 70.2	<= 19.3	<= 10.7
Polytechnic	>= 67.3	<= 26.9	<= 16.3
FCE-T	>= 58.2	<= 33.3	<= 12.7

Note: in this table I have summarised the 7-point Likert scale used to collect the data by referring to points 1, 2 and 3 of the scale as agreements; points 5, 6, 7 as disagreement and point 4 has been identified as is (neither agree nor disagree).

The data summarised in Table 6-8 indicates the following:

- All four institutions were in majority agreement (>= 58.2%) that the candidate elements are elements that contribute to DCM.
- The University presented the highest agreements with 75.2%, followed by the National Institute (70.2%), then the polytechnic (67.3%).
- The FCE-T presented the lowest agreements (58.2%), and highest disagreements (33.3%).
- All four institutions consistently presented some disagreement with the statement, although the agreements far outweighed the disagreements in every instance.
- All the institutions presented a similar and consistent result in terms of the number of participants with neutral opinions, ranging between 6.4% to 16.3%.

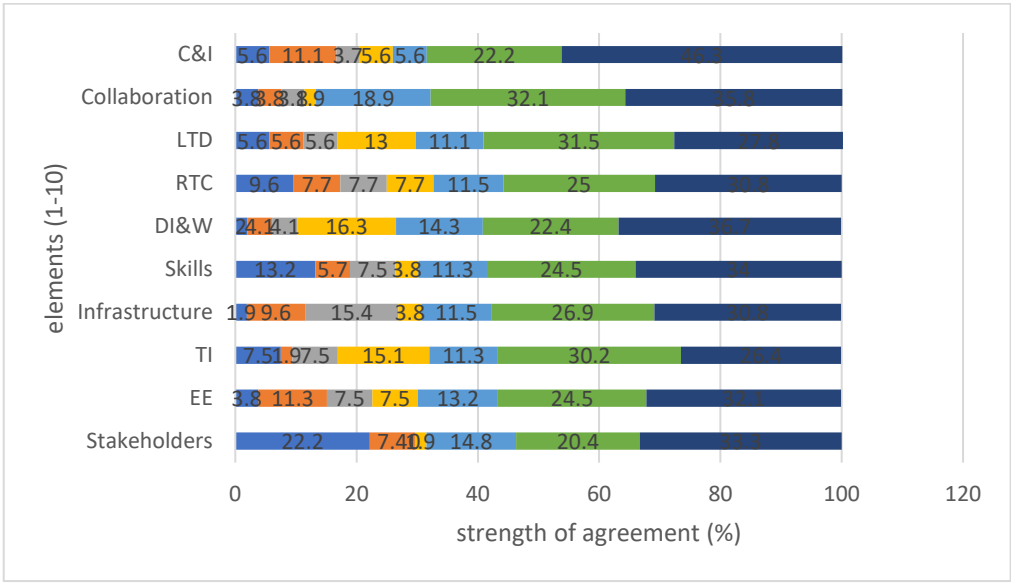

Figure 6-6: results from Polytechnic (Q1)

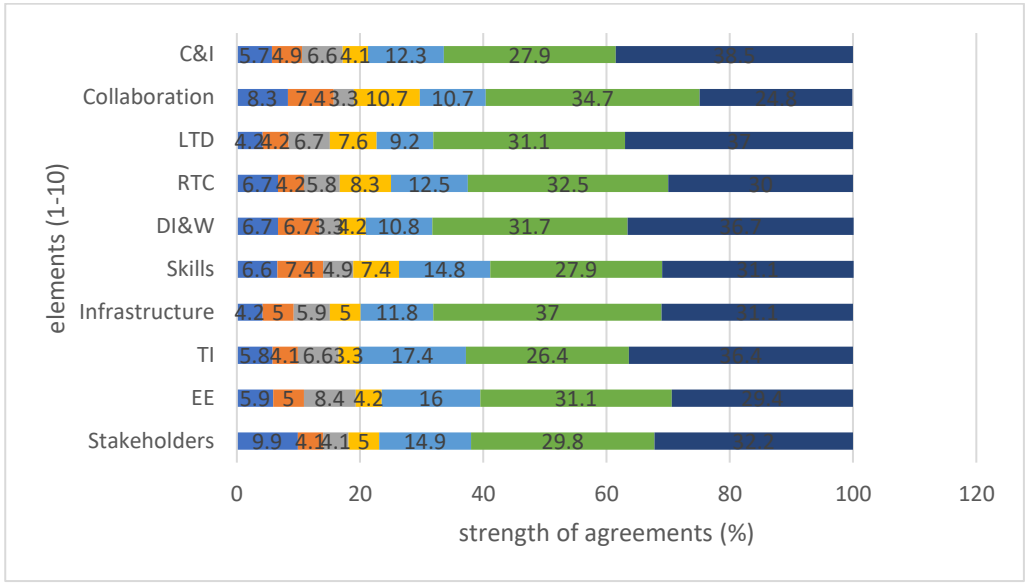

Figure 6-7: results from National Institute (Q1)

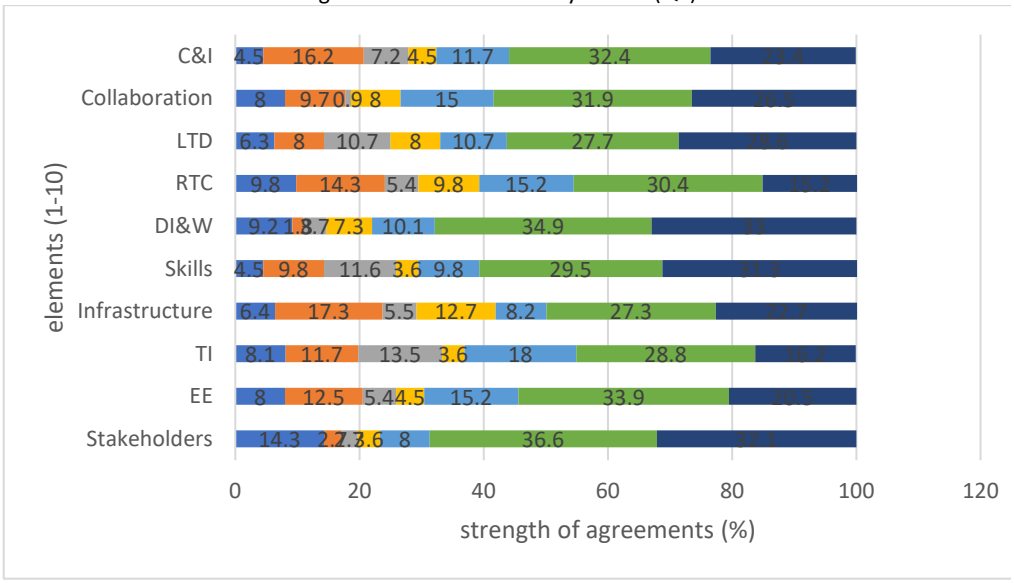

Figure 6-8: results from FCE-T (Q1)

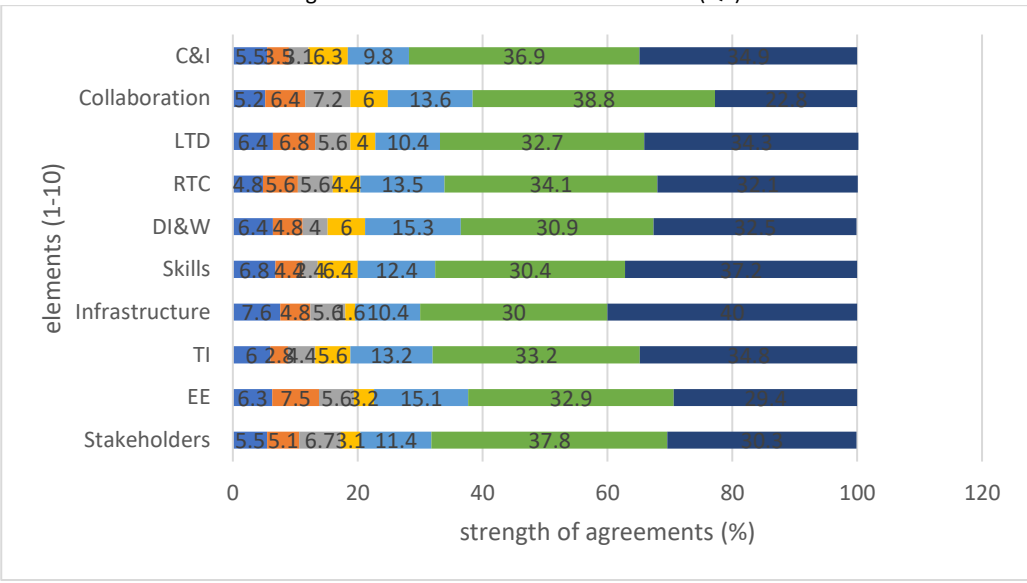

Figure 6-9: results from University (Q1)

Analysing results of Study Question 1 by Institution

The focus of this study was to capture the respondents' opinions across the case study area as a representation of the typical responses of the population of NW Zones of Nigeria. In comparing responses from the different institutions, I was able to explore the differences and similarities between them.

Table 6-9 presents the range of agreements, showing that the overall agreements levels from the university and NI are higher than those from Polytechnic and FCE-T. The range between the highest and lowest overall agreements are much smaller in the university and the NI, than they are in Polytechnic and FCE-T.

Table 6-9: range of agreements across the four institutions (Q1)

Tertiary Institution	**Range of agreements (%)**		
	Agreements	Disagreements	Neither agree not disagree
University	**6.4** (75.2 – 81.6)	**7.3** (12.1 - 19.4)	**4.8** (1.6 - 6.4)
NI	**10** (70.2 – 80.2)	**4.2** (15.1 - 19.3)	**7.4** (3.3 - 10.7)
Polytechnic	**19.5** (67.3 – 86.8)	**16.7** (10.2 - 26.9)	**15.4** (0.9 - 16.3)
FCE-T	**19.8** (58.2 - 78.0)	**18.6** (14.7 - 33.3)	**9.1** (3.6 - 12.7)

The university presented the narrowest range of responses with only 6.4% difference between the highest and lowest agreement levels. The NI followed closely with 10% range. The Polytechnic and FCE-T had relatively higher ranges between agreements with 19.5% and 19.8% respectively.

The same pattern of ranges is seen in disagreements and neutral opinions with the University and the NI showing smaller ranges, and the Polytechnic and FCE-T showing higher ranges.

Table 6-10 below, presents the findings based on the categories used for analysis, I explain the reason for this categorisation in Table 6-11: justification for categories used in analysis.

	Overall agreements	Strong agreements	Overall disagreements	Neither agree nor disagree
University	The results from the University were consistent in terms of agreement levels across all ten elements. C&I had the highest overall agreements with 81.6%, Co had the lowest agreements with 75.2% and agreements from all other elements fell within this range.	Infrastructure (40.0%), skills (37.2%) and C&I (34.9%) had the highest strong agreements.	The disagreements also presented the same consistent pattern, with the highest overall disagreement from EE at 19.4% and the lowest from C&I at 12.1%. All other elements presented overall disagreements within this range.	A very small portion of responses ranging between 1.6-6.4% across the ten elements indicated not having an opinion about the elements contributing to DCM.
National Institute (NI)	The results from the NI showed a similar pattern to that of the University. The agreement patterns were consistent across all ten elements. Overall agreement strengths on all elements ranging between 80.2% from DI&W and 70.2% from Co.	Looking at unanimously 'strong agreements' (value = 7 on the Likert Scale), C&I showed the highest number of strong agreements (20%), closely followed by LTD, DI&W and TI.	On the other hand, the highest overall disagreements were with EE (19.3%) and the lowest Infrastructure and LTD both with (15.1%). The overall disagreements from all other elements fell within this range.	3.3 - 10.7% of respondents across the ten elements neither agreed not disagreed that the element(s) contributed to DCM.
Polytechnic	In Polytechnic, the highest overall agreements were from Co at 86.8% and the lowest was 68.5% from stakeholders.	C&I (46.3%), DI&W (36.7%) and Co (35.8%) showed the highest strong agreements.	Stakeholders presented the most overall disagreements with 29.6% DI&W had the least overall disagreements with 10.2%. 0% respondents indicated value 3 on the Likert Scale 'slightly disagree'.	The polytechnic also had the highest percentage of participants who selected level 4 on the Likert Scale = neither agree not disagree (<=16.3%). This institution also presented the widest range in this category.
FCE-T	DI&W (78.0%), stakeholders (76.7%) and Co (73.4%) presented the highest overall agreements. With the lowest agreements from Infrastructure (58.2.%).	In the FCE-T, the highest strong agreements were from DI&W (33.0%), followed by Stakeholder (32.1%) and Skills (31.3%).	TI presented the most disagreements (33.3%) followed by RTC (29.5%) and the infrastructure (29.2%).	3.6 – 12.7% of respondents neither agreed nor disagreed.

Table 6-10: Summary agreements for Q1 based on categories for analysis

Analysing results of Question 1 by the elements

To support the analysis in terms of the specific elements that have been indicated most frequently among the four institutions as contributing to DCM, I have summarised the result data in

Table 6-12, showing the three elements with the highest agreement strengths in three categories that I used to analyse and compare the data. The reason for choosing these three categories has been summarised in Table 6-11.

Table 6-11: justification for categories used in analysis.

Category	Reason
Overall agreements	To identify which elements/ Institutions presented the highest overall agreement that the element contributes to DCM.
Strong agreements	To spotlight unanimously strong agreements and be able to compare the strong agreements with the total overall agreement to find any patterns.
Overall disagreements	To identify which elements respondents least agreed contributed to DCM. Also, to be able to compare the disagreements with lowest agreements to see if there is a pattern.

Table 6-12: summary of occurrences of elements (Q1)

Tertiary Institution	Overall agreements	Strong agreement	Overall disagreement
University	1. C&I (81.6%) 2. TI (81.2%) 3. Infrastructure (80.4%) Lowest: Co (75.2%)	1. Infrastructure (40.0%) 2. Skills (37.2%) 3. C&I (34.9%)	1. EE (19.4%) 2. LTD (18.8%) 3. Co (18.8%) Lowest: C&I (12.1%)
NI	1. TI (80.2%) 2. Infrastructure (79.9%) 3. DI&W (79.2%) Lowest: Co (70.2%)	1. C&I (38.5%) 2. LTD (37.0%) 3. DI&W (36.7%)	1. EE (19.3%) 2. Co (19.0%) 3. Skills (18.9%) Lowest: Infrastructure (15.1%) and LTD (15.1%)
Polytechnic	1. Co (86.8%) 2. C&I (74.1%) 3. DI&W (73.4%) Lowest: stakeholders (68.5%)	1. C&I (46.3%) 2. DI&W (36.7%) 3. Co (35.8%)	1. Stakeholders (29.6%) 2. Infrastructure (26.9%) 3. Skills (26.4%) Lowest: DI&W (10.2%)
FCE-T	1. DI&W (78.0%) 2. Stakeholders (76.7%) 3. Co (73.4%) Lowest: Infrastructure (58.2%)	1. DI&W (33.0%) 2. Stakeholders (32.1%) 3. Skills (31.3%)	1. TI (33.3%) 2. RTC (29.5%) 3. Infrastructure (29.2%) Lowest: DI&W (14.7%)

In terms of the different elements, Table 6-12 shows the frequency of occurrences and how many times each element appeared in the top three highest responses for each category:

- 6 elements most frequently appeared with the highest overall agreements: DI&W (3), C&I (2), TI (2), Infrastructure (2), Co (2) and stakeholders (1).
- 7 elements most frequently appeared with strong agreements: C&I (3), DI&W (3), Skills (2), Co (1), Infrastructure (1), LTD (1) and Stakeholders (1).
- 8 elements most frequently appeared with overall disagreements: EE (2), Skills (2), Co (2), Inf (2), LTD (1), TI (1), RTC (1) and stakeholders (1).

More specifically:

- DI&W appeared in the top three highest overall agreements in FCE-T (78.0%), the Polytechnic (73.4%) and the NI (79.2%). This element also appeared in the top three 'strong agreements' in the same institutions.

DI&W also scored the lowest levels of disagreements in the Polytechnic and the FCE-T.

- C&I scored the highest overall agreements in the University and the third highest 'strong agreement'. C&I also scored the highest 'strong agreements' in both the NI and the Polytechnic, as well the second highest overall agreement in the Polytechnic.

  This element also scored the lowest disagreements in the University.
- Co scored the lowest overall agreements in the University and the NI, although these agreement levels were both high at 70.2% and 75.2% respectively.

  This element also appeared with the highest overall agreement in the Polytechnic and the third highest in FCE-T.
- Skills had the second highest 'strong agreements' in the University (37.2%) and the third in FCE-T (31.3%) but did not appear among the top three highest overall agreements in any of the institutions.

  Skills also appeared with the third strongest disagreements in both the NI (18.9%) and the Polytechnic (26.4%).
- Infrastructure showed the largest 'strong agreement' in the University (40%); and appeared with the second and third highest overall agreement levels in the NI (79.9%) and the University (80.4%) respectively. It also showed the lowest amount of disagreement in the NI.

  Infrastructure also made a frequent appearance among the top three highest overall disagreements in both the Polytechnic (26.9%) and the FCE-T (29.2%).
- TI scored 81.2% overall agreement in the University and 80.0% in the NI, it did not appear in with high 'strong agreements' from any of the institutions.

  TI scored the highest overall disagreements in FCE-T.
- Stakeholders had the second highest overall agreements (76.7%) in FCE-T, they also showed the second highest 'strong agreements' in this institution.

  Stakeholder had the lowest overall agreements in the Polytechnic (68.5%) and the highest overall disagreements (29.6%).
- LTD scored the second highest 'strong agreement' in the NI (37.0%) and also had the least overall disagreement (15.1%); but did not appear in the top three overall agreements in any of the other institutions.

  LTD also had the second highest level of disagreement in the University (18.8%).
- EE scored the highest disagreements in both the University and the NI. This element did not appear in the top three agreements or strong agreements in any of the institutions.

In conclusion, these findings suggest the following:

There are 8 elements that most frequently appeared with high agreements as contributing to DCM, ordered as follows:

1. DI&W
2. C&I
3. Skills
4. TI
5. Infrastructure
6. Co
7. Stakeholders
8. LTD

We also note that there are 4 elements that most frequently appeared with the least agreements (thus meaning disagreement) that these elements contribute to DCM:

- EE
- Co
- Skills
- Infrastructure

There was an overlap with Co, Skills, and Infrastructure as they appear with high agreements in certain institutions and high disagreements in others. The level of contribution of these elements cannot be understood from quantitative analysis, therefore; looked to the content analysis of interviews with management to add context to these results in Section 6.4.2 Results from Study Phase II (Qualitative).

However, it is unequivocal that respondent in all four institutions in NW Nigeria agree that EE is the elements that has the least contribution to DCM.

Summary of Findings for Question 1 of the Case study

To summarise the findings from Study Question 1, 58.2% and above of total respondents across all institutions agreed that elements 1-10 are elements of DCM. No more that 33.3% of respondents disagreed with the statement and fewer than 16.3% neither agreed nor disagreed.

Confirmation of elements contributing to DCM

I thus conclude that since a majority of respondents from all institutions agreed, this confirms that the elements uncovered in the SLR are elements that contribute to DCM. Within the boundaries of this study, no other elements have been identified.

The University and National Institute presented the highest agreement levels and the least number of respondents who did not have an opinion, closely followed by the Polytechnic.

The FCE-T had the lowest agreement levels and the highest number of respondents who did not have opinions.

DI&W had the highest agreement levels, followed by C&I, TI, Stakeholders, LTD, Co, Skills, and Infrastructure. EE had the lowest agreement levels.

Future studies

Co, Skills, and Infrastructure presented an overlap; therefore, I will be looking to further understand their contribution in future studies.

6.4.1.2.2.2 The elements found in the literature review are the elements that contribute to Digital Capability (RQ2)

The second question that stakeholders were asked in this validation study was on the effect of the 10 elements on DCMiTI.

> **Study Question 2**: On a 7-point scale (where 1 = strongly disagree and 7 = strongly agree), please indicate your level of agreement that each of the elements (1-10) makes a positive contribution to Digital Capability in tertiary institutions.

Table 6-13 provides a summary of the results obtained from each of the institutions in the case study.

Table 6-13: summary of results for Question 2 from the study investigating DCMiTI among four institutions in NW Nigeria

Tertiary Institution	**Strength of agreements (%)**		
	Agreements	Disagreements	Neither agree not disagree
University	> 75.2	< 5.6	< 8.5
NI	> 70.0	< 10.0	< 10.1
Polytechnic	> 68.5	< 11.5	< 11.5
FCE-T	> 57.5	< 9.3	< 15.7

Note: in this table I have summarised the 7-point Likert Scale used to collect the data by referring to points 1, 2 and 3 of the scale as agreements; points 5, 6, 7 as disagreement and point 4 has been identified as is (neither agree nor disagree).

From the summary of data in Table 6-13, I deduced the following:

- All four institutions presented majority agreements >= 57.5% that the elements have a positive effect on the DCMiTI in NW Nigeria.

  The University showed strongest agreements levels with 75.2%, followed by the NI (70.0%), then the Polytechnic with 68.5% and the FCE-T with 57.5%.
- There was a very low level of disagreement with the highest level of overall disagreement from the Polytechnic with 11.5% and only 5.6% disagreement from the University.
- There was a small portion of participants who neither agreed nor disagreed with the statements presented in the study and they ranged between 8.5% from the University, to 15.7% from the FCE-T.

Analysing results of Question 2 by Institution

The range of responses between the highest and lowest agreements; disagreements; and neither agree not disagree, are presented in table 12.

Table 6-14: range of agreements across the four institutions (Q2)

Tertiary Institution	**Range of agreements (%)**		
	Agreements	Disagreements	Neither agree not disagree
University	**6.4** (75.2 - 81.6)	**17.2** (22.8 - 40.0)	**0.3** (1.6 - 16.3)
NI	**11.9** (70.0 - 81.9)	**19.9** (26.4 - 46.3)	**7.6** (2.5 - 10.1)
Polytechnic	**17.5** (68.5 - 86.0)	**14.0** (11.7 - 25.9)	**11.5** (0.0 - 11.5)
FCE-T	**13.1** (57.5 - 70.6)	**21.5** (22.7 - 44.2)	**13.9** (1.8 - 15.7)

The University presented the smallest range of responses (0.3%) followed by the NI (7.6%). The Polytechnic and the FCE-T showed a wider range with 11.5% and 13.9% respectively.

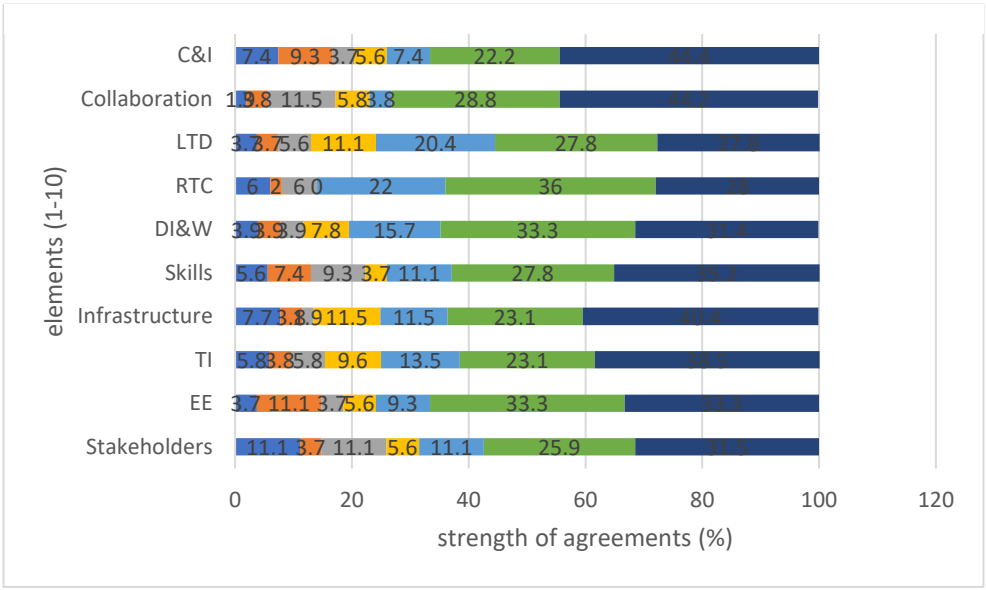

Figure 6-10: results from Polytechnic (Q2)

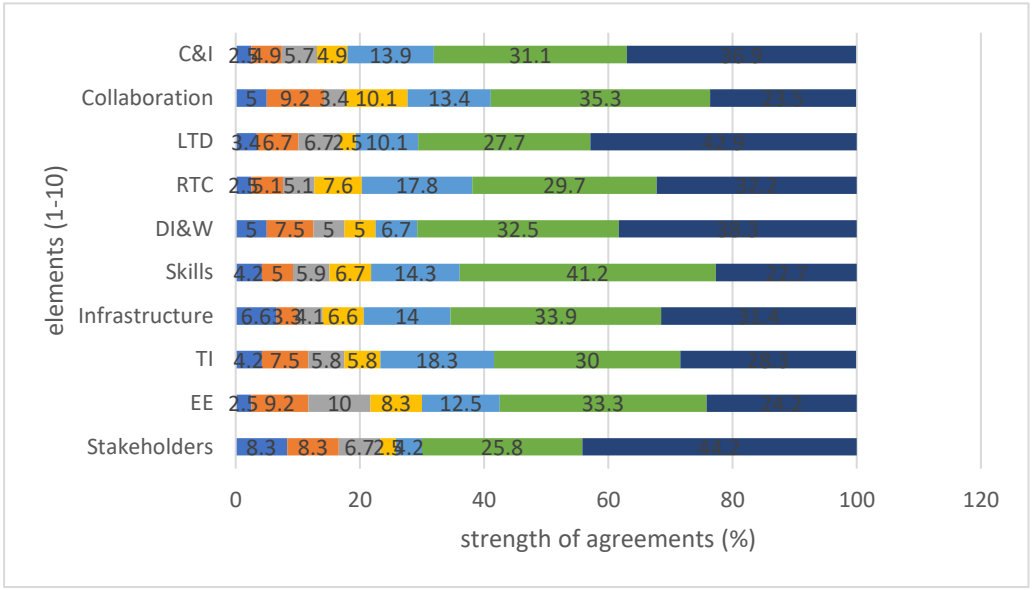

Figure 6-11: results from National Institute (Q2)

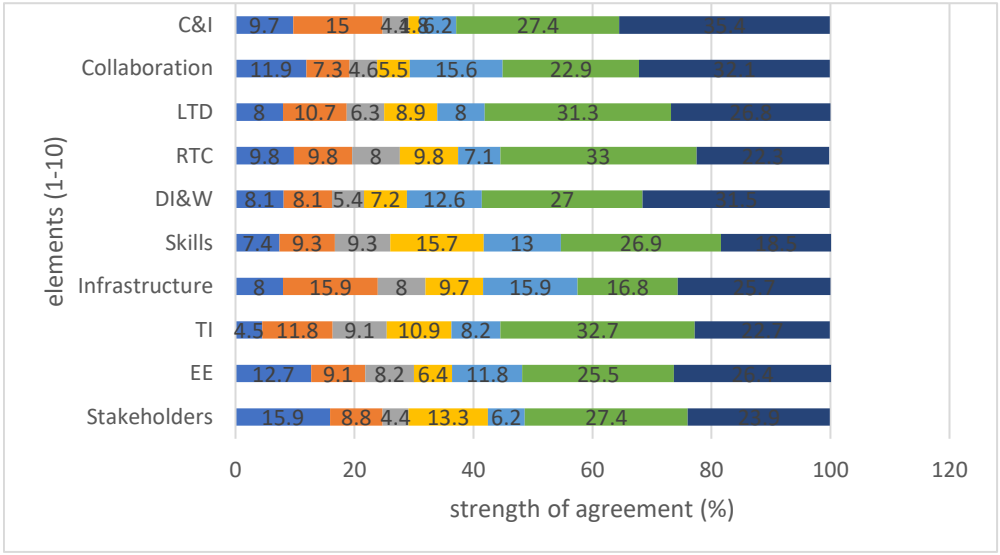

Figure 6-12: results from FCE-T (Q2)

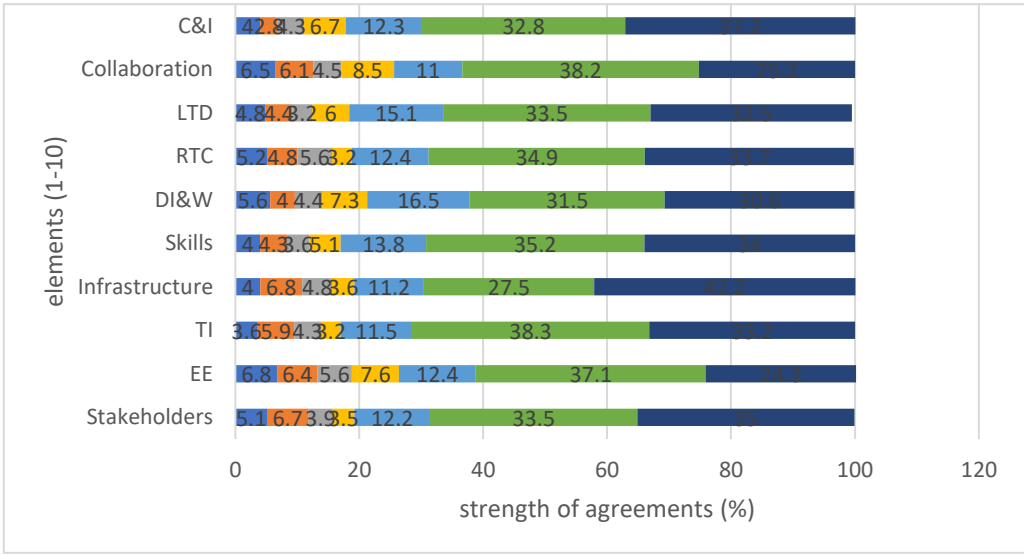

Figure 6-13: results from University (Q2)

	Overall agreements	Strong agreements	Overall disagreements	Neither agree nor disagree
University	TI and Skills jointly presented the highest level of overall agreements with 83.0%, closely followed by C&I with 82.3%.	However, Infrastructure had the most 'strong agreements' with 42.2% and C&I with 37.2% responses being unanimous agreement.	EE presented the most overall disagreement with (18.8%). (Followed by Co with 17.1%).	A consistent number of responses across all elements showed between 3.2 – 8.5% neither agreed nor disagreed. The University presented the lowest range of this category in the case study.
NI	C&I showed the highest level of overall agreements with 81.9% of response being point 7, 6 and 5 on the scale. Closely followed by LTD (80.7%), RTC (79.7%), Infrastructure (79.3%) and EE with lowest level of overall agreements at 70.0%.	Stakeholders showed the largest number of 'strong agreements' with 42.2% of agreements being point 7 on the scale, followed by LTD with 42.9% of agreements being strong.	stakeholders also had the highest level of overall disagreements with 23.3% of responses scoring 1, 2 and 3 on the Likert Scale. Followed by EE with 21.7%.	A small percentage of respondents ranging from of 2.5 – 10% across the 10 elements, indicated neither agreeing nor disagreeing with the statement.
Polytechnic	RTC scored the highest overall agreements (90%), this is the highest strength of agreement amongst all the elements and across all the institutions involved in this study. RTC is also the only elements across all the institutions to present no uncertainty, meaning none of the participants selected item 4 on the Likert Scale. This element also presented the lowest level of overall agreement at 14%.	C&I showed the highest level of unequivocal agreement with 44% of agreements being 'strong', closely followed by Co with 44.2%.	Stakeholders presented the highest level of overall disagreement with 25.9% of respondents no agreeing with the statement. This was followed by skills (22.2%) and C&I (20.4%).	RTC was the only elements which all participants had an opinion on (meaning Zero respondents selected option 4 on the Likert Scale). The range of respondents who neither agreed not agreed on the elements contributing to DCMiTI ranged between 0.0 – 11.5%.
FCE-T	DI&W presented the highest overall agreements with 71.1%, closely followed by Co with 70.6% and C&I with 69.0%.	C&I had 35.4% strong agreement, followed by DI&W with 31.5%.	Infrastructure had the highest level of overall disagreements with 31.9%, followed by EE with 30.0%. (C&I 29.1%).	A relatively wider range of respondents between 1.8 – 15.7% expressed not having an opinion on the matter. The FCE-T presented the widest range of this category in the case study.

Table 6-15: Summary agreements for Q2 based on categories for analysis

Analysing results of Question 2 by elements

Looking at the same three categories used to analyse Question1, as described in Table 6-11 on pg132, and taking into account the frequency of occurrences as shown in Table 6-16; I have summarised the elements (and the number of occurrences of the top three response for each category) as follows:

- Seven (7) elements appeared with the highest overall agreements: C&I (3), DI&W (2), RTC (2) and Collaboration (2). TI (1), Infrastructure (1), LTD (1).

- Seven (7) elements appeared most frequently with strong agreements: C&I (3), DI&W (2), Co (2), Infrastructure (2), LTD (1), skills (1) and Stakeholders (1).

- Seven (7) elements appeared most frequently with high overall disagreements: EE (3), Stakeholders (2), Co (2), C&I (2), LTD (1), skills (1) and infrastructure (1).

Table 6-16: summary of occurrences of elements (Q2)

Tertiary Institution	Overall agreements	Strong agreement	Overall disagreement
University	1. C&I (81.6%) 2. TI (81.2%) 3. Infrastructure (80.4%) Lowest: Co (75.2%)	1. Infrastructure (40.0%) 2. Skills (37.2%) 3. C&I (43.9%)	1. EE (19.4%) 2. LTD (18.8%) 3. Co (18.8%) Lowest: C&I (12.1%)
National Teaching Institute	1. C&I (81.9%) 2. LTD (80.7%) 3. RTC (79.7%) Lowest: EE (70%)	1. Stakeholders (44.2%) 2. LTD (42.9%) 3. DI&W (38.3%)	1. Stakeholders (23.2%) 2. EE (21.7%) 3. Co (17.6%) Lowest: C&I (13.1%)
Polytechnic	1. RTC (86.0%) 2. DI&W (80.4%) 3. Co (76.8) Lowest: Stakeholders (68.5%)	1. C&I (44.4%) 2. Co (44.2%) 3. Infrastructure (40.4%)	1. Stakeholders (25.9%) 2. Skills (22.3%) 3. C&I (20.4%) Lowest: DI&W (11.7%)
FCE(T)	1. DI&W (71.1%) 2. Co (70.6%) 3. C&I (69.0%) Lowest: Stakeholders (57.5%)	1. C&I (35.4%) 2. Co (32.1%) 3. DI&W (31.5%)	1. Infrastructure (31.9%) 2. EE (30.0%) 3. C&I (29.1%) Lowest: DI&W (21.6%)

The data summarised in Table 6-16, shows the following:

- **C&I** scored the highest overall agreements in both the university (81.6%) and NI (81.9%). It is also scored the third highest in FCE-T (69.0%). While it did not appear in the top 3 in the polytechnic, it did score the highest of the strong agreements with 44.4%. in strong agreements, it also scored (43.9%) in the university, and the highest strong agreement in FCE-T (35.4%).

  C&I also appeared among the lowest overall disagreements in all 4 institutions with lowest in NI (13.1%) and the university (12%). Followed by 20.4% in the polytechnic and 29.1% in FCE-T.

- **DI&W** scored the highest overall agreements in FCE-T (71.1%) and the second highest in the polytechnic (80.4%). It scored the third highest 'strong agreement' in both the NI (38.3%) and FCE-T (31.5%).

  DI&W also had the lowest overall disagreements in both the polytechnic (11.7%) and FCE-T (21.6%).

- **Co** scored second and third highest overall agreements in FCE-T (70.6%) and the polytechnic (76.8%) respectively. It also scored the second highest strong agreements in both institutions, FCE-T (32.1%) and polytechnic (44.2%). In the other two institutions, this element appeared with the third highest overall disagreements in the NI (17.6%) and the University (18.8%).

- **Infrastructure** appeared with the third highest overall agreements in the University (80.4%). It also scored the highest 'strong agreements' in the university (40.0%) and the third highest in the Polytechnic (40.4%).

  Infrastructure scored the highest overall disagreements in the FCE-T (31.9%).

- **LTD** scored the second highest overall agreement in the NI (80.7%), and the second highest 'strong agreement' in the NI (42.9%).
  It did not spear in the top high agreements in another of the other institutions. However, it did appear with the second highest overall disagreement from the University (18.8%).

- **RTC** scored the highest overall agreements from the Polytechnic (86.0%) and the third highest in the NI (79.7%).

  This element did not appear in the top 'strong agreements', neither did it appear in the top overall disagreements in any of the institutions.

- **Skills** did not appear in the top overall agreements in any of the institutions, although it did score the second highest 'strong agreement' from the University (37.2%).

  This element then appeared with the second highest overall disagreement from the polytechnic (22.3%).

- **EE** scored the lowest overall agreement in the NI, and to further confirm that result; it scored the highest overall disagreements the University (19.4%). EE also scored the second highest overall disagreements in both the Polytechnic (21.7%) and FCE-T (30.0%).

- **Stakeholders** did not appear in the top highest agreement levels in any of the institutions, but they did score the lowest overall agreements in both the Polytechnic (68.5%) and FCE-T (57.5%). This element also scored the highest 'strong agreement' in the NI (44.2%).

  Stakeholders scored the highest overall disagreements in NI (23.2%) and the Polytechnic (25.9%).

- **TI** scored the second highest overall agreements in the University (81.2%). It did not appear in the top 'strong agreements' in any of the four institutions.

These findings suggest the following:

There are 7 elements that most frequently appeared in the top three responses with high agreements on having a positive effect on DCMiTI:

1. C&I (3)
2. DI&W (2)
3. Co (2)
4. RTC (2)
5. Infrastructure (1)
6. TI (1)
7. LTD (1)

It is important to note that four of these elements also frequently appeared with the least agreements (thus meaning disagreement) that these elements have a positive effect on DCMiTI:

- EE (3)
- Co (2)
- C&I (2)

- Stakeholders (2)

Similar to the results from Study Question 1, there is an overlap with four elements which makes it difficult to interpret the nature of the contribution of these elements towards DCMiTI. C&I, Co, Infrastructure and LTD frequently appear in the top overall agreements and in the top overall disagreements. Thus, indicating some level of ambiguity as to the contribution of these elements and making it difficult to draw meaningful conclusions as to their effect on DCMiTI. Therefore, qualitative studies will be required to get a more in-depth understanding of the nature of the contribution of such elements to DCMiTI, I address this in the future work section of this dissertation.

However, there is unanimous agreement across all institutions that EE is the element with the least agreements and most disagreement about positive contribution to DCMiTI.

Summary of findings from Study Question 2

To summarise the findings from Questions 2, more than 57.5% of respondents from each of the four institutions agreed that elements 1-10 have a positive effect on DCMiTI. No more than 11.5% of respondents disagreed with this statement and a maximum of 15.7% of respondents did not have an opinion on the matter.

Confirmation of elements positive contribution to DCMiTI

The majority of responses from all institutions agree with the statement in Question 2; I therefore conclude that the elements uncovered in the SLR (Chapter 3) all have a positive effect on DCMiTI. Within the boundaries of this study, no other elements have been identified.

The University showed the highest agreement levels and the smallest range between agreements; followed by the NI and the Polytechnic. The FCE-T presented the lowest agreements and the highest number of respondents who did not have opinions on the impact of the elements.

C&I presented the highest agreements levels, followed by DI&W; then Co, RTC, Infrastructure, TI and LTD. EE had the lowest agreement levels across all institutions.

Further Studies

C&I and Co appeared frequently in both high agreements and high disagreements. LTD and Infrastructure also presented the same overlap at a lesser scale. This overlap requires further

investigation in order to draw any meaningful conclusions regarding the effect of these elements on DCMiTI.

6.4.1.2.2.3 Results of Study Question 3 - Ranking Elements

The last question that survey participants were asked in this study was to rank the elements contributing to DCMiTI in order of significance of their impact.

> **Study Question 3**: Please rank the elements (1-10) in order of significance of their impact on Digital Capability in tertiary institutions on a scale of 1-10 (where 1= least impactful and 10=most impactful.

Analysing results of Question 3 by Institution

In comparing the results of the rank ordering across the four institutions, no obvious or consistent pattern was apparent. However, the results of ranking from the University contained the same top 4 elements as those from the National Institute (NI). The other institutions presented some similar ranking but others completely different. Therefore, no pattern can be reported here.

Analysing results of Question 3 by elements

The graphs from Figure 6-14 to Figure 6-17 show the ranking order obtained from each institution based on the mean values for each element. These graphs show the following:

Two elements consistently ranked 1st and 2nd:

- **Learning Training & Development** ranked most impactful in three institutions: the University, the Polytechnic and FCE-T. It then ranked 2nd most impactful in the NI.
- **Creation & Innovation** ranked most impactful in the NI. It then ranked 2nd most impactful in the other three institutions: University, Polytechnic and FCE-T.

A set of elements were ranked highly in certain institutions while they ranked low in others:

- **Digital Identity &Wellbeing** ranked 3rd most impactful in both the University and the NI. It then ranked 8th and 9th in the Polytechnic and FCE-T, respectively.
- **Tertiary Institution** ranked 3rd most impactful element in FCE-T. It ranked 4th in both the University and the NI. Then it was ranked 9th in the Polytechnic.
- **Collaboration** ranked highly (2nd) in the Polytechnic. It ranked 4th and 5th in the FCE-T and NI respectively. Then it was ranked 8th in the University.

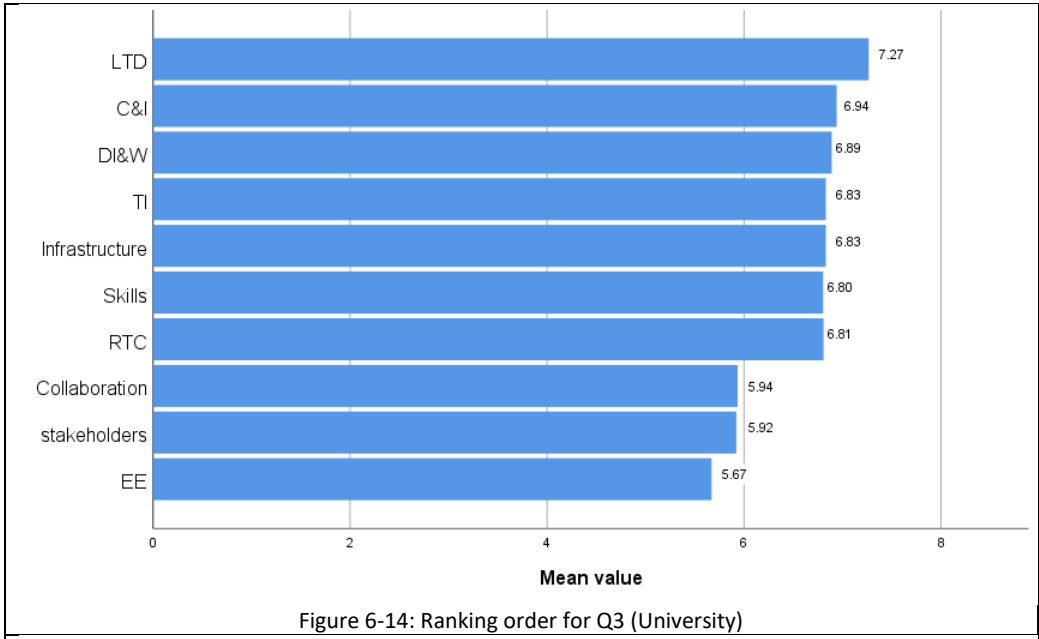

Figure 6-14: Ranking order for Q3 (University)

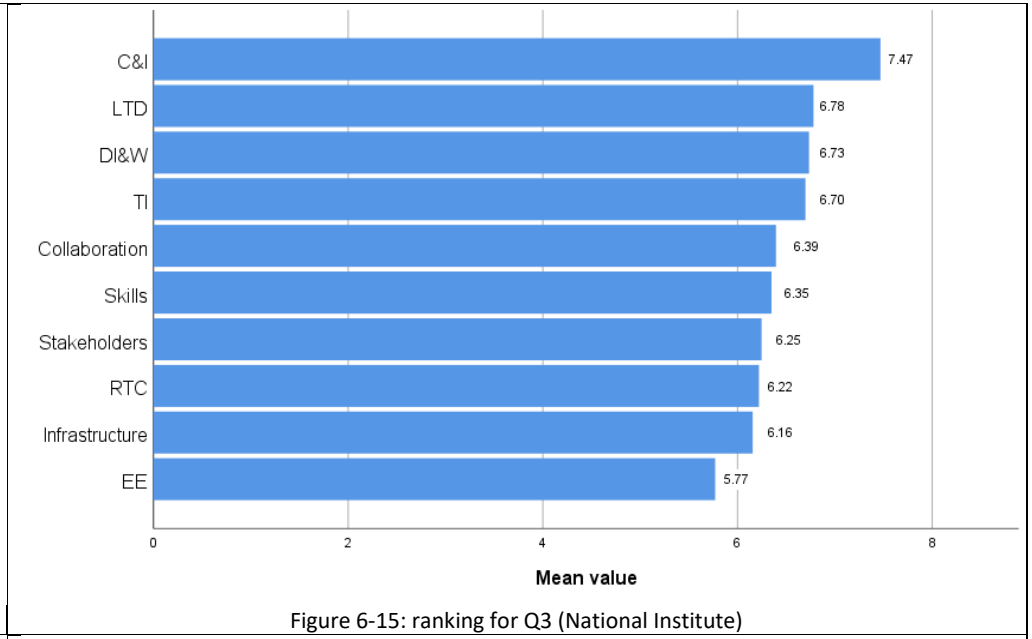

Figure 6-15: ranking for Q3 (National Institute)

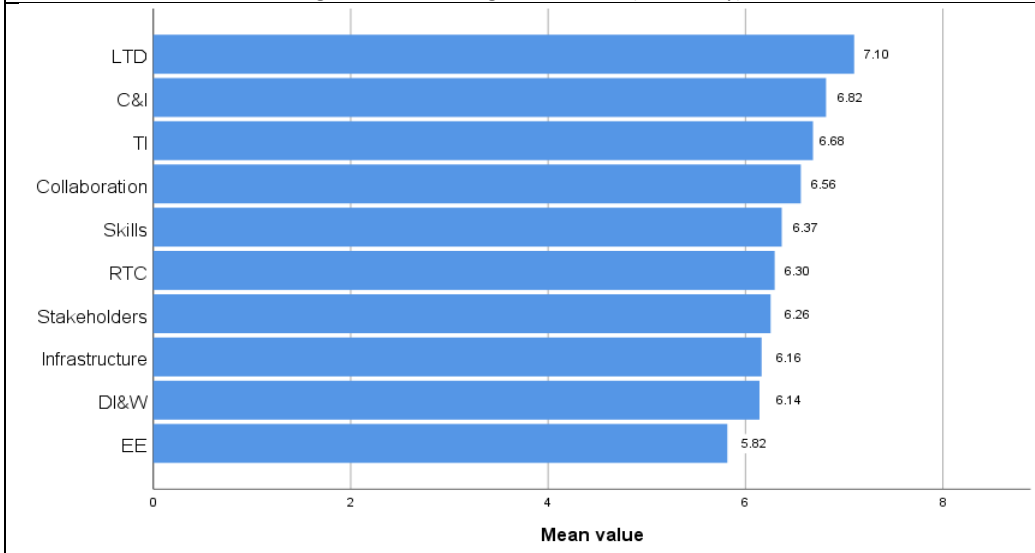

Figure 6-16: ranking order for Q3 (FCE-T)

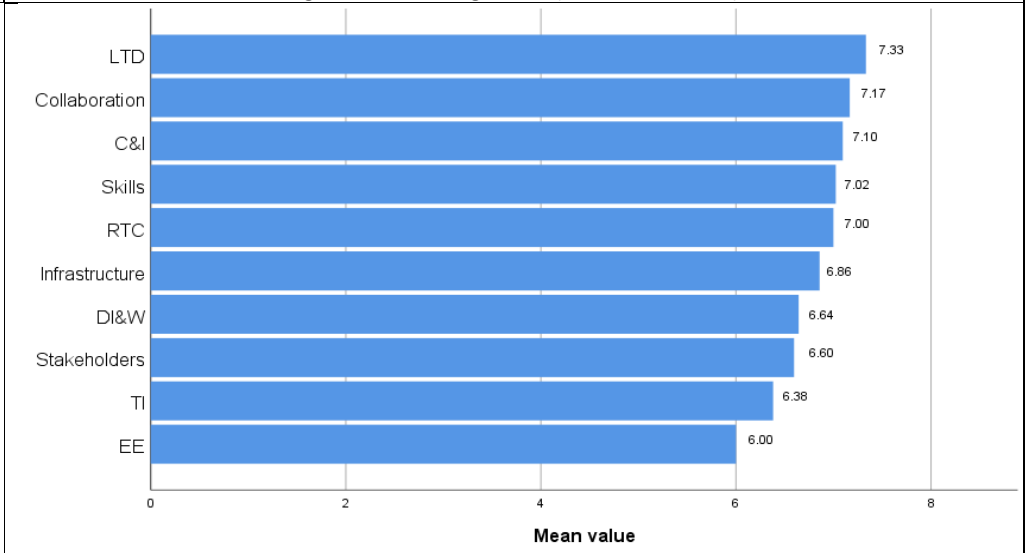

Figure 6-17: ranking for Q3 (polytechnic)

A group of elements consistently ranked in the middle region of the scale:

- **Skills**: Polytechnic (4th), FCE-T (5th), NI (6th) and University (7th).
- **Resources, Tools & Content**: Polytechnic (5th), 6th in both University and FCE-T. 8th in NI.
- **Infrastructure**: University (5th), Polytechnic (7th), FCE-T (8th) and NI (9th).

A set of elements were consistently ranked as low impact in all four institutions:

- **Stakeholders:** ranked 7th in both NI and FCE-T, Polytechnic (8th) and University (9th).
- **External Environment:** consistently ranked 10th (least impactful) in all four institutions.

Summary of findings from Study Question 3

In summary, the order of significance of impact of elements (1-10) on DCMiTI indicates a division into four groups: the high impact, the upper-middle, lower-middle and the low impact. The most impactful element was LTD. The upper middle elements were DI&W, TI, and Co. The lower middle elements were skills, RTC and infrastructure. Stakeholder and EE were the least impactful with EE holding unanimous agreements that it is the single least impactful element on the development of DCMiTI in Nigeria based on the opinions of stakeholders of four institution in the North-West zones.

6.4.1.3 Summary of Quantitative Results

To conclude the overall findings from the quantitative studies undertaken in the case study in Nigeria, Figure 6-18, Figure 6-19, and Figure 6-20 summarise the data from the entire case study. This data confirm that the candidate elements surveyed:

Confirmation of RQ1 and RQ2 Findings:

1. Are elements contributing to DCMiTI and no other elements were identified.
2. Have a positive effect on DCMiTI, and no other elements were identified. The nature of the effect on elements is reported in section 6.4.1 Results from Study Phase I (Quantitative)6.4.2 Results from Study Phase II (Qualitative).
3. The order of significance of the elements based on the opinion of learners in NW Nigeria is shown in Figure 6-20, with LTD being the most impactful and EE being the least impactful.

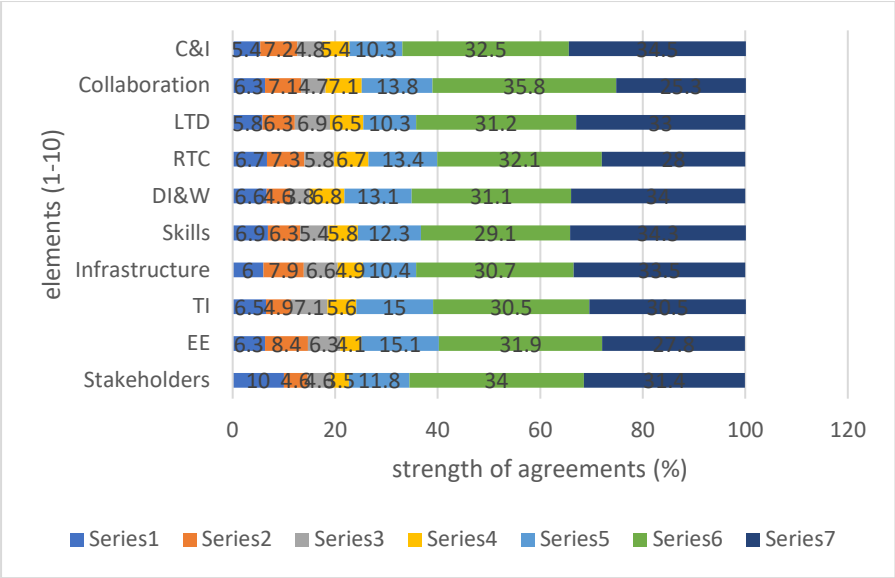

Figure 6-18: results from Q1 for NW Nigeria

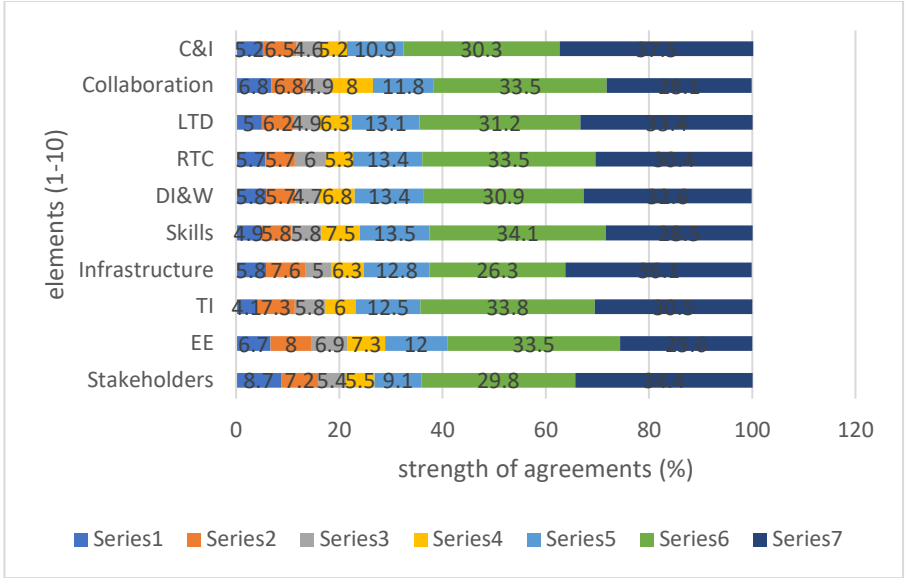

Figure 6-19: results from Q2 for NW Nigeria

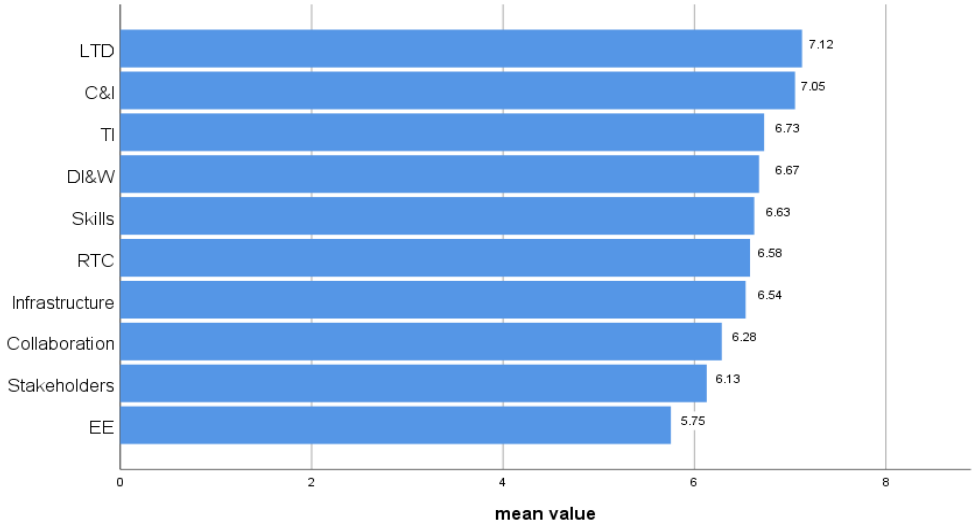

Figure 6-20: results of rank ordering for Q3 NW Nigeria

6.4.2 Results from Study Phase II (Qualitative)

A total of (n=13) interviews were conducted with management level staff among the four institutions. The interviews ranged between 13 to 36 minutes in length and the participants engaged well in the conversations.

Table 6-17: No. of participants in the case study

	University	Polytechnic	National Institute (NI)	Federal College of Education – Technical (FCE-T)	**Total**
No. of participants	4	3	3	3	**13**

6.4.2.1 What elements contribute to DCM?

Nine elements were found to contribute to Digital Capability from the opinion of management level staff in the case study in NW Nigeria. Table 6-18 shows the elements and/or sub-elements found in analysis; and how frequently they were mentioned as elements impacting DCMiTI.

	Element	**Sub-Elements**	**Description**	**Interviews**	**occurrences**
1	Infrastructure	Connectivity (access) Services (MOOC, OODM) Hardware Software Power supply	Network infrastructure and connectivity to services such as internet.	10	14
2	C&I	-	Innovating new way of doing things.	1	1
3	LTD	-	Imparting knowledge on students, training, and re-training staff	6	8
4	RTC	Access to facilities e-Library Digital centres	The facilities, hardware and software required to support teaching and learning.	10	20
5	Skills	Digital literacy Technical skills Knowledge Pedagogy Attitude Acceptance Motivation perception	Learners' skills upon entry into HE. Tutors pedagogical and technical skills to deliver digital education. Learners' perception of benefit of digital literacy.	-	-
6	Stakeholders	Staff Students Government intervention	Staff, students, and government.	-	-
7	EE	Power supply Corruption economy	Matters that are not within the control of the Institution's management.	4	5
8	TEI	Policy (e-learning policy) Strategic goals Budgeting Social behaviour	Every day running of the institution, including funding, policies, and strategic goals. Motivation of staff as well as the managing general conduct.	8	21
9	Collaboration	-	Working with others both from within the institutions and outside.	2	3

Table 6-18: frequency of occurrences of elements contributing to DC

A few sub-elements such as 'access' appear under multiple elements/ sub-elements, access is repeatedly discussed under infrastructure indicating connectivity to the internet and other online learning content. Access also comes under RTC in relation to having access to hardware and software that facilitate the learning process.

Notably, DI&W was the only element that did not appear in this study; despite literature and previous studies indicating it as a contributing factor. I offer an interpretation of this findings in section 0.5.4.3 Interpretation of Results

6.4.2.2 How do these elements impact Capability Maturity in Tertiary Institution?

In the analysis of this question, there were 9 elements found to impact maturity of TEI in Northwest Nigeria. Eight of them were explicitly mentioned either by name or by synonym, along with the kind of effect they have. The nineth, *Creation & Innovation*, was not found but implied by one participant who said:

> *"…utilising elements effectively with regards to helping them develop their ideas and to be able to bring such ideas into real practise in terms of developing model of their projects…"*

Table 6-19 shows the frequency of occurrence of the elements mentioned as having an effect on DCMiTI. I synthesise the points derived from the analysis of this question as a narrative in Appendix X: Synthesis of RQ2 Data from Qualitative Analysis of Study 4.

Element	**Inf**	**LTD**	**RTC**	**Skills**	**TI**	**Collab**	**C&I**	**EE**	**Stake**
Occurrences	18	28	24	11	19 +8	1	1	4	3

Table 6-19: frequency of occurrence of elements affecting DCMiTI

In Summary, all elements impact the institution positively, if developed. However, if underdeveloped these elements contribute to making teaching and learning processes inefficient.

These results further buttressed the findings from previous studies which suggested the relationships between the elements as interwoven and demonstrated the dependencies between the elements and sub-elements.

Table 6-20Table 6-18 details the nine elements alongside the sub-elements found in the analysis of this question, with a brief description of the impact on maturity and a reference to the narrative from which the points were derived, see Appendix X: Synthesis of RQ2 Data from Qualitative Analysis of Study 4.

Table 6-20: summary of how elements impact maturity in TI's

	Element	Sub-Elements	Sub-sub elements	Effects/ relationships	References	
1	**Infrastructure** (EXPLICIT)	Network infrastructure	Internet connectivity (adequate bandwidth)	- Network infrastructure is the bedrock of all services within an institution. A good infrastructure means online, and distance learning courses can be offered, resulting in learning convenience for those unable to attend lectures physically. On the reverse, poor infrastructure limits the extent to which TEL processes can be effective. Installation of a robust infrastructure does not guarantee maturity, maintenance and upgrades are necessary and reoccurring expenditure without which the network would deteriorate. - Physical infrastructures like digital centres and micro-teaching labs provide access to computers and the internet. This provides opportunities for learners to be at the forefront of knowledge in their various subject areas. Additionally, access opens opportunities for global dissemination of local research and collaboration. - Bandwidth (enough to service the entire population of the institution) means that both services (LTD) and resources (RTC) are easier to implement. Without adequate bandwidth learners are unable to download larger digital content like videos and software downloads. Sufficient bandwidth improves the user experience and has a positive impact on learner motivation and engagement. - Intermittent power supply from the national grid impacts the success of TEL. However, the existence of backup power within the institution means that generators and inverters can be used to support the continuity of services without interruption. Although running and maintenance of backup power requires additional funding.	3, 4, 11, 13, 14, 20, 26, 36, 37, 39, 45, 49, 58, 60, 62, 64, 86, 87	18
		Physical infrastructure	Digital centres			
		Power Supply	National grid			
		Backup power	Generators Inverters			
		Policy implementation				
2	**Learning, Training & Development (LTD)** (EXPLICIT)	Services	Academic learning activities learning support mobile learning Distance learning	- Before we have manpower (staff), we must train them. Employing additional manpower who are not ICT literate means additional training must be provided by the institution. - Well-trained manpower (tutors, digital mentors, technical staff, and administrative staff) are required to achieve the core objectives of an institution. Without enough tutors' the available tutors will struggle with student ratio's, with un-trained tutors' they would struggle to deliver the knowledge and skills efficiently. - If all tutors were ICT literate, that would be the foundation of the road towards DCM. Thus, general ICT literacy training is fundamental. However, ICT training without a good understanding of the need for literacy and its perceived benefits could result in able but unmotivated staff. Teaching all staff basic ICT literacy skills alongside the knowledge/ understanding of the need for literacy motivates them to use their skills and further look to develop their capabilities. Training allows leaners and tutors to utilise both monetary and technical inputs into the institution. Investing without training staff and students on how to use what has been invested in, may not necessarily lead to maturity. Government interventions for training go a long way in developing the gradates that are fed back into the society.	4, 7, 10, 13, 19, 20, 27, 28, 31, 32, 33, 37, 39, 44, 51, 52, 54, 56, 62, 63, 64, 65, 69, 71, 72, 75, 79, 85	28
		Training/ teaching				
		Capacity building				
		Workshops				
		Adoption of digital learning				
		Internally sponsored training				

		Browse internet for academic purposes				
3	**Resources, Tools & Content (RTC)** (EXPLICIT)	Tools	Computers Laptops Interactive boards Projectors Mobile technology	- Digital tools improve the learning process and make it easier to pass information onto the learner. Audio and visual aids improve clarity and so enhance learning. it improves visibility and audibility, promotes interaction (question asking), and improves cognition (absorption of information). Interactive boards store lectures notes and annotations allowing learners to retrieve it later – increasing the accessibility of content. Other visual aids reduce manual dictation of knowledge and assist in efficient delivery of lectures. - Availability/ access to digital tools is essential for TEL. without a computer and the internet, TEL cannot happen. - Broad access (access from anywhere within the institution). Making access easy improves the user experience and increases their willingness to use digital tools. Difficulty accessing resources makes it tiresome and reduces the likelihood of the user wanting to do it again. - Availability of digital facilities such as digital centres and micro-teaching labs, increase access to willing learners; facilities must provide access to online content and resources which impacts learning and develops capabilities. Facilities without access are not serving their purpose and end up having no effect on maturity. - Mobile technology is more affordable for learners, and they can use their mobile phone to access the internet and navigate online content. In some cases, mobile phone tethering is also used to connect their laptops to the internet. This is used as a standby solution when digital centres are full and wireless internet is not available – by virtue of mobile technology, many learners have some means of interacting or accessing digital content. - Transferring skills from manual to digital (hand notes to slides) requires a series of new skills to be learnt. Learning digital teaching methods and pedagogical skills could ease the transition and help tutors utilise available resources, tools, and skills. - Providing laptops without training on how to use them demonstrates how training is a by-product of availability of equipment.	4, 7, 8,10, 13, 20, 26, 31, 32, 34, 38, 39, 43, 51, 52, 53, 60, 62, 65 75, 76, 79, 86, 87	24
		Acquisition				
		Adoption				
		Access				
		Content				
		Accessibility				
		ICT facilities	Digital centre Micro-teaching labs			
		Service delivery/ Quality of Service (QoS)	Audibility Visibility			
4	**Skills** (EXPLICIT)	Knowledge	Subject knowledge Understanding ICT benefits	- Capacity building of tutors is the first stage towards maturity. Building confidence allowing them to deliver both in terms of knowledge and technical skills. - Digitally capable tutors train digitally capable learners, and regardless of technological investments, an institution can only be as capable as the stakeholders within it. Therefore, the more capable the tutors are, the more capable the students will be and the more capable the tutors and students the faster the institution can climb the steps of maturity. - Knowledge and skills are transferred to learners and other stakeholders within the institution, cultivating change towards the digital. Training tutors has a positive ripple effect that	10, 19, 25, 33, 34, 38, 46, 81, 84, 85, 87	11
		Digital literacy	ICT skills			
		Motivation				
		Learning and teaching methods				

		Previous background		supports change across the institution. Appointment of digital mentors (Educational Technologists) whose role is specifically to effect this change can speed up the maturity process. - Without training on how to use available software, even when access is available, users will struggle to utilise the tools and resources. - Learners lack motivation to learn new things when they do not understand why the skill is required or how it could be of use to them. This is mostly applicable to staff who require continuous learning. The difficulty is in getting existing staff to change/ adapt what they know so well and are used to. This notion of 'a continuous learning culture' is necessary for institutional maturity.		
		Previous education				
		Confidence				
		Knowledge transfer				
		Feedback				
		Skills transfer				
5	**Tertiary Institution (TI)** (EXPLICIT)	Functions	Research Learning and teaching	- A mature institution would produce well-trained graduates, highly sort after in modern industries and produce state-of-the-art research work. In comparison an institution with limited access to the internet where they would struggle to keep up to date with and current global research. Limited access to resources would also mean graduates would have less exposure to modern technology. Tutors would also find themselves more exposed to modern technology and techniques and be at the forefront of knowledge in comparison to products of institutions that are not digitally mature. - Government interventions go a long way in developing the graduates that make up the wider economy, relying on government interventions alone is not sustainable. Institution must ensure they generate their own internal funds to ensure continuity of services in between interventions. This ensures continuity and continuous improvement without period of delay or regression. - Developing capabilities means an institution will be able to meet up to and keep up with international standards. If capabilities are not developed, then institutional maturity well be slow and possibly non-existent in some areas. - Funding of the Institutions facilities and services is essential or even a pre-requisite to Capability Maturity. Without adequate funding development would not be possible, resources could not be acquired, and infrastructure cannot be maintained. - Time management is a negative of effect of poor capabilities – everything takes longer – for example dictating instead of trying to understand, send mailer boys instead of emails etc. ultimately an institution with poor capabilities is less productive in all areas.	3, 7, 8, 16, 25, 27, 28, 29, 35, 58, 59, 44, 49, 61, 66, 71, 72, 76, 77, 81	19
		Products/ outcomes	Graduates Research Feedback			
		Sustainability				
		Policy (and implementation plans)	eLearning Policy			
		Manpower	Digital mentors			
		Funding	Running cost maintenance Maintenance cost Financial constraints Funding Fund allocation Government interventions			
	TI Management* (EXPLICIT)	Management commitment		- Management should have at their disposal a range of tools and techniques to assess various aspects of the institution's operations and processes – specifically how well staff and students		8

		Continuity of service		are utilising the technology they are investing in. (i.e., Usage of newly acquired software and its impact on staff productivity and student outcomes). - Having a strategic plan means the institution is setting gaols towards achieving higher levels of maturity and once documented it is less likely that the goals will be delayed. - Having policies is not enough to ensure continuous improvement, for every policy there is need for an implementation plan guiding how the institutions plan to roll out and enforce the policy. If this is backed with adequate funding, then the goal can be achieved, and maturity ensured. - Political will from management plays a big role in the institution growth. Showing commitment and sustainability in the ability to deliver facilities and services. However, often the issues arises when a new administration comes onboard, without that commitment to the existing plan. New plans and too many changes to strategic goals are often regressive.	1, 4, 9, 21, 49, 58, 61, 77	
		Strategic planning	SWOT Analysis QA techniques			
		Policy implementation				
6	**Collaboration** (EXPLICIT)	Resource collaboration		- Collaborating with other institutions would support the development of capabilities. For example, sharing infrastructure with other institutions that are in proximity. - Institutions can also collaborate in terms of sharing e-resources, learning and research work. The digitally mature institution would transfer not only knowledge but also digital skills to the collaborative partner who is less digitally mature	48	1
7	**Innovation (IMPLIED)**	Innovation		- Supporting learners' innovations and the chance to implement their projects is essentially an experience that develops skills and consequently capabilities. Innovation requires access to training and facilities that would allow the learner to bring their project to life.	41	1
8	**External Environment (EE)** (EXPLICIT)	Society		- Learners from disadvantaged backgrounds come into the institution with little to no ICT literacy skills, meaning more effort is required to train them to a suitable level of capability. This is not within the control of the institution, but the additional effort can be made to circumvent the shortfall. - Economic status also does not permit many students access to personal computers meaning many of them will reply on the institution ICT facilities. This reinforces the need for institution to ensure facilities is available, functional, maintained and enough to service the learner intake. - How well a person is trained goes a long way in impacting society. The onus is on TEI's to get it right at Tertiary Education Level, so that their products can get it right when delivering output to the immediate or global economy.	37, 38, 49, 56	4
		National grid	Power supply			
9	**Stakeholders** (EXPLICIT)	Government	Government agencies	- Feedback from learners and tutors about facilities is an important part of the institution's development. The feedback loop starts from the learner, processed by the institution, actualised in the facilities and services that are delivered back to the learner again for feedback. - If all stakeholders are not adequately using technology to impact the knowledge of their field to the students, then full benefits of the digital may not be seen.	10, 19, 87	3
		Staff				
		Learners				

6.4.2.3 Which elements have the most Impact on learning

Analysis of the interviews with management revealed varying opinions on elements which impact learning the most in TEI. Participant responses ranged from, the fewest number of elements listed were 3, and the most were 7. Furthermore, consistent which other findings in this dissertation, participants used a range of names and/or synonyms to describe certain elements. During the interviews, unclear words were clarified through probing.

Table 6-21Table 1-1 shows the key elements that emerged from analysis and links each theme back to the relevant element/ sub-element of DCMiTI. Table frequency below shoes how frequently each theme was mentioned as impacting learning.

Table 6-21: frequency of occurrence of elements impacting (data from interviews)

Element	TI	RTC	Skills	Stake	Infra.	LTD	EE	Innovation
Frequency	10	8	6	6	4	4	3	1

TI has the most impact on learning followed by RTC. Skills and stakeholders had the same frequency of occurrences suggesting they have the same level of impact on DCMiTI based on the opinions of management stakeholders. Infrastructure and LTD also presented the same level of impact, followed by EE, and lastly Innovation was thought to have the least impact on DCMiTI. participant argued that the learner is central to DCMiTI because everything that happens in the TEI revolves around how to support the learner. One participant said: “Right from management decisions through to professional development is all they can impart knowledge to the learner”.

Table 6-22: elements and their Impact on learning

	Element	**Sub-element**	**Impact on learning**	**Frequency**
1	RTC	-	Knowledge of digital tools and how to use they is a necessary skill to achieve full capability.	2
		-	However, there is that argument that in terms of resources and software there is always open-source options and so they are not a top priority.	1
		-	Additionally, one participant mad reference to a 2016 World Bank Report that claimed technology is NOT the barrier and suggests that same for the case study.	1
		-	Even with technology, there are other inhibiting factors that would not allow institutions to realise their potentials.	2
		e-Library	Access to e-library and resources has a direct impact on student performance.	2
2	Tertiary Institution	Management	TI management invest resources with learners in mind.	1
		Internal funding	Internally generated funds are very little.	2
		Policy	Policy, specifically eLearning policies have a positive impact on capabilities. Not just the existence of	5

			policies but also the documented implementation plan. Policies on ICT literacies also ensures that all staff are ICT literate with adequate reward for doing so.	
		Processes and procedures	A digital revolution needs a strong analogue foundation. So, there must be a good and functional manuals system in place before it can be upgraded to digital.	2
3	Skills	Tutors' skills	The tutor's ability to teach is only as good as the skills they have, and even with the best skills, their ability to deliver the knowledge may still be inhibited my lack of access to resources and the internet.	2
		Student knowledge Attitude Appreciation	Students' knowledge and attitude towards learning, as well as their appreciation of digital tools all impact capabilities. Students educational background and whether they have previously been exposed to technology in primary and/or secondary education.	4
4	LTD	Training/ re-training Professional development Capacity building	Training that tutor receive has a big impact on the learner, to achieve a good learning outcome, there must be equally well skilled tutor.	4
		-	However, no matter how well trained a tutor is, without adequate infrastructure they cannot achieve full impact.	-
5	Infrastructure	Internet access Connectivity Infrastructure	If there is no good infrastructure in place, then	4
6	EE	Geographical location	-	1
		Power supply	-	1
		Government interventions	External funding makes a very positive impact on ICT capabilities because they finance many things such as e-Libraries, professional teaching labs, internet access	4
7	Stakeholders	Student	The student is central to DCMiTI. TI management decision are all driven by the goal to improve students' skills. Even lecturers and instructors learn so they can teacher the students. Student background in many cases has a negative impact on capabilities because many students come from background where they may not have had previous exposure to technology.	1 1
		Tutors	-	-
8	Innovation	Innovation	-	1

Participants discussed several aspects of the TI from their processes and procedures, management decision making, existence of policies (e.g., e-learning police) that drive change and the detailed policy implementation plans. There needs to be a sound and functional analogue system in place before technology can come in and make those processes more efficient. A respondent said: "… *digital revolution needs a strong analogue foundation*". **A participant from the University**

"In terms of learning, you have to be a little bit good manually and that is what would upgrade you to the digital."

A participant from the Polytechnic

With specific reference to policy implementation, many institutions make certain skills compulsory and use the policy of those who are trained acting as digital mentors for those colleagues with less ICT skills. In this way tutors are constantly upgrading their skills and knowledge is constantly being transferred.

With the capacity and the funding to maintain services, learning can be maximised. Although funding varies depending on geographical location, a participant from the college said: "… *internally generated revenue for a rural setting like ours, it only compliments what we get from government interventions because we cannot generate enough*…" **A participant from the College**

With the regard to computers, e-libraries and other RTC used in learning, the popular opinion is that access to tools and a wide range of information improves student performance. One participant shared: "… *we set up a committee to analyse the performance of students over the last decade year by year, and we have noticed a trend of increased performance… especially from the period when we made available access to more information particularly; in terms of the e-Library."*

A participant from the College

However**,** there is the argument that RTC have limited impact on learning because they are heavily dependent on other factors such as skills of both the learner and the tutor. Without the 'know-how' even where resources are available, it would be difficult to utilise them. Entangled here is also the issue of infrastructure, even with the state-of-the-art resources and best trained and experiences tutors, without adequate infrastructure, there will be a limit to what can be achieved with the regards to learning.

"*The students background is more of a negative impact…*" **A participant from the College**

A participant from the university said: "*The fact is, using digital content in teaching and learning in this part of the world is still new. You find that people are not comfortable*…". One of the factors that impact learners' capabilities includes background, a particular issue is that many learners have not been exposed to educational technology during primary and secondary education meaning there is a steeper learning curve when they are introduced to it for the first time at tertiary level. Other factors include motivation, attitude towards learning, digital appreciation and access to resources and tools.

In addition to the argument that RTC has a vast and visible impact on learning outcomes, one participant from the University said: "*The largest barrier is not in technology because you know the latest mobiles or phone or tablet in the world can be found in virtually every corner of the world in the*

shortest possible time. So, it means technology is not the barrier". With the availability of internet and access to various Open Source that could serve as an option, although maybe not with as many features as the subscribed software and content; this suggests that RTC may not be the top priority.

Another participant emphasised on the significance of the learner/ student being key to all development within the institution including learning. "*… as far as I'm concerned, the student; they are central because even the lecturers and instructors whatever, they try to learn before they can teach the students so the students, they are central so whatever the school and management are trying to do is to improve the skill of the students to meet up with the 21st Century."*

> *"… they have professional development courses to improve the skills of the instructors/ lecturers, it's all so they can teach the student*!"
>
> **A Participant from the University**

Training is also an import aspect of learning; tutors can only teach the students what the know, therefore it can be said that the learning is only as good as the quality of the tutor, aided by RTC and infrastructure to support the process.

Another important element for learning is availability of internet facilities. This is often an issue because where it is not available, learners are unable to access online content and resources which has a negative impact on learning. often where it available the bandwidth is supplied through government intervention projects. However, the problem arises where sometimes the project ends and funding stops, and the institutions is unable to generate enough internal revenue to maintain the services.

The College of Education put heavy emphasis on the reliance of government funding for both physical/ infrastructural development as well as ICT resources and teaching facilities and e-Library. One respondent commented that: "... TET Fund sponsorship has so greatly influenced the Digital Capability of the college... and other supporters like NITDA". They went on to say: "*… they should be ranked first in bringing positive development...*". **A participant from the College**

One participant mentioned the aspect of Innovation ask key to learning for both learners and tutors, suggesting that a different more innovative approach is required with regards to teaching, if difference a is expected in terms of learning.

Finally, little mention of corruption was made as a factor that impacts learning, mainly regarding misappropriation of funding which then has a negative impact on learning.

5.4.3 Interpretation of Results from Study 3

In this section, I interpret the study data as a whole and its implication on answering the research questions as shown in Table 6-23.

Table 6-23: Summary of study 3 findings

	Question 1	**Question 2**	**Question 3**
General summary	To summarise the findings from Study Question 1, 58.2% and above of total respondents across all institutions agreed that elements 1-10 are elements of DCM. No more that 33.3% of respondents disagreed with the statement and fewer than 16.3% neither agreed nor disagreed. We can therefore conclude that since a majority of respondents from all institutions agreed, this confirms that the elements 1-10 uncovered in the SLR are elements that contribute to DCM, and within the boundaries of this study, no other elements have been identified.	To summarise the findings from Questions 2, more than 57.5% of respondents from each of the four institutions agreed that elements 1-10 have a positive effect on DCMiTI. No more than 11.5% of respondents disagreed with this statement and a maximum of 15.7% of respondents did not have an opinion on the matter. Since the majority of responses from all institutions are agreements; we can there conclude that the elements uncovered in the SLR (Chapter 3) all have a positive effect on DCMiTI. Within the boundaries of this study, no other elements have been identified.	In summary, the order of significance of impact of elements (1-10) on DCMiTI can be divided into four groups. Group 1: The most impactful Group 2: Upper middle Group 3: Lower middle Group 4: The least impactful
Institutions	The University and Nation Institute presented the highest agreement levels and the least number of respondents who did not have an opinion, closely followed by the Polytechnic. The FCE-T had the lowest agreement levels and the highest number of respondents who did not have opinions.	The University showed the highest agreement levels and the smallest range between agreements; followed by the National Institute and Polytechnic. FCE-T presented the lowest agreements and the highest number of respondents who did not have opinions.	The ranking order from the University and National Institute had a similar order for the first 4 elements. All institutions agreed on the impact of EE.
Elements	DI&W had the highest agreement levels, followed by C&I, TI, stakeholders, LTD, Co, Skills, and Infrastructure. EE had the lowest agreement levels. Co, Skills, and Infrastructure presented some ambiguity/ uncertainty/ overlap therefore I will be looking to further understand their contribution in future studies.	C&I presented the highest agreements levels, followed by DI&W; then Co, RTC, Infrastructure, TI and LTD. EE had the lowest agreement levels across all institutions. C&I and Co appeared frequently in both high agreements and high disagreements. This overlap needs further investigating. LTD and Infrastructure also presented the same overlap at a lesser scale.	The most impactful element is LTD. The upper middle elements are DI&W, TI, and Co. The lower middle elements are skills, RTC and infrastructure. Stakeholder and EE are the least impactful with EE holding unanimous agreements that it is the single least impactful element on the development of DCMiTI in Nigeria based on the opinion of four institution in the North-West zones.

This study investigated the ten (10) elements that contribute to DCM as uncovered in CHAPTER THREE: SYSTEMATIC LITERATURE REVIEW and their effect on DCMiTI in Nigeria. I consider how these elements affect the maturity efforts of four tertiary level institution in Nigeria, and attempt to provide answers to Research Questions RQ1, and part of RQ2 of this thesis:

RQ1: What elements contribute to Digital Capability Maturity?

1. DI&W
2. C&I
3. Skills*
4. TI
5. Infrastructure*
6. Co*
7. Stakeholders
8. LTD

The elements that have be mentioned as least likely to contribute are:

1. EE
2. Co*
3. Skills*
4. Infrastructure*

***The overlap with Co, Skills and Infrastructure will be ironed out in the narrative followed analysis of the interviews.**

RQ2: How do these elements affect the Digital Capability Maturity of Tertiary Education Institutions?

The four institutions in the case study have validated the statement that: "elements (1-10) have a positive effect on DCMiTI" in four institutions in Northwest Nigeria, thus, I have determined here, the effect is positive. Below I provide the context of 'how'; this knowledge has been derived from the content analysis of interviews with TEI Management:

The highest agreements (conversely the lowest disagreements) were from the 'University'; it also presented the least number of respondents who did not have an opinion. This may be because almost half (46.87%) of respondents for the entire survey were from the University. Furthermore, this University, albeit anonymised for analysis, is one of the most established Universities in the Northwest regions. Therefore, suggesting that the institution and the participants therein have some level of DCM and perhaps a better understanding of the survey questions. This supposition is also supported by the fact that the difference between the highest and lowest agreements was only 6% showing that the

respondents provided very similar answers; and the consistency and small range suggest they were very certain about the matter.

The National Institute (formerly known as a monotechnic), consistently followed closely behind the University with the second highest agreements in most questions. The pattern of results was very similar to that of the University despite them being two completely different types of institutions and operating quite differently in terms of structure. Even in the ranking question, the rank ordering for the top four most impactful elements were also similar. The main reason for this could be that the two institutions are close in physical location. They take advantage of their proximity by the University providing connectivity services to the National Institute. It could be that it is their 'physical location', better known in this dissertation as EE (External Environment), accounts for the similarity in results. Alternatively, it could be that both institutions have similar levels of DCM, since they share similar contributing factors between them.

Another similarity between the University and the Monotechnic is the range between responses were smaller; meaning that majority of responses were concentrated in a small area as opposed to the results from the Polytechnic and Federal College, where there was a much wider range between responses. This concentration in agreements means that respondents from the University and the Monotechnic were a lot more consistent with their responses, therefore suggesting certainty in their opinions. In comparison, the other two institutions where there was a wider the distribution hence less of a consensus or certainty.

The Polytechnic and Federal College alternated between presenting the lower agreement levels. These responses were generally much lower than those from the other 2 institutions. The Federal College was physically situated in a very remote area, on the outskirts of a main city. The responses provided in Q4 (the open-ended question) indicated that some respondents were more preoccupied with their physical environment and lack of basic amenities to the point where it could be perceived that there was limited understanding of the context. The polytechnic on the other was located with a main city and where most amenities were available, including internet access, albeit irregular. However only (n=54) participants were from the Polytechnic, and they were all from one department, so the data does not represent the entire institution. Thus, making it difficult to draw meaningful conclusions.

There was a general ordering of institutions in terms of the pattern of results that was consistent across the survey. The University presented the highest agreements, followed by the National Institute

then the Polytechnic and the Federal College presented the lowest agreements in general. This suggests that the ordering may indicate the level of DCM in the respective institutions.

6.4.3.1 Triangulated the Literature findings

The results from this study triangulate the literature findings and confirm that the candidate elements found in Chapter 3 and confirmed in Chapter 5 are the same elements that contribute to DCMiTI in the case study of northwest Nigeria.

6.4.3.2 The Order of significance towards a development structure

The order of significance of impact of elements (1-10) on DCMiTI show a division into four groups. The most impactful elements are LTD. The upper middle elements are DI&W, TI, and Co. The lower middle elements are skills, RTC and infrastructure. Stakeholder and EE are the least impactful with EE holding unanimous agreements that it is the single least impactful element on the development of DCMiTI in Nigeria based on the opinion of stakeholders of four institution in the case study.

This order would be best utilised in delivering a management report providing guidance of which area of capability to develop or to support the allocation of resources among the various elements of capability.

6.4.3.3 The status of DCMiTI in Northwest Nigeria

Stakeholder in the case study have the opinion that DCMiTI is learner centred, corroborating literature and the UK Study findings. Two participants from different institutions argued that the struggle with delivering effective digital education maybe because the method of delivering classic blackboard education lacks innovation, engagement, and structure, therefore the same difficulties are being transferred. This is a fair argument to raise, however, I would counter the argument by suggesting that the inclusion of LTD among the classification of elements leaves room for transforming existing methods to become more effective as there is no obligation to directly transfer any ineffective processes, without optimising them. Thus, still suggesting that a DCMiTI structure would be well suited to case study area.

The status of DCMiTI is such that a more capable workforce is required, and management have suggested more focus be put on training tutors to achieve better student outcomes. Despite hesitation towards introduction of new technologies, most participants suggested that once the facilities are available, the tutors will embrace it with the support of technical support staff. One participant said “Once the delivering of lecture is good you will notice that learners will be more willing to be in that

class. So, if we have the manpower and facilities, other things will follow." Another management participant said: "both teachers and students must learn how to do things differently, if we expect a different result…", again suggested that once the change is implemented, stakeholders will catch on. These findings are positive towards the development of a support structure as they suggest, once a structure is agreed upon and informed decisions are made on which areas of capability to focus on for best results, the digital education transformations may happen more organically.

DCMiTI in Nigeria has been an increasing amount of attention but is still underdeveloped, suggesting that this is good time to implement a development structure to support digital education processes which would in turn support the TEIs with allocation of funding based on the elements that have the most impact on learning, and developing a maintenance culture to support the working capabilities and ensure continuous improvement.

Lastly, the results from the study presented a wide range of high level and low-level issues that affected the deployment of DCMiTI. For example, the availability of high-tech equipment without securing stable connectivity and constant access to electrical supply. This range of issues suggests that resources are allocated without guidance or structure. Further supporting the need to propose a DCMiTI Framework.

6.5 Summary of contextualising DCMiTI in a case study of Northwest Nigeria

In this chapter, I reported a study investigating the ten candidate elements contributing to DCMiTI as uncovered in the Systematic Review (Chapter 3). The study aimed to gain a deeper understanding of how these elements affect the maturity efforts of TEIs. The results drew out factors specific to the Nigerian Tertiary Education landscape; contextualising DCMiTI to four institutions in Northwest Nigeria. This chapter substantiates the answers to Research Questions 1, 2 and 4 with empirical evidence.

RQ1: What elements contribute to Digital Capability Maturity?

Primary studies confirmed a general agreement that the elements identified in the literature search (Chapter 3) and confirmed in the UK study (Chapter 5) are the same elements found to contribute to DCMiTI in Nigeria.

DI&W, C&I, Skills, TI, Infrastructure, Co, stakeholders and LTD had the highest agreement levels suggesting they have the most impact on DCMiTI. EE has lowered agreements suggesting it has the least impact on DCMiTI.

RQ2: How do these elements affect the Digital Capability Maturity of Tertiary Institutions?

Primary studies confirmed the effect of elements on DCMiTI is positive. The four institutions in the case study validated the statement that: “elements (1-10) have a positive effect on DCMiTI”.

The context of ‘how’ each element impacts DCMiTI is provided in the results and summarised in Table 6-20. Co, Skills, and Infrastructure presented inconclusive results in the quantitative analysis, however interview with management clarified that both skills and infrastructure should be highly ranking to support digital education initiatives.

The order of their impact significance of elements must be assessed to contextualise the structure to the area in which it will be used. It provides insight into what is important or lacking in the specific environmental setting.

RQ4: What is the status of DCMiTI in Nigeria?

The status of DCMiTI in Nigeria is progressing steadily as many local and international funds are being expended towards digital resources, structures, and internet connectivity. The transformation is still in early stages as there are still aspects of teaching and learning that are yet to be considered. The range of concerns prevalent in the case study institutions suggests resources are allocated without guidance or structure, therefore, the status of DCMiTI is Northwest Nigeria suggests that introduced a development structure at this stage would have a large influence on institutions ability to keep up the dynamic education shift and supporting the effective and efficient delivery digital education.

The findings presented in this chapter provide sufficient confirmation to proceed to the next chapter of this dissertation, in which I proffer a development structure by way of the DCMiTI Framework.

FRAMEWORK DEVELOPMENT CHAPTERS

7. CHAPTER SEVEN: CONSTRUCTING A DCMiTI FRAMEWORK

This is the only development chapter in this dissertation. In this chapter, I report methods used to gather the findings of the previous chapters in this dissertation to proffer a solution to the absence of a development structure by way of developing a Digital Capability Maturity Framework for Tertiary Education institution in Nigeria. The framework provides a means by which institutions can assess their digital maturity and develop their ability to sustainably deploy and support digital education programmes. The solution presented in this chapter offers the most substantial contribution to knowledge in this dissertation, and answers Research Question 5.

Research Question 5: What is the solution to addressing the absence of a development structure for DCMiTI?

7.1 Background

In the context of this research, I define a *model* as a structure for thinking of a problem; and a *framework* as an extension of a model because it goes on to provide guidance on how to solve the problem. For this reason, I may use the terms 'model' and 'framework' interchangeably. Thus, I report the development of the proposed DCMiTI Framework which is a structured set of guidelines that give instruction on how TEIs can achieve digital maturity.

Since the advent of the digital, Institutions have faced continuous pressures to leverage their technological investments for value, in the form of teaching excellence, technology utilisation, and education outcomes (Anthony et al., 2017). There are competing needs to achieve organisational goals, while keeping up with learning trends in academia and meeting the skillset demands of the dynamic digital workforce (Hubschmid-Vierheilig et al., 2020). Over the years, numerous maturity models have been developed and utilized in different domains to support the achievement of such goals.

However, one of the main criticisms is the adoption pre-existing models and their application in different domains (Kohlegger et al., 2009) without a full review of its appropriateness in the problem domain. I have addressed this criticism in this thesis by holistically exploring the complexities of the problem domain and identifying a set of elements befitting of the domain (Bello et al., 2019b) which I have used as the criteria to build a maturity model appropriate for DCMiTI.

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Typically, models are used as an evaluative and comparative basis for improvement (de Bruin et al., 2005) and to derive an informed method of achieving Capability Maturity in a specific area (Paulk et al., 1993). Maturity models are designed to assess the degree of sophistication of a selected domain based on a set of criteria. The most popular scale used in maturity assessment is based on a 5-point Likert scale where '5' represents the top level of maturity.

7.1.1 Types of Maturity Models

Typically, maturity models may be categorised into 3 types: descriptive, prescriptive, or comparative.

Purely **descriptive models** present single point encounters and make no provision for improving maturity. They do, however, place some emphasis on the domain's relationships to the objective. These types of models are good for presenting the current situation in the domain.

Prescriptive models provide emphasis on the domain relationships to performance and indicate how to approach improving performance of an institution in a specific area. Such models enable the development of an improvement roadmap.

Comparative models enable benchmarking across industries or in the case of this research, across different type of tertiary level learning institutions. They compare similar criteria in each institution and assess them individually to then benchmark maturity across different institutions in a region. Such a model would recognise that similar levels of maturity across different types of institutions, offering different types of courses, may not necessarily translate to similar levels of performance.

De Bruin et al. (2005) argues that while these models may be seen as distinct, they represent evolutionary phases of the model life cycle:

1. First the model is descriptive, so that the as-is domain situation is understood.
2. Then the model is evolved into being prescriptive as it is only through a sound understanding of the current situation that substantial, repeatable improvements can be made.
3. Finally, for a model to be comparative it must be applied in a comparable fashion to a wide range of institutions to attain sufficient data to enable a valid comparison.

Consequently, the proposed DCMiTI Framework I present in this chapter is currently prescriptive because it provides guidance on how to approach digital maturity improvements. Albeit the long-term goal is to develop a comparative model, which I discuss further in section 10.6 Future Work.

7.2 Aim and Objectives

The aim in this chapter was to leverage the knowledge gained from previous chapters of this dissertation, to propose a DCMiTI Framework that would serve as a structure upon which TEIs can build the various elements that contribute to their overall Digital Capabilities. The proposed Framework would support institutions in better understanding the complexities of capabilities and further enable the improvement of capabilities specific to the delivery of Digital Education in TEIs.

The objectives for the proposed DCMiTI Framework were:

1. Allow institutions to assess their level of Digital Capability
2. Provide guidance on steps towards achieving higher levels of Digital Capability Maturity (DCM)

The outcomes of this chapter provide evidence to answering Research Question 5 of this dissertation.

RQ5: What is the solution to addressing the absence of a development structure for DCMiTI?

In the next section, I detail the model construction process.

7.3 The Development Process

The methods used in this chapter are different to the other empirical and non-empirical chapters of this dissertation. In this chapter, I report on the framework development process guided by de Bruin et al. (2005) where they documented the main phases of constructing a maturity assessment model as illustrated in Figure 7-1; and Kohlegger et al. (2009) provide guidance on the re-creation of maturity models. The first step was scoping the purpose and boundaries of the model, then designing the structure for the model. Followed by populating the model and then testing it.

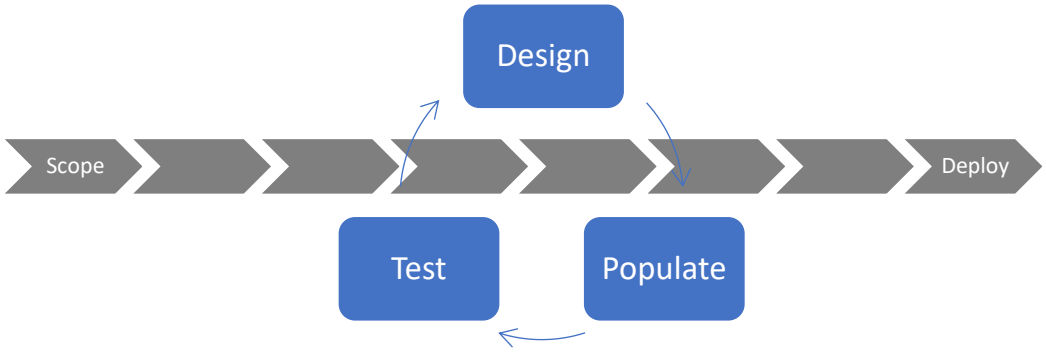


Figure 7-1: Model development phases

Although only a single iteration is reported in this dissertation, it is important to note that early scoping decisions influenced all the remaining phases of model development, although the iterative phases

(as shown in Figure 7-1), make it possible to revisit and adjust decisions made in earlier phases. For example, the results of testing may show the need to further scope or the need to make changes to the design phase.

Table 7-1 demonstrates how the phases of the model construction process aligned to the various chapters in this dissertation.

Table 7-1: Alignment of phases and thesis chapters

Phase	Methods	Description	Dissertation Chapter
Phase 1 – Scoping	SLR	- Informed the model's purpose	Chapter 2 (SLR)
	Focus group	- Informed by SLR results - Development stakeholders influenced by the model purpose - Further informed by focus group results	Chapter 2 (SLR) Chapter 3 (Ed. Tech study)
Phase 2 – Design	Questionnaire/ Interviews	- Initial elements informed by SLR - Confirmed in UK Study - Confirmed and contextualised in Ng. Study	Chapter 4 (UK Study) Chapter 5 (Nigeria Study)
Phase 3 – Populate	Questionnaire/ Interviews	- Initial elements informed by SLR - Confirmed in UK Study - Confirmed and contextualised in Ng. Study	Chapter 4 UK Study Chapter 5 (Nigeria Study) Chapter 7: Framework Assembly
Phase 4 - Test	Perception study (online workshop)	A full testing of the utility and accuracy of the model was not possible in the duration of this PhD research, so an initial perception study of the proposed framework was conducted to receive comments and feedback from the target audience	Chapter 8: (Validation Study)
Phase 5 - Deploy	-	Outside the scope of this research	Chapter 10 (Future work)
Phase 6 - Maintenance	-	Outside the scope of this research	Chapter 10 (Future work)

Below, I detail and justify the decisions made in each phase.

7.3.1 Phase 1 – Scoping

The initial phase of model assembly was to scope the domain of the proposed model and set out the outer boundaries for model application and use. Much of this was informed by the findings presented in *Studies 1, 2 and 3*. For the purpose of a systematic and replicable model construction process, I describe the focus and boundaries of the proposed DCMiTI model, as shown in Figure 7-2.

7.3.1.1 Focus of the Model

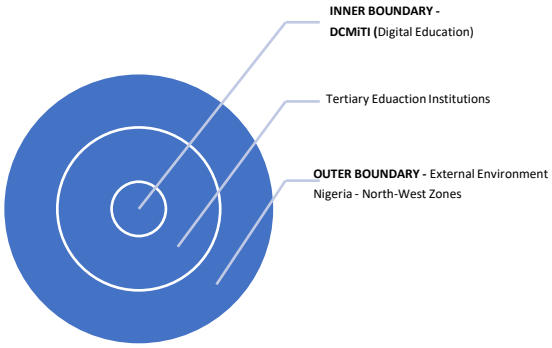


Figure 7-2: boundaries of the model domain

The proposed model is domain specific; meaning it is designed to be targeted and applied targeted to address a specific focus area.

The Focus of the proposed DCMiTI Framework is to support the deployment, delivery, and sustainability of digital education, in the context of TEIs (inner boundary) within North-West Nigeria (outer boundary).

7.3.1.2 Identifying Development Stakeholders

Selecting the stakeholders who assisted model development was largely influenced by Chapter Three and Chapter Four of this dissertation. In these study chapters, I identified various stakeholders that impact the development of DCMiTI. Then with the purpose of the model in mind, I engaged a variety of stakeholders in investigating DCMiTI further in Chapter Five and Chapter Six to gain multiple perspectives and make informed decisions about developing a model specific to Northwest Nigeria.

I utilised the views of learners in confirming literature findings and educational technologists to compare theory with practitioners' real-world perceptions. Academia management were engaged to better understand elements that impact DC in context of TEIs and to gain initial views on the current ('as-is') status of DCMiTI. Tutors, administrators, and other technical staff were surveyed but their views are not well represented in this research due to limited participation.

Following the extensive review of domain specific literature and investigating DCMiTI among a variety of stakeholders, I was able to determine *TEI Management* and *government stakeholders* as the target audience for the proposed model.

Table 7-2: Criteria for model development

Criterion	Characteristic	Detail
Focus of Model	Domain specific	Digital Education
Development stakeholders	Combination	Learners Tutors Administrators TI Management Practitioners Government
Target Audience	Combination	TI Management Government

Table 7-2 summarises all the scoping decision made in the first phase of the Framework development process.

7.3.2 Phase 2 – Designing

The design phase of the model development was to determine the model's architecture. This was achieved by leveraging the knowledge gained from previous chapters to make decisions about:

1. The intended audience and their needs for the model.
2. How the model will be applied
3. Who will be involved in the model application?
4. What can be achieved through successful implementation of the proposed DCMiTI Model?

Table 7-3 provides a summary of the decision made in this phase, which I detail in subsequent sections.

Table 7-3: summary of design decisions

Criterion	Characteristic
Audience	Executives and senior management/ government agencies
Method of Application	Self-assessment (verified)
Driver of Application	Internal and external requirements
Respondents	Learners / tutors / management
Application	Multiple entities/ multiple regions

7.3.2.1 Intended audience and needs

The intended audience for the model is executives, senior management, and other decision makers within the TEI; in addition to government stakeholders in Nigeria such as, the *National Universities Commission (NUC)*, *The Tertiary Education Trust Fund (TETFund)*, Federal and state *Ministries of Education (MoE)*, among other government agencies. The results from interviewing management members in Chapters Four and Five identified some of their needs as summarised below:

- To be able to measure their current level of capability.
- To determine the way forward while utilising the resources available.
- Manage the allocation of resources efficiently and effectively.

7.3.2.2 Model application

The proposed DCMiTI Framework has three application purposes as listed below, however the version of the Framework presented in this research only enables the first two to be achieved. The third purpose requires the model to be further developed to a comparative model in 10.6 Future Work.

1. As an assessment tool that would enable a DCMiTI Assessment or description of the status of DCMiTI in a specified institution.

2. To assist the determination of the desired 'to-be' status of DC and provide a roadmap for improving DCMiTI.
3. As a benchmarking tool for inter-institutional comparison.

7.3.2.2.1 How the Framework will be applied

The proposed DCMiTI Assessment process which describes how the Framework would be applied in a TEI is illustrated by the use case diagram in Figure 7-3. The use case actors, who are the users of the Framework, are detailed in the section below, with a brief scenario.

7.3.2.3 Users of the Framework

There are four main types of users involved in the DCMiTI Assessment process:

1. **TI Management**: stakeholders who are responsible for decision making.
2. **Assessment Committee**: responsible for assembling sub-committees to investigate each element/sub-element and supervising the assessment process. They are also responsible for reviewing and approving assessment reports before presenting to management.
3. **Sub-Committee**: responsible for gathering the data required for assessment and reporting self-assessment ratings to the assessment committee for approval.
4. **A data entry clerk**: responsible for using the ***Assessment TOOL*** to enter assessment scores and produce the auto generated DCMiTI Assessment Report.

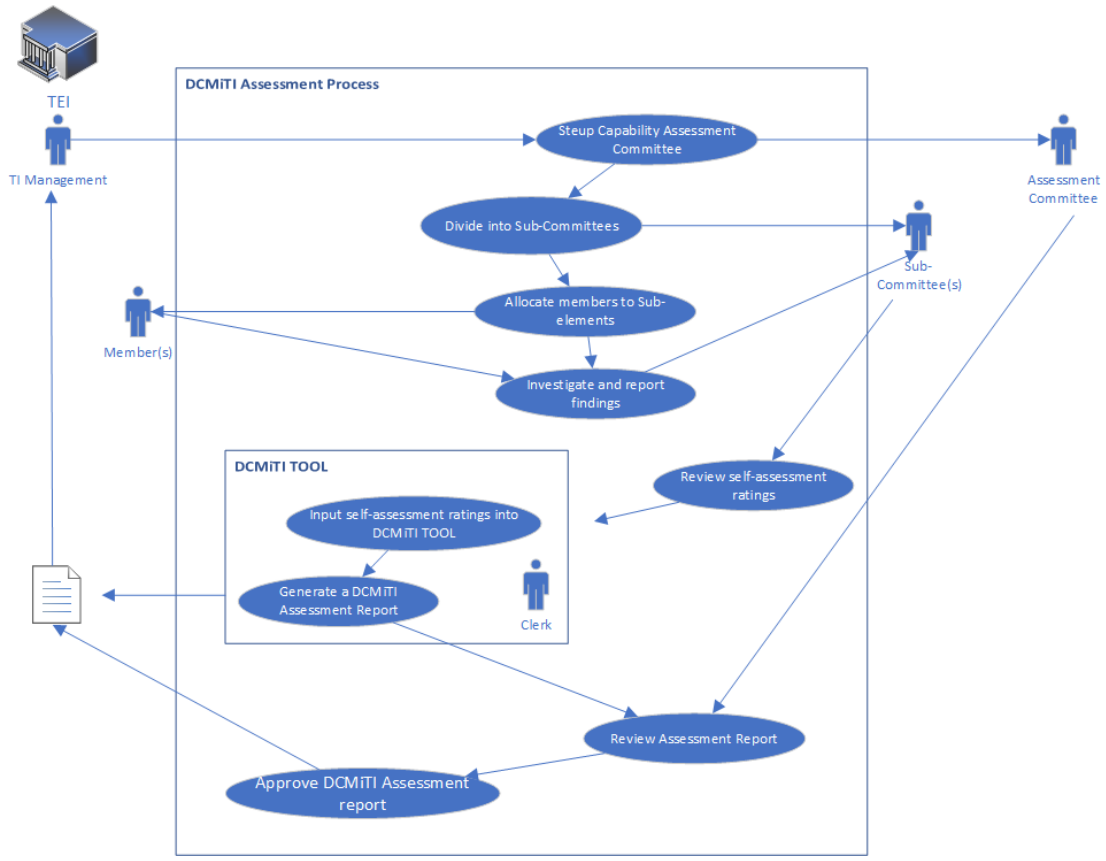


Figure 7-3: Use Case diagram for proposed DCMiTI Assessment process

7.3.2.3.1 A brief Scenario

A TEI wishing to conduct a maturity assessment would do the following:

1. TI Management would assemble a DCMiTI Assessment committee.
2. The Assessment Committee would further assemble a number of sub-committees to investigate the various elements and/or sub-elements depending on the size of the institution and their specific objectives.
3. Sub-Committee members will investigate their allocated element/sub-elements and report back with a self-assessment rating.
4. Feedback and ratings will be reviewed by each Sub-Committee, before reporting back to the Assessment Committee.
5. A Data Entry Clerk will input the self-assessment ratings into the DCMiTI Tool and generate a self-assessment report. The report will be reviewed by the Assessment Committee.
6. On approval, the assessment report will be presented to TI management for decision making and relevant action.

7.3.2.4 Benefits of Successful Implementation

Benefits of implementing the proposed DCMiTI Framework in a TEI would be:

- Showcase the relative strengths and weaknesses of the Instîtution.
- Identify inhibiting factors to education delivery.
- Provide a roadmap for institutions aiming to improve their capabilities.
- Help mitigate risks.
- Support resource allocation decisions.
- Support the development of improvement strategies that prioritise vital areas.
- Provide the organisation with a CMMI based Maturity rating.
- Deliver a means for inter- and intra-institutional benchmarking.

7.3.3 Phase 3 – Populating

After scoping and designing the proposed DCMiTI framework, I populated it with relevant content of exactly *what* needs to be assessed, how it can be assessed, and how the assessment may be reported.

7.3.3.1 What needs to be assessed?

The details of what needed to be assessed were identified through the investigations reported in previous chapters of this dissertation as summarised in Figure 7-4 and listed below:

- I identified an initial list of critical domain elements/ sub-elements that contribute to DCMiTI through an extensive systematic Literature Review in CHAPTER THREE: SYSTEMATIC LITERATURE REVIEW.

  The list of elements was then categorised and presented as a classification of elements that contribute the development of DCMiTI (Bello et al., 2019b).
- In CHAPTER FOUR: INVESTIGATING ROLES CONTRIBUTING TO DCMITI, I elaborated on the key stakeholders that impact successful implementation of digital initiatives in TEIs, further expanding the body of knowledge on the domain.
- I confirmed the candidate elements/ sub-elements by surveying the initial classification in CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK and further extending the body of knowledge on the domain with insight into contemporary issues in TEIs.
- In CHAPTER SIX: INVESTIGATING DCMiTI IN A CASE STUDY OF NORTHWEST NIGERIA, I triangulated the candidate elements/sub-elements, by further surveying the classification in Nigeria. This chapter expanded the body of knowledge on the domain and allowed me to capture contextual issues unique to the Nigerian Tertiary Education landscape.

I thus exploited the knowledge of the domain supported by sufficient empirical evidence to establish the structure for the proposed DCMiTI Framework as shown in Figure 7-4 below.

Table 7-4: summary of establishing the proposed structure

Chapter	**Study**	**Structure**	**Configuration**
Chapter 3	Study 1: Systematic Literature Review	Initial classification of elements	Universal
Chapter 5	Study 3: Exploratory study Investigating DCMiTI	Revised classification	A UK University
Chapter 6	Study 4: Contextualising DCMiTI to Northwest Nigeria	Contextualised classification	TEIs in Northwest Nigeria

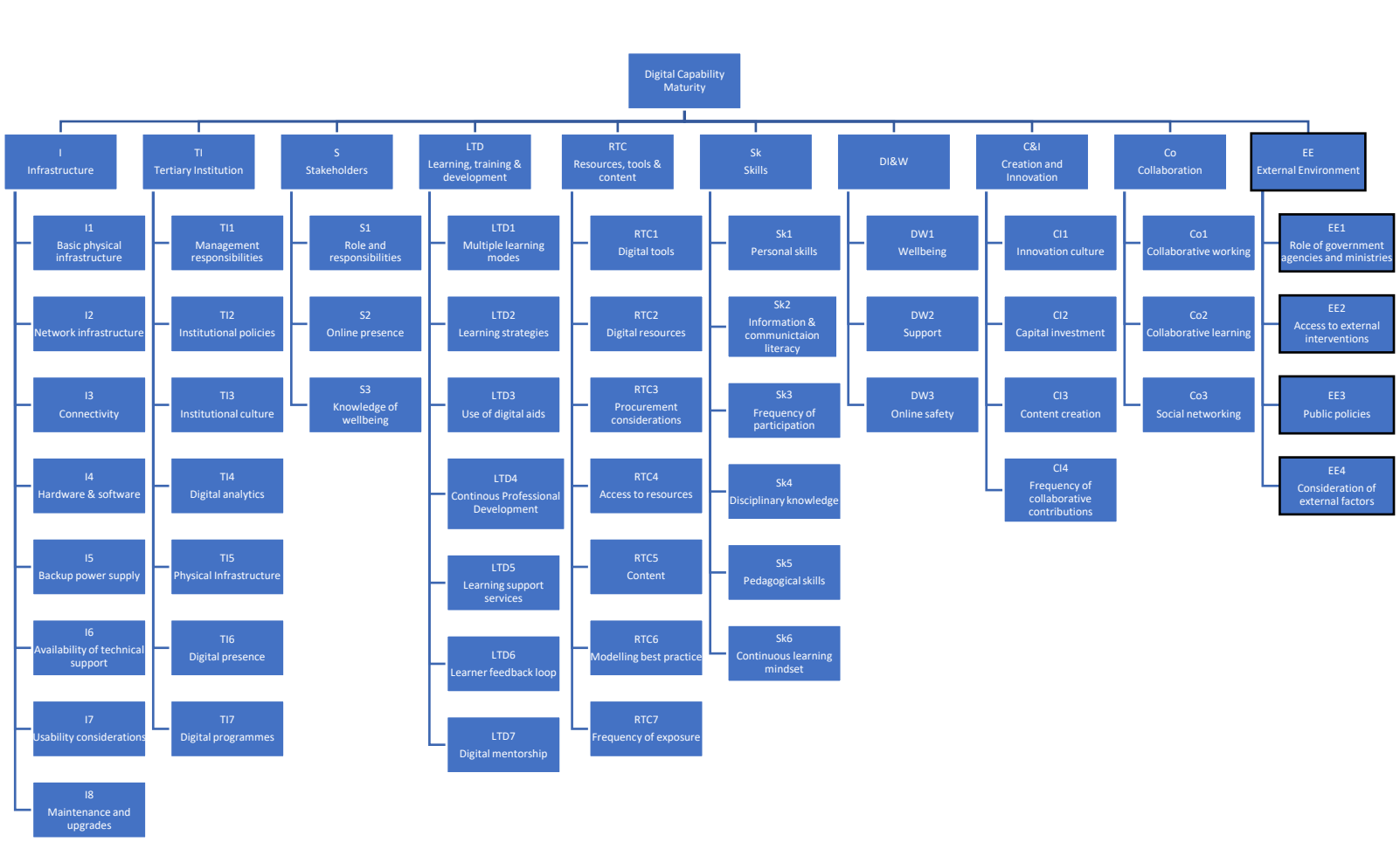


Figure 7-4: structure of elements and sub-elements

7.3.3.2 How it will be assessed?

In this section, I detail how the elements/sub-elements that formed the structure of the proposed Framework will be assessed.

7.3.3.2.1 Maturity Levels

The proposed Framework leans on the design principles of maturity modelling (Paulk et al., 1993), in which maturity is commonly represented as a number of cumulative levels where the higher levels are built on the requirements of lower levels. The number of stages varies from model to model, but the most important thing is that the stages are distinct, and well defined with a logical progression through the levels (de Bruin et al., 2005).

The proposed DCMiTI Framework has six progressive levels of maturity running from Level 0, which indicates an institution does not have the capacity to deliver digital education programmes; through to Level 5, where digital practices are established and in a state of constant optimisation.

Although digital education is a well-developed domain, there was little evidence on what is thought to represent the concept of DCMiTI as presented in this dissertation. Therefore, the emphasis in Chapters 3 to 6 of this dissertation, was on what represents maturity and its constructs. I then exploited the results and knowledge from those investigations to write level definitions that reflect this, as shown in Table 7-5.

7.3.2.2.1.1 Level definitions

Level definitions provide a summary of the major requirements at each maturity level, specifically highlighting those aspects that are new to the level and not included in lower levels.

The *level descriptors* are short labels that give a clear indication of the intent at each level. Different models have used different descriptors so there is no standard nomenclature for these descriptors in assessing DCMiTI. Therefore, I have listed multiple descriptors which I subsequently investigated to see which short label best suits each definition. The findings from this investigation are presented in CHAPTER EIGHT: VALIDATING THE PROPOSED DCMiTI FRAMEWORK.

Table 7-5: level definitions for the proposed DCMiTI Framework

Capability Maturity Level	Level Descriptors	Definitions
Level 0	▪ Not possible ▪ Not available ▪ Not considered	- Digital Education is not possible - There are generally insufficient facilities to support the process
Level 1	▪ Possible ▪ Ad hoc ▪ Unpredictable ▪ Reactive ▪ Poorly controlled	- Digital Education is possible but inefficient - Practices are ad hoc. Tools and services are unpredictable - The value of digital skills is unrealised
Level 2	▪ Often reactive ▪ Encouraged	- Digital Education Programmes are stable - The value of digital knowledge and skills is recognised - The TI encourages digital skills and practices - Services and maintenance are often reactive
Level 3	▪ Proactive ▪ Practised ▪ Defined ▪ Standardised ▪ Procedures in place	- Digital services are standardised with the availability of policies and guidelines that support the smooth running of digital education - The TI actively promotes the use of digital tools and skills (e.g., Through recognition reward schemes) - There is a focus on the development of digital services and skills
Level 4	▪ Managed ▪ Measured and controlled ▪ Quantitively surveyed	- Digital programmes, services and facilities are quantitively measured and controlled - Stakeholders expect to locate knowledge, policies and guidelines related to digital practices, and the concept of digital Wellbeing is woven into policies - Usability becomes a consideration in resource acquisition - Tools and equipment are easy to use, with user manuals and instructions - Management stakeholders demonstrate commitment to digital practices, and digital policies have detailed implementation plans
Level 5	▪ Optimizing ▪ Stable and flexible ▪ Continuous improvement	- Digital Maturity is continually optimised through data analytics and visualisation - An established assessment feedback loop informs decision making - Tools, resources, and processes are continuously and regularly updated

7.3.3.2.1.2 Meta-descriptors

Finally, I applied the body of knowledge gained, to construct a prioritised set of **meta-descriptors** across the progressive levels of maturity, one for each sub-element, detailing criteria to be satisfied for each maturity level (0-5).

The meta-descriptors make up the body of the structure and form the instrument that is to be used for conducting maturity assessments. The full Framework with meta-descriptors is available in Appendix Y: The Proposed DCMiTI Framework v1.1.

7.3.3.2.1.3 Assessment scale

Quantitative measurements are commonly used to measure maturity because they enable statistical analysis and improve the comparability of results. In conducting a DCMiTI assessment only sub-

elements are assessed by the users on a 6-point assessment scale, that is the maturity level 0-5 as shown in Table 7-5*Table 7-5: level definitions for the proposed DCMiTI Framework*.

		Assessment scale						Assessment Rating	Maturity
		0	**1**	**2**	**3**	**4**	**5**		
Domain Element 1	Sub-Element 1.1	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	**[enter rating here]**	Overall maturity rating for Domain element 1
	Sub-Element 1.1	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	**[enter rating here]**	
	Sub-Element 1.1	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	**[enter rating here]**	
Domain Element 2	Sub-Element 2.1	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	**[enter rating here]**	Overall maturity rating for Domain element 2
	Sub-Element 2.2	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	**[enter rating here]**	
	Sub-Element 2.3	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	Meta descrp.	**[enter rating here]**	

Figure 6.5: assessment scale for the proposed DCMiTI framework

The assessment scale is populated with 6 meta descriptors for each sub-element, and a user is expected to enter an *assessment rating* for each sub-element, that best represents the criteria (meta-descriptor) they satisfy.

7.3.3.2.1.4 Calculating maturity

The self-assessed sub-element ratings are used to calculate the maturity of individual domain elements by computing the *mean* of the sub-element assessment ratings and demonstrated by the equation in Figure 7-5.

The 10 domain element ratings are further aggregated by calculating the mean of the 10 values to provide an overall DCMiTI Level.

DCMiTI Level= (MEAN
(Domain element 1 = (mean (Sub-element 1.1 + Sub-element 1.2 + Sub-element 1.3))
Domain element 2 = (mean (Sub-element 2.1 + Sub-element 2.2 + Sub-element 2.3))
Domain element 3 = (mean (Sub-element 3.1 + Sub-element 3.2 + Sub-element 3.3))
Domain element 4 = (mean (Sub-element 4.1 + Sub-element 4.2 + Sub-element 4.3))
Domain element 5 = (mean (Sub-element 5.1 + Sub-element 5.2 + Sub-element 5.3))
Domain element 6 = (mean (Sub-element 6.1 + Sub-element 6.2 + Sub-element 6.3))
Domain element 7 = (mean (Sub-element 7.1 + Sub-element 7.2 + Sub-element 7.3))
Domain element 8 = (mean (Sub-element 8.1 + Sub-element 8.2 + Sub-element 8.3))
Domain element 9 = (mean (Sub-element 9.1 + Sub-element 9.2 + Sub-element 9.3))
Domain element 10 = (mean (Sub-element 10.1 + Sub-element 10.2 + Sub-element 10.3)))
)

Figure 7-5: calculating domain maturity levels and over DCMiTI Level

Next, I detail how elements/sub-elements are reported after an assessment.

7.3.3.3 How it will be reported

Many existing maturity models have been represented as a series of one-dimensional linear steps and have been widely accepted (de Bruin et al., 2005). However, findings reported in CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK suggest that a one-dimensional model does not adequately represent maturity in a complex domain like DCMiTI and may not provide a roadmap for institutions wishing to see the steps they need to take to improve their capabilities.

Therefore, I adopted a layered approach, also commonly known as a stage-gate approach which provides different layers of details that enable separate maturity assessments for the various sub-elements, in addition to an overall maturity assessment for the institution.

This layered approach means that TEIs can use the assessment outcomes to gain a deeper understanding of their relative strengths and weaknesses in the overall domain element as well as the individual components that it is made up of (sub-elements). Furthermore, the ability to drill down through the maturity assessment means that assessment reports can be tailored to the varying needs of multiple audiences. **Error! Reference source not found.** illustrates how the layers match the needs o f the varying hierarchical audiences within a TEIs. Domain elements are reflected in general level definitions and enable clustering of results to the audience. Sub-elements are more specific capability areas that provide further details as to the composition of each element enabling target maturity improvements that happens at lower organisational levels.

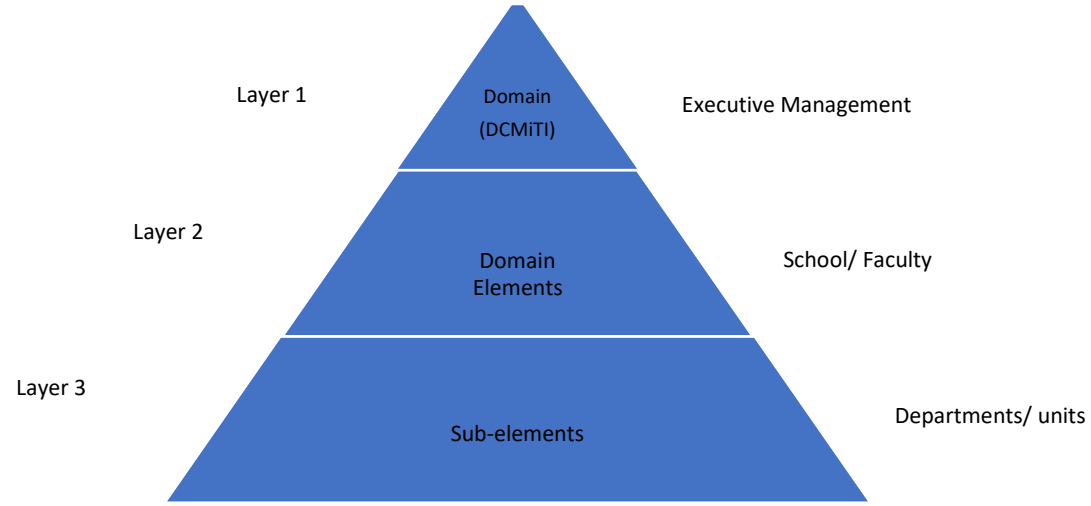


Figure 7-6: layered approach

7.3.4 Phase 4 – Testing

I conducted a perception study to assess the perceived relevance for the proposed DCMiTI Framework using an expert panel which I report on in CHAPTER EIGHT: VALIDATING THE PROPOSED DCMiTI FRAMEWORK.

The fifth phase of the framework development process is deployment. This requires the proposed model to be tested in a real-world case study to evaluate the extent of the model's generalisability. Finally, an additional sixth stage would be maintenance. Typically, evolution of models occurs as the domain knowledge and model understanding broadens (de Bruin et al., 2005). Furthermore, as technology evolves, so the domain must evolve, therefore regular maintenance is necessary to keep up with this continuous evolution. Due to time limitations in the duration of a PhD, both deployment and maintenance are out of the scope of this research however, I have proposed thoughts on how this may be done in the future work section of this dissertation.

7.4 The Proposed DCMiTI Framework

Earlier in this dissertation, I defined Digital Capability as the extent to which an institutions culture, policies and infrastructure enable, and support digital practices (Killen et al., 2017a). I further extended this definition to include the ability to support and sustain such capabilities and keep up with the continuously evolving nature of the digital landscape – this capturing the notion of maturity.

The proposed Framework provides a structure to support the development of Digital Capability Maturity in Tertiary Institutions (DCMiTI). The Framework is designed to ensure that TEIs can meet the baseline criteria to enable the design, development, and deployment of digital education.

The Framework assesses and builds capability in a layered and progressive manner, governed by underlying theories and assumptions, in addition to concepts of Capability Maturity Model Integrated (CMMI). The complete framework and guidance notes can be seen in Appendix Y: The Proposed DCMiTI Framework v1.1.

7.4.1 Underlying Theory

The underlying theory that guided the development of the DCMiTI Framework is that the ability of a TEI to be effective in deploying and supporting digital education is dependent on their Digital Capability Maturity.

7.4.2 Key Concepts of the Framework

The framework incorporates two main concepts:

1. There is emphasis on the concept of maturity, which is the ability to sustain continuous improvement of such capabilities, after developing them.
2. The elements /sub-elements that make up DCMiTI form an ecological system; whereby developing individual elements/sub-elements in isolation may result in a particular area (sub-domain) progressing but not necessarily result in overall improvement.
   Note: most maturity models represent components that are mutually exclusive – therefore, this concept is peculiar to the DCMiTI domain.

7.4.3 Assumptions

The framework is based on the following assumptions:

- The domain elements and sub-elements of DCMiTI are collectively exhaustive of the domain.
- The elements are representative of the success factors for the delivery of effective digital education.
- The domain elements/sub elements are not mutually exclusive.
- DCM is a moving target.
- There is a need to capture cross-sectional relationships between elements (although the current version of the Framework does not fully represent this).
- Presuming specific technologies or pedagogies is unlikely to provide a meaningful assessment, particularly over an extended period.

7.4.4 The Artifact (DCMiTI Tool)

To supplement the proposed DCMiTI Framework, I developed a prototype of an instrument that demonstrates how a TEI might input assessment ratings to calculate maturity and produce a DCMiTI Assessment report, see The Proposed DCMiTI TOOL.

7.5 Summary of Constructing the Proposed DCMiTI Framework

In this chapter, I detailed the methods used to assemble the knowledge gained from previous chapters of this dissertation in the construction of the proposed DCMiTI Framework. The proposed framework is intended as the structure upon which TEIs can build the various elements that contribute to their overall Digital Capability Maturity. This chapter provides the answer to Research Question 5 of this dissertation:

RQ5**: What is the solution to addressing this gap?**

I asserted that the absence of a structure to support the development of DCMiTI may be impeding the success of digital education in TEIs in Nigeria. Consequently, I proposed a domain-specific structure

that focuses on DCMiTI, providing guidance on how to develop the individual areas of Digital Capability and a pathway to progressively achieving higher levels of digital maturity.

The Proposed DCMiTI Framework enables TEIs to self-asses their readiness and/or ability to deliver digital education. I also presented an artefact that demonstrates how an institution may conduct a self-assessment and generate a DCMiTI Assessment report. The assessment outcomes can either be reported as specific capability areas (sub-elements), clustered into domain elements highlighting relative strengths and weaknesses; or clustered as the whole domain reporting on the ability to deliver digital education.

In summary, the proposed structure (DCMiTI Framework):

1. Provides a structure that incorporates the 10 elements contributing to DCMiTI and their comprising sub-elements, supported by a full glossary.
2. Provides 6 maturity *level definitions* for the progressive level of maturity (0 to 5).
3. Provides prioritised *meta-descriptors* showing a roadmap towards enhancing digital maturity.
4. Enables a TEI to self-assess their level of digital maturity.
5. Reports TEIs' relative strengths and weaknesses in specific capability areas, clustered as domain elements and as a whole (DCMiTI).

In addition, this chapters presents an artifact to demonstrate functionality of the proposed Framework.

In the next chapter, I report the testing phase of development in which I assessed the relevance and perceived usefulness of the proposed DCMiTI framework for its intended use.

8. CHAPTER EIGHT: VALIDATING THE PROPOSED DCMiTI FRAMEWORK

This is the last empirical chapter in this dissertation. In this chapter, I present a study investigating the efficacy of the proposed DCMiTI Framework. I report on how reasonable the solution is for its intended purpose of assessing and supporting the progressive development of digital capabilities in TEIs. Expert participants have accepted the proposed DCMiTI Framework as a functional structured approach to supporting DCMiTI and approved it as a practical and valuable research effort toward supporting the implementation of digital education programmes. In addition to the validation, future work recommendations are listed and further addressed in subsequent chapters. This concludes the research argument by providing answers to Research Question 6.

RQ6: Is the proposed solution a reasonable one to support the implementation of digital education?

8.1 Background

In Chapter Seven, I reported the development of the proposed DCMiTI framework to support TEIs in improving Digital Capability Maturity (DCM). The proposed framework was populated based on literature and empirical findings from the previous chapters of this dissertation.

Once a model is populated, it should be tested for **relevance** and **rigour** (Bruin et al., 2005). In testing for relevance, the construct of the model is evaluated while testing for rigour involves evaluating the validity, reliability, and generalisability of the model instruments.

The methods used to investigate DCMiTI resulted in the formation of the constructs upon which the framework was built. The overall research methodology described in CHAPTER TWO: RESEARCH METHODOLOGY explained how the constructs of DCMiTI were investigated, substantiated, and triangulated to confirm a good understanding of the constructs (a sound knowledge base) had been achieved, and the domain had been well represented in the proposed classification. 'The extent of literature review and breadth of the domain covered provides a measure of content validity' (de Bruin et al., 2005).

Furthermore, it can be said that once the initial classification was completed, Study 4 and Study 5 was used to improve the convergence of opinions and confirm a reasonable theoretical basis of DCMiTI had been achieved.

It was then necessary to test for rigour. This involved testing the Proposed DCMiTI Framework for validity and reliability and as such, the investigation reported in this chapter had the objectives as detailed below.

8.2 Aim and Objectives

The aim of this study was to evaluate the proposed DCMiTI Framework (Appendix Y: The Proposed DCMiTI Framework v1.1) and establish some rationale for how reasonable the proposed Framework was as a tool to support the continuous development of digital capabilities and consequently support digital education in TEIs.

The following objectives were used to guide the investigation:

1. Comment on how reasonable the proposed Framework is as tool to measure DCMiTI.
2. Comment on the applicability and reliability of the assessment instruments
3. Comment on the usefulness for the proposed DCMiTI Framework as a tool to support effective and efficient digital education.

In the next section, I summarise the methods and tools used to conduct the study.

8.3 Methods

To elicit perceptions on the validity of the proposed DCMiTI Framework, I conducted a perception study under UH Ethics Protocol number SPECS/PGR/UH/04959. A full study protocol can be seen in Appendix AA: Protocol for Study 5. Below, I summarise the study protocol.

8.3.1 Tools – Expert Panel Workshop

To survey experts' opinions, I conducted an online workshop which combined quantitative and qualitative data collection techniques. Due to participants' scheduling constraints, I conducted two separate online workshops via zoom meetings. The sessions consisted of an online questionnaire followed by a discussion.

8.3.1.1 Online Questionnaire

The workshop involved engaging expert participants in completing an online semi-structured questionnaire about the proposed framework, which they were asked to review beforehand.

The questionnaire consisted of 6 questions of 3 types:

- Questions 1 – 3 used a 7-point Likert scale to gather participants' views on the reasonability, applicability, and usefulness of the proposed DCMiTI Framework.

- Question 4 presented multiple options for the wording of level descriptors and allowed only a single choice answer, including the option of 'other' where participants could answer outside the options list.
- Questions 5 and 6 were open-ended, allowing each participant to express a summary of their opinion in writing, with a 300-word limit due to the limited duration of the workshop.

8.3.1.2 Workshop Discussion

Immediately following the questionnaire, I engaged participants in an open discussion guided by the questions as shown in Table 8-1 for further depth and clarity. During this discussion, participants were prompted to share the rationale behind their answers.

Table 8-1: questionnaire questions

	Questions
Question 1	The proposed framework is intended as a basis for assessing the level of maturity of a Tertiary Education Institution. In your opinion, how reasonable is the proposed framework in that regard? (7-point Likert scale)
Question 2	In your opinion, how applicable is the proposed framework for supporting the development of Digital Capabilities in TEIs? (7-point Likert scale)
Question 3	In your opinion, how useful would the proposed framework be in supporting the implementation of digital education programmes? (7-point Likert scale)
Question 4	Given that Level Descriptors are short labels summarising the definitions of each maturity level and intended to indicate the key achievement at each stage of maturity. In your opinion, which one of these level descriptors best describes Level 0 of maturity? (Multiple options – single choice) In your opinion, which one of these level descriptors best describes Level 1 of maturity? (Multiple options – single choice) In your opinion, which one of these level descriptors best describes Level 2 of maturity? (Multiple options – single choice) In your opinion, which one of these level descriptors best describes Level 3 of maturity? (Multiple options – single choice) In your opinion, which one of these level descriptors best describes Level 4 of maturity? (Multiple options – single choice) In your opinion, which one of these level descriptors best describes Level 5 of maturity? (Multiple options – single choice)
Question 5	Do you have any additional comments or observations that could improve the proposed framework? (open-ended)
Question 6	How might you envisage using this DCMiTI Framework in your institution? (open-ended)

8.3.2 Participants

Higher education stakeholders with prior knowledge and interest in DC and maturity modelling as well as experts in implementing digital initiatives in the Nigerian Tertiary Education landscape were invited as expert participants. The targeted expertise for participants in summarised in Table 8-2 below.

Expert	Targeted Experience
DC Expert	Experience working in the Digital Capabilities field OR experience implementing digital initiatives in the Nigerian Tertiary Education landscape.
TEI Expert	TEI stakeholders with prior knowledge and interest in DC and maturity modelling and/or Experience in a decision-making level within TEI in Nigeria.
Maturity Modelling Expert	Experience developing and/ or implementing maturity models.

Table 8-2: Experience required for target participants

8.3.3 Sampling

Purposive sampling was used to identify participants who qualified as experts based on the qualifying roles shown in Table 8-2. Experts were identified through professional recommendations from the management of TEIs that were engaged in Studies 3 and 4. Experts were recruited via email correspondence as detailed below.

8.3.4 Recruitment

Email invitations were sent out to participants inviting them to take part in the study. Once all the experts confirmed their attendance, a documentation pack was sent out sharing the following documents:

1. The proposed DCMiTI Model
2. Glossary of framework terms
3. Guidance notes

Expert were asked to review the complete documentation pack prior to the workshop date.

8.3.5 Analysis Techniques

In this study both the discussion recordings and the survey data were anonymised. I utilised Zoom's built-in functions to survey experts' opinions.

8.3.5.1 Statistical Analysis

Digital questionnaire data was automatically transferred into an Excel spreadsheet. I used descriptive statistics to analyse Likert scale values for questions 1 – 3. Below, I provide a summary of the quantitative and qualitative data analysis.

8.3.5.2 Content Analysis

The workshops were recorded using Zoom's recording function. The recordings were transcribed verbatim and used in a content analysis together with the open-ended answers to Questions 5 and 6 of the questionnaires to gain in-depth reasoning on participants' opinions about the proposed framework.

8.4 Results and Analysis

A total of (n=8) participants were involved in the study out of 13 invitations sent out, giving a 62% response rate. Participants' evenly represented males and females, eliminating any possibility of introducing gender bias into the results.

Most participants (n=7) were affiliated with universities, and (n=1) was from an external stakeholder body in Nigeria, potentially benefiting from this research. **Error! Reference source not found.** shows t he countries where participants and their respective TEIs are physically located. The spread across four countries gives a broad representation of responses, with n=3 (37.5%) from the target domain (Nigeria).

Table 8-3: expert participants' physical environment and roles

Participants	**Region (External Environment)**	**Expertise**	**Qualifying Role**
Participant 1	United Kingdom	TEI + DC + Maturity Modelling	Professor in Business School. Areas of expertise include: Digital Literacy and skills, e-Learning and Digital Capabilities, with experience developing frameworks for Blended Learning.
Participant 2	United Kingdom	TEI + DC + Maturity Modelling	Principal Lecturer and head of data Science Subject Group. Area of expertise is Digital Capabilities sand Data Modelling.
Participant 3	United Kingdom	TEI + Maturity Modelling	Academic Director for supported Distance Learning. Principal Lecturer in the Business School. Experience implementing Maturity Models in Education.
Participant 4	Ireland	TEI + DC + Maturity Modelling	Senior Research fellow with research interests and experience in Systematic Literature Reviews, Software process Improvement and Maturity Modelling.
Participant 5	Saudi Arabia	TEI + Maturity Modelling	Professor of Software Process Improvement and Maturity Modelling.
Participant 6	Nigeria	TEI + DC	A Senior Lecturer for an established Nigerian University – Director of the ICT Unit and decision-maker on adoption and implementation of digital tools and training
Participant 7	Nigeria	TEI	A Reader from an established Nigerian University –member of the university board and decision-maker regarding digital programmes.
Participant 8	Nigeria	DC	A Technical Expert from The Nigerian National Universities Commission (NUC) – with over 10years experience supporting the implementation of digital initiatives in Nigeria.

Most participants (n=5) were experts in maturity modelling, n=2 were experts in Digital Capabilities, and n=1 was a DC expert with experience in implementing frameworks in TEIs.

8.4.1 Results of reasonability of the Proposed DCMiTI Framework

Table 8-4: Expert participants' responses to Questions 1 to 3 presents a summary of the results for questions 1, 2 and 3 of the workshop questionnaires, showing the number of respondents that

selected each value on the Likert scale, and the median and mode rank values for each question (which worked out the same).

Table 8-4: Expert participants' responses to Questions 1 to 3

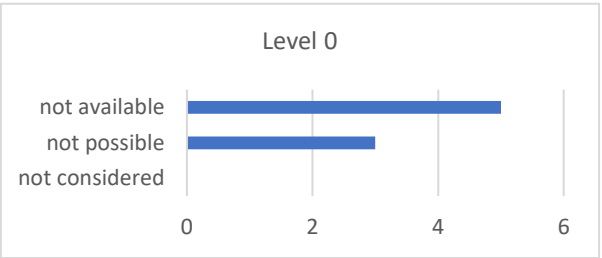
	Likert values	1	2	3	4	5	6	7		
		No. of respondents							Median	Mode
Question 1	Reasonable	0	0	0	0	2	5	1	6	6
Question 2	Applicable	0	0	0	2	4	1	1	5	5
Question 3	Useful	0	0	0	0	1	4	3	6	6

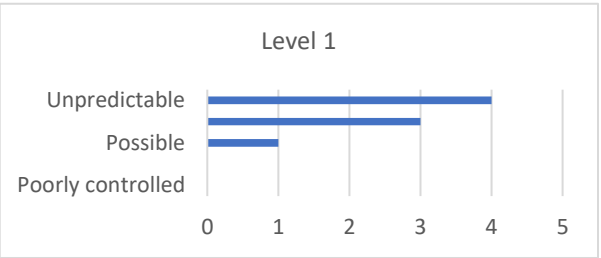
The response pattern shows strong agreement on all questions, and none of the respondents selected Likert values 1-3, indicating a no negative opinions regarding the reasonableness, applicability, or the usefulness of the proposed DCMiTI framework. Two (n=2) respondents selected Likert value 4 (= neutral), indicating neither agreement nor disagreement about the proposed framework's applicability. All the other responses for the three questions ranged between Likert values 5 to 7, indicating agreement with the statements presented in the questionnaire. Further analysis and discussion of these results will be shown in the discussion section below.

In summary, all respondents (100%) felt that the proposed DCMiTI Framework is a reasonable framework for assessing the level of maturity in TEIs. 75% of respondents believed the framework is applicable to supporting the development of DCMiTI. Lastly, 100% of respondents thought the framework would be useful in supporting the implementation of digital education programmes.

8.4.2 Results for wording of Level Descriptors

The next set of questions surveyed among expert participants were to agree on the words that best summarised the descriptions of Maturity Level 0 – Level 5. Figure 8-1 shows the number of respondents that selected each of the different wording options presented to participants, and Table 8-5: most popular wording for level descriptors summarises the most accepted wording for each level.





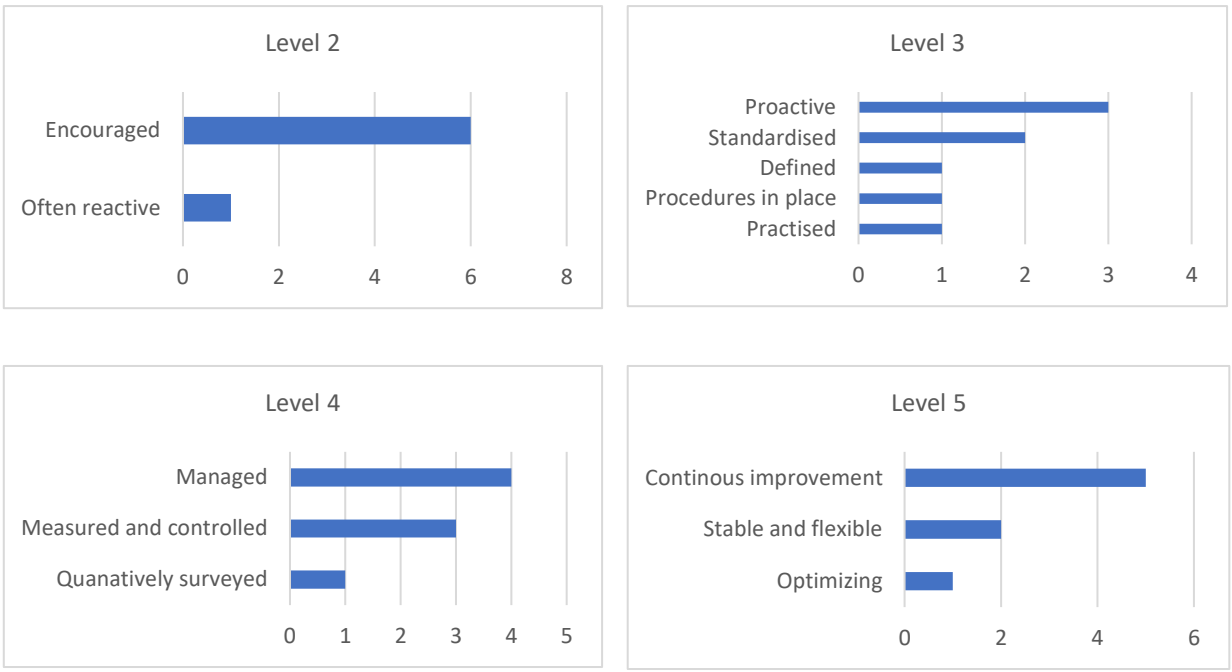


Figure 8-1: Participant's responses to Question 4 on the wording of level descriptors

Table 8-5: most popular wording for level descriptors

Maturity Level	Most popular wording	No. of respondents (n)	%
Level 0	Not available	5	62.5
Level 1	Unpredictable	4	50.0
Level 2	Encouraged	6	75.0
Level 3	Proactive	3	37.5
Level 4	Managed	4	50.0
Level 5	Continuous improvement	5	62.5

8.4.3 Results for envisaged modes of use

I combined the written answers to question 5 with transcripts from the discussions in content analysis. Table 8-6 shows a summary of participants' responses to how they might envisage using the proposed framework in their respective institutions, alongside the frequency of occurrences of each mode of use.

This question was intended firstly to elicit additional factors for consideration on modes of use that may not have been captured in this research so far and to confirm that the intended mode of use was clear to participants. This was important considering that prospective users would receive the same supporting documents given to expert participants and be expected to use the framework

independently. For this reason, I did not share the use case in Figure 7-3 with participants in the documentation pack for this study.

Table 8-6: Summary of participant's envisaged mode of use for the Proposed Framework

	Envisaged mode of use		**Frequency (n)**
1	As an assessment tool	Self-audit tool (with strategic direction)	3
		Assessment tool	2
		Diagnostic tool	2
2	Used by a team of people together to avoid bias		3
3	Documentation/ evidence of satisfying criteria		3
4	Used along with a set of assumptions or entry-level scope		3
5	to support programme design, management, and validation		1
6	To support staff training and appraisal		1
7	Programme marketing or league tables		1
8	As a fee differentiator		1
9	As a tool for discussion		1
10	To assist in raising the adoption of digital education		1

The responses to Question 5 of this study are divided into two types: confirmatory modes of use which are those responses that confirm the intended mode of use of the proposed Framework as documented in the preceding chapter of this thesis. Then the additional modes of use that emerged from this study have not been previously reported in this dissertation.

8.4.3.1 Confirmatory modes of use

The most popular vision for using the proposed DCMiTI Framework was as an assessment tool with a frequency of (n=7). Participants referred to the proposed framework using different terms such as an assessment tool, a diagnostic tool, and an audit tool that would provide strategic direction for the TEI on what needs to be done to achieve a higher level of maturity. This was the model's intended use and confirmed that respondents understood what the proposed DCMiTI Framework is intended to do.

Participants' (n=3) mentioned they envisaged the framework being used by a *group* or *team* of people because a natural bias occurs when conducting any form of self-assessment. This is something that I had already considered and factored into the model assembly process. Participants' (n=2) also recommended engaging an external person in the assessment process to further help neutralising potential biases that may arise.

Furthermore, participants discussed the need to collect evidence justifying how or why each sub-element criteria have been met would increase transparency and open the possibility of validating the assessment findings and levels awarded. Such rigour in the documentation and validation procedure gives a more tangible basis for cross-institutional assessment.

8.4.3.2 New modes of use that emerged from this study

Participants (n=3) envisaged the need to collect supporting documentation as evidence of satisfying the criteria in the various stages of maturity. This would also serve as additional tangible support for controlling self-assessment bias. Recording documentation unlocks the possibility of introducing an external body into the process either during or after an assessment to verify the Maturity rating awarded. Furthermore, it permits using the framework as a mechanism for cross-institutional analysis.

Participants (n=3) discussed the need for a clear set of assumptions to accompany the framework. They also suggested the need for basic entry-level scope, environmental, infrastructural, or otherwise. This was one of the reasons why I decided that the model needs to start from Level 0 because Level 0 is the baseline level set of criteria for getting on the maturity ladder. Institutions at Level 0 cannot deliver successful digital education. Then the requirements to satisfy Level 1 are essentially listing the entry-level criteria that rubber-stamps the institution's readiness to begin to provide digital education programmes.

Another participant suggested a Level 0 was not necessary. However, while eliminating level 0 would reduce the bulkiness of the framework, leaving it in would also support TEIs unable to meet the basic requirements to deliver digital education. Therefore, it is necessary to include Level 0 as a starting point which would qualify TEIs for implementing digital initiatives.

Other suggested modes of use all had single occurrences n=1 and included the following:

- Using the framework as a mechanism to support programme design, management, and validation.
- Using the proposed framework as a tool to support decision-making about staff training and appraisal.
- As a marketing support tool or as a mechanism for calculating league tables
- To support administrative tasks such as fee differentiation
- As a tool to aid discussions around DCM among the various TEI stakeholders not limited to management
- To support technology adoption and support institutional goals such as raising the adoption of digital education.

8.4.4 Analysis of additional comments

Participants made additional comments and observations that might help improve the proposed DCMiTI Framework. Content analysis was used to organise the questionnaire data and discussion comments. Transcripts can be seen in Appendix AB: Transcripts from .

(n=6) the comments about improving the framework were considered and justified during its development. Another (n=5) was partially addressed; these included commentaries on external systemic factors that impact DCMiTI, having a clear set of baseline assumptions and considering the affordability of implementing digital structures. These considerations were made in Chapter 1 when scoping the thesis and again when scoping the model domain in chapter 6. In the discussion section below, I provide a deeper analysis of both types of comments.

The remaining (n=3) comments highlighted factors not considered in this thesis. These observations will be listed in the recommendation section below, and further detailed in future work.

8.4.5 Interpretation of results

The proposed DCMiTI Framework was intended as a basis upon which TEIs can assess their current level of digital capabilities with clear guidance on progressing to higher maturity levels. After being surveyed among experts to evaluate its efficacy in supporting the development of Digital Education programmes, this discussion extends the analysis from the section above and highlights the key findings from the survey.

8.4.5.1 Framework Approval

The proposed DCMiTI Framework has been approved by experts from different countries as a reasonable structured approach for supporting Digital Capability Maturity. It has been strongly approved regarding its reasonability for assessing institutional maturity. One of the DC experts said:

> "I thought the framework is **reasonable** and makes sense regarding the categories used for qualifying capabilities. "

The proposed DCMiTI Framework has also been approved regarding its applicability to supporting institutions implementing digital initiatives/ programmes. A Maturity Modelling expert said:

> "I think there is definitely a niche for this framework…."

The proposed framework has been strongly approved as a useful mechanism for supporting the implementation of digital education programmes.

"I think a framework like this will be very **useful**… you are doing potentially very valuable research for the community..."

- One of the Maturity Modelling experts

The consensus on the framework's validity provides sufficient confirmation that this research endeavour has yielded successful results.

8.4.5.2 Validation of wording for level descriptors

The expert participants' agreed on the level descriptors (words that best summarised each level of maturity level), and these will be adopted in the next version of the proposed DCMiTI Model.

Given that CMMI is established and accepted, one participant cautioned against the renaming of level descriptors and suggested upholding the standardised nomenclature associated with maturity frameworks. One participant believed the proposed framework to be a variant of the standard CMMI which supports process improvement by looking at specific process areas. However, the proposed DCMiTI exploits the principles of continuous improvement by using Capability Maturity levels as an approach to achieving digital maturity. The key difference is that it does not explicitly look at process areas but rather a combination of tools, equipment, processes, and stakeholder skills derived from my SLR. The elements of DC replace the process areas in a standard CMMI Framework, and these elements are one of the key contributions to knowledge in this thesis. The proposed framework demonstrates how the elements of DC could be exploited to achieve digital maturity. I have discussed this in detail in the previous chapters. The guidance is important to manage users' expectations and avoid undue confusion given the link between complexity and usefulness, which I discussed above.

8.4.5.3 Envisaged mode of use

After presenting my proposed framework to the expert participants with no guidance on the mode of use, I asked how they might envisage using such a framework in their respective institutions. This question was intended as both a confirmatory and investigatory exercise; to confirm clarity on how the framework would be used to support DCMiTI and to elicit any additional benefits their expert experience may shed light on.

I confirmed that participants understood how the tool could be used to support institutions in developing their digital maturity. A Maturity Modelling expert suggested that:

"… you would be using it as a diagnostic tool first… and the descriptors would tell you what the next steps is you could achieve at a certain point in time…and what activities you or the organisation need to take to get to the next level."

A DC Expert added that:

"I really see this as an audit tool… but also with a strategic direction as to where they need to go."

Participants supported the comprehensiveness of the model in capturing so many different aspects of the institution. They suggested the framework could be used as an audit tool that provides the added benefit of giving strategic guidance on steps to take to achieve digital maturity. Participants also said the model would help guide discussions around DCM.

8.4.5.4 Additional Comments

The further discussion shed light on expert experiences that may help improve the proposed framework. One TEI expert from the suggested the Levels, particularly Levels 4 and 5, are very similar and could be merged. Then create a new level 5 of maturity that is more profound because, in this day and age, no organisation collects data to keep in a repository; "I think that everybody is collecting the data and many organisations that are collecting the data are actually using them for something". - TEI expert

Another expert from a UK institution with experience working with partners from a range of different educational settings commented: "I have partners in Pakistan, Indonesia, Singapore, and Kenya. I fully agree that the realities of digital capabilities data analysis and data use are very different to our own in the UK… what my international partners do in their institutions is very different sometimes."

Given the proposed framework and levels were based on empirical data and only one expert disagreed with the levels, therefore, I consider this insufficient to warrant further action. It does, however, highlight those different countries or environments have different educational settings, norms, and standards, thus reinforcing the requirement to configure the framework to the national or regional context in which it will be used to enable successful implementation. This configuration process may need to involve consideration of socio-economic and systemic issues and in this way address some important factors that sit outside the domain/framework's scope.

There was a comment from a Model Expert about the complexity of the proposed framework. In surveying 'reasonableness' and 'applicability', it became apparent that there is overlap between the terms, or perhaps a dependency. The term 'Applicability' was perceived both as the applicability for

the proposed purpose and as applicability in terms of how easy it may be to apply or use, which further shows the link between applicability and usefulness.

One participant also noted the overlap between definitions of elements in the glossary; for example, wellbeing is dotted in various places around the framework and suggested filtering out unnecessary repetition. However, the said overlap is a characteristic of the floating elements of DCMiTI identified in previous studies. If the overlap is to be addressed, further investigation will be required to explore representing DCMiTI as a multi-dimension concept where the overlap can be represented without repetition.

Respondents had some concerns about how easy it would be to apply the proposed framework, mainly because it was perceived as complex; one participant said:

> "I think It is only somewhat **applicable** because it is overly complicated."
>
> TEI expert

Another participant suggested her opinion of a good framework is that it should be simple enough to be used. Otherwise, it may not be well accepted. Other experts suggested that simplifying the framework would make it more usable and improve its usefulness.

> "Simplifying the framework would definitely be for me useful in a sense because I would then be able to use it, but I do understand where you are coming from and where you are putting all those different sections together."
>
> Maturity Modelling expert

The proposed framework is wide-ranging, combining elements contributing to DCMiTI from theory and empirical investigations. While I agree that there is some overlap between the elements, I would argue that removing any elements/sub-elements at this stage may risk eliminating a crucial success factor of DCMiTI. Studies 3 and 4 identified the strong inter-relationships between elements, so until those relationships are further explored and then applied to the next version/iteration of the framework (which I discuss at length in the future work chapter of this thesis); then removing any elements or sub-elements at this stage risks losing potential critical success factors. I propose refining elements systematically and methodologically after the framework is tested in a real-world case study.

A participants mentioned that "one of the major criticisms of the CMMI is that is that it's not how the real-world works". An institution rarely satisfies all the processes in Level 1 before going to Level 2. In

reality, it is a pick and mix of various factors. Some factors depend on others (a general example: data cannot be analysed at Level 5 if the data is not being collected at Level 4). Therefore, the overall concept of being unable to improve without satisfying prerequisites is implicit in the hierarchy. However, within that hierarchy, a TEI may be very mature in one element while lacking in others, so being able to assess your current (as-is) capability is an essential step to determining the roadmap for improving DCMiTI.

In response to this, another expert participant proposed using the continuous representation of CMMI rather than the staged representation I used in the proposed Framework that was surveyed.

> This participant said: "…in the continuous representation the people get more freedom to pick and choose the areas they want to improve…. You can also check which domain has the strongest maturity and which domain needs more work."
>
> "…they should be able to check which areas they have already improved, and which areas need to be improved – and this can be done with the continuous representation."
>
> Maturity Modelling expert

These comments suggest that further research into investigating whether the use of continuous representation of the CMMI may be better suited to the proposed model, specifically with regards to making it more practical and usable by the intended audience - Nigerian TEIs. This finding will be further addressed in the future work section of this thesis.

8.4.5.5 Recommendations

The following recommendations emerged as an output of this study and were not previously considered in the framework development process. They will be further discussed in the future work section of this dissertation.

1. The framework should be scalable and flexible to suit an individual TEI's needs.
2. Consider the continuous representation this will provide the flexibility to select elements based on external environment circumstances and TEI needs.
3. Record evidence or documentation for satisfying criteria.

8.5 Summary of Chapter of Validating the Proposed Framework

This chapter reports on a study investigating the efficacy of the proposed DCMiTI Framework. Consequently, this chapter also Research Question 6 of this dissertation.

RQ6: Is the proposed solution a reasonable one to support the implementation of digital education?

The proposed DCMiTI Framework has received support from a panel of experts as a reasonable Framework for measuring an institution's level of Digital Capability and providing useful guidance toward developing institutional digital maturity. Experts have also given their support to the framework as an applicable structured approach to supporting TEI in Nigeria with implementing digital education programmes.

This study has demonstrated that assessing and guiding TEIs towards digital maturity is a useful process for which there is a niche in the TEI landscape in Nigeria. While I recognise the process of developing and testing the model requires further refinement due to the need for real-world application to ensure accuracy and repeatability. In its current state, it already offers benefits:

1. A structure that supports TEI who seek to develop digital capabilities.
2. Guidance on the path towards digital maturity.
3. TOOL: An assessment tool for TEI wishing to assess their capacity to deliver digital education.
4. Assessment report: a report on the current maturity level for each element and overall maturity of the institution. This report can be used:
    - By all levels of stakeholder as a means for discussing Digital maturity (conversational tool)
    - To support decision making
    - For guiding strategic planning and management

A fully prescriptive model will require additional refinement of the proposed framework through field testing to improve the quality of the assessment outcomes and general acceptability of the proposed framework.

Furthermore, this study confirmed that for the full benefits of the proposed framework to be realised, it will need to be evolved to enable the formal function of cross-institutional benchmarking. This phase requires a sound understanding of the current situation through a rigorous assessment before substantial and repeatable improvements can be made.

For these additional benefits to be realised, it is necessary to configure the framework to the environment in which it is used to enable successful implementation. If configuration highlights multiple areas of the framework that do not apply to the educational setting, then exploration of the staged representation of CMMI may be explored. Additional findings from this study have guided the direction of future work.

This chapter concludes the thesis argument and closes off all studies and model development. In the following chapter of this dissertation, I discuss the implications of these results along with the results collected in my other studies toward the overall thesis argument.

CONCLUDING CHAPTERS

9. CHAPTER NINE: DISCUSSION

In this chapter, I address all the Research questions set out at the start of this dissertation and discuss the implication of my study findings on the overall research effort.

9.1 Answer to RQ1: What elements contribute to Digital Capability Maturity?

The systematic review of literature presented in Chapter 3 indicated that between 2012 to 2017, no research papers investigated the concepts of digital capabilities and maturity together. Therefore, this research investigated the concept of Digital Capability Maturity (DCM), which was defined through analysis of existing literature as: "extent the to which an institution's culture, policies and infrastructure enable and support digital practices" and the extent to which such practises can be continuously monitored and sustained.

My review data indicated 498 elements contributing to DCM. However, a thematic analysis consolidated them into a classification of 10 elements, each comprising of several sub-elements. The proposed classification was identified from literature as a universal list of the composition of DCM, with positive support from the British Academy of Management Conference where attendees agreed that this universal classification could cater to multiple types of organisations (BAM Conference 2019). Thus, suggesting that any type of organisation may adopt this classification and tailor it to their specific organisational needs, meaning that some sub-elements may not be necessary or considered.

My review data further suggested that, individually, the elements identified have all been well documented and researched as indicated by the number of papers published in relation to each element Table 3-5 and Table 3-7. However, no academic literature was found to show consideration of all the elements from a holistic perspective, therefore suggesting that an examination of literature from this holistic angle was worthy of investigation. I thus proceeded to tailor this dissertation to investigating the proposed classification of DCMiTI in the context of TEIs.

The Joint Information Systems Committee (Jisc) were found to be leading in digital capabilities in UK Universities with the only one existing digital capabilities framework which considers multiple elements (Killen et al., 2017a). The Jisc framework (Jisc, 2014) presents six elements of Digital Capability in Higher education with limited scholarly research to support the framework. The Jisc framework provided significant knowledge that was relevant to this research and although it was not found in the automated search of my systematic review, it was still included in the analysis as one of the papers manually selected based on relevance and value. However, the absence of peer-reviewed academic research papers evidencing Jisc's work suggests, firstly that the body of knowledge

published by Jisc was not intended as an academic undertaking and secondly, there is limited credence to support the origin of the elements they used to measure capabilities. Therefore, providing further reason to support my investigation of the elements.

The proposed classification of DCM presents some elements/ sub-element which overlap with Jisc's framework and therefore, it can be said that the results from the systematic review provide academic support for some of the elements in the Jisc Digital Capabilities Framework.

A closer investigation of the classification of elements among TEI stakeholders in CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK, who were largely learners (83.5%) confirmed that the elements found in literature were the elements that contributed to DCM. The classification of DCM was substantiated the theoretical findings with empirical evidence and further supported the continuation of this research as a worthy undertaking.

A larger investigation of the classification of elements in a case study of Northwest Nigeria in CHAPTER SIX: INVESTIGATING DCMiTI IN A CASE STUDY OF NORTHWEST NIGERIA further substantiated the literature findings with empirical evidence confirming the classification of elements contributing to DCM. These results triangulated the classification and suggested that the knowledge on elements contributing to DCM was a sound base upon which a development structure could be built.

My investigation of the significance of Educational Technologists in CHAPTER FOUR: INVESTIGATING ROLES CONTRIBUTING TO DCMITI indicated that there has always been some ambiguity associated with technology enhanced learning roles. There are many categories of stakeholders that play a role in the development of DCMiTI, and the capabilities of learners, tutors and other stakeholders plays a significant part in the maturity of the TEI. This suggests that the role and description of responsibilities is more significant than the title, which may change over time. Therefore, stakeholder roles and responsibilities should be well defined in any digital learning environment.

The review indicated the frequency of occurrence of each element in literature, which only suggested the popularity of elements in academic research. I went on to investigate the order of significance of elements to determine any implication towards digital maturity by surveying the opinion of stakeholders in a UK University CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK and four TEIs in Northwest Nigeria CHAPTER SIX: INVESTIGATING DCMiTI IN A CASE STUDY OF NORTHWEST NIGERIA. However, the order of significance varied in the two studies, which I suggest may be due to the differences in external environmental factors as well as different organisational cultures and goals. Consequently, these results suggest that the universal classification is useful to any institution

implementing DCM, however the order of significance of elements will vary from institution to institution. As such my proposed classification must be configured to the environment in which it is being used.

9.2 Answer to Research Question 2: How do these elements affect the Digital Capability Maturity of Tertiary Institutions?

Firstly, the results of my systematic review suggested that elements in the classification of DCM all have a positive effect on organisational maturity, provided they are considered and addressed adequately, and the inverse effect otherwise.

The results from investigating Educational Technologists showed the existence of a role that bridges the gap between technology and pedagogy, which is crucial to the success of DCMiTI. Which suggested that in any digital structures the emphasis must be on the roles and responsibilities as the titles used in technology related roles evolve with the technology. This positive effect of elements identified in the classification on DCMiTI was substantiated by a survey in the UK in CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK, and further triangulated through a study in Northwest Nigeria in CHAPTER SIX: INVESTIGATING DCMiTI IN A CASE STUDY OF NORTHWEST NIGERIA. These results confirmed the literature findings on the positive effect of DCM, further indicating that the proposed classification of elements also has a positive effect on maturity of Tertiary Education Institutions (TEIs), consequently confirming the classification is applicable to DCM in general as well as DCMiTI. These findings suggest that the elements identified in the classification of DCMiTI are representative of the critical success factors for digital maturity. The study also showed the order of significance of elements based on data from the UK university and suggested that the ordering of elements must be configured to the environmental setting in which it is being used. Furthermore, these results suggest that further investigating the relationships between the elements would provide richer knowledge to support the assembly of a development structure.

My review went on to analyse the relationships between the elements and sub-elements in the classification of DCMiTI. My findings indicated a strong interrelationship between the elements which I described as a web because it is very difficult to find a paper which is about one element in isolation without making mention of another element/sub-element; this was apparent in the nature of the literature reviewed. I thus concluded the likeness of the relationship between elements of DCMiTI to that of an ecological system (Shengquan and Li, 2006). Ecological systemic change theory describes an environment where no two elements are mutually exclusive and any changes to one element require consideration of other elements to see overall change. This finding suggests that in considering the

development of DCMiTI, if elements are matured in isolation they may lead to frustration and no visible results in the development efforts. To increase the chances of seeing positive outcomes, elements should be matured in parallel. Therefore, any DCMiTI development structure must adopt this ecological systemic change theory. Furthermore, these findings suggested the need to further investigate the intricacies of the relationships between elements to fully represent them.

Therefore, I went on to further investigate DCMiTI (CHAPTER FIVE: EXPLORATORY STUDY OF DCMITI IN THE UK) to confirm whether my literature findings reflected the real-world scenario on the impact of DCMiTI. I surveyed TEI management to explore their opinions on elements contributing to DCMiTI and the relationships between them based on their lived experiences. I found my theoretical conclusions on the web of elements that contribute to theory were true to the real-world. My results indicated strong interdependencies between elements/ sub-elements, which I represented as bi-directional relationships (Table 5-9: bi-directional relationships between elements). I further represented a map of the interdependencies between elements which showed how strong the cross-sectional relationships were (Figure 5-6: Concept map of the interrelationships between elements/ sub-elements). As a results of these findings, I suggest that for any structure or improvement model to fully represent the concept DCM, these interdependencies and cross-sectional relationships must be captured.

Providing logical ordering of the classification would help towards assembling a robust structure. Therefore, I attempted to explore the possibility of the level of agreements for RQ2 being indicative of the level of significance. I suggest an order of elements and provide details of the analysis techniques used to derive the order. However, I resolved that given the intricate nature of these interdependencies, any generalisable ordering of elements would require its own research effort and given the limited duration of my PhD programme and considering my research is looking at a wide scope of elements, the time would not be sufficient to conduct a thorough investigation into all the relationships found. Thus, the relationships presented in this dissertation are contextual to the environments in which each study was conducted.

However, my results from this study indicate that incorporating the generalisable and operational relationships would make for a much more robust and sustainable DCM structure. Therefore, I suggest that the order of the significance of elements is an aspect worthy of further investigation and I discuss this in my future work.

From the results of the exploratory study in the UK, emerged the existence of data analytics and data visualisation as elements of DCM that had not be captured in the literature review. Given the novelty of this research in fusing the concepts of DC and maturity together, the emergence of data analytics indicated that maturity may be data-driven, and consequently DCMiTI would also be data-driven. Therefore, suggesting that any improvement structures must consider the role of data in driving maturity and improvement.

This dissertation focuses on supporting digital education initiatives in TEIs in Nigeria, therefore I surveyed a case study of a University, a Polytechnic, a Federal College of Education and a Monotechnic which were representative of TEIs in Northwest Nigeria. The purpose of this study was to contextualise DCMiTI to the TEI landscape in N-W Nigeria. This study indicating the following:
Observations in the external environments and qualitative results indicated that the economic conditions classified under External Environment plays a big part in the ineffective implementation of digital education programmes.

Another interesting and noteworthy result was TEIs presented a range of elements at high levels, such as tools and resources, while in the same institutions results indicated limitations of necessities of water supply and electricity. This results in indicative of elements not being matured in parallel, suggesting that perhaps TEIs are reaching for revolutionary innovations and failing to take the small evolutionary steps that would result in continuous improvement. Therefore, this suggests that that a development structure would be a well-suited solution to support TEIs in Nigeria to realise value for the technological investments and attain and sustain higher level of institutional maturity. Therefore, these findings provide support for the approach of using the affordances of a maturity modelling to solve the research problem.

9.3 Answer to Research Question 3: What is the status of research on Digital Capability Maturity in Tertiary Institutions?

My systematic review identified multiple research efforts towards the various elements that make up DC, as well as various solutions that have suggested to support successful eLearning, TEL and other terms that maybe used synonymously with DCM. Although the review concluded there was no research efforts that considered the concept of DCMiTI as it is proposed in this dissertation. Consequently, suggesting that the research on DCMiTI is novel.

Coming back to Jisc's digital capabilities framework, the model was initially designed as part of a literacies project and only later refined as an effort to underpin a range of activities to support digital learning and teaching. Jisc eloquently define digital capabilities as "the extent to which the culture and infrastructure of an institution enable and motivates digital practices"(Killen et al., 2017b), and although they make some mention of a continuous learning culture, there is not a clear emphasis on a maturity pathway. These results suggest that in current academic literature, there is lack of evidence to suggest the existence of a digital capabilities model for higher education which presents a maturity pathway. Therefore, the proposition of a Digital Capability Maturity Framework for Tertiary Education Institutions will make a valuable contribution to research.

Limited information is available on the affordances of Capability Maturity Frameworks on improving efficiency and quality in TEIs. Marshall's (2010) eMM focuses on developing e-Learning in higher education, however the indicators that are assessed do not appear exhaustive of the domain of this research, which is DCM. Thus, the success factors considered in the eMM do not adequately represent DCMiTI. Furthermore, there is no extensive documentation on how those indicators were selected.

9.4 Answer to Research Question 4: What is the status of Digital Capability Maturity in Tertiary Institutions in Nigeria?

The last section of my review narrowed down the research to DCMiTI in the Nigerian landscape. The country is divided into six geopolitical zones for easier allocation of resources, and my review findings indicated the absence of academic research efforts on DCM from the Northern axis of Nigeria, which prompted me to contribute to knowledge by surveying DCMiTI in this region. I surveyed the proposed classification among a cross-section of TEIs which were considered representative of the population in the northwest geopolitical zone. My findings triangulating the candidate elements contributing to DCMiTI confirming the classification was acceptable to the environmental and education setting in Northwest Nigeria.

No additional elements were found during this survey, however new sub-elements emerged from this study which were not captured in other studies. Furthermore, the qualitative narrative indicated the need for re-alignment of sub-elements which were represented in an updated classification of elements. These results allowed me to contextualise DCMiTI by adjusting the universal classification to the peculiarities of the Northwest Nigerian setting.

However, there was notable absence of wellbeing in this study, where interviews among management stakeholders made mention of 9 elements and failed to make mention of wellbeing. Given the

extensive background knowledge gained in the domain, I suggest this finding indicates the maturity in the case study population may not be at the level where wellbeing has started to be factored in or considered. Therefore, its limited appearance in this study does not suggest it is not an element or it doesn't affect DCMiTI in Nigeria, rather my interpretation is that it suggests low levels of maturity.
This was further confirmed by observations during the field work where I noted the combination of high-level resources such as projectors and smart boards in institutions where some necessities were absent, such as power and water supply. These observations indicate a combination of high maturity of some elements and low maturity of others, in this case for example, making effective use of digital resources would not be possible without electricity. In an Ideal situation, either power supply should be developed to a high level of maturity before investing in digital resources, or the two elements/sub-elements should be developed in parallel. Consequently, the results from this study provided further support and confirmation that a maturity framework would be well suited to the status of DCMiTI in Northwest Nigeria.

9.5 Answer to Research Question 5: What is the solution to addressing this gap?

My review in CHAPTER THREE: SYSTEMATIC LITERATURE REVIEW suggested the absence of a development structure for building DCMiTI. The need for such a structure was further supported by empirical studies in Nigeria (CHAPTER SIX: INVESTIGATING DCMiTI IN A CASE STUDY OF NORTHWEST NIGERIA). This dissertation proposes a structure by way of a domain-specific Framework to support the development of DCMiTI. The Framework is based on elements/ sub-elements that contribute to DCMiTI, which were surveyed, confirmed, and calibrated in the previous chapters of this dissertation. Therefore, the proposed Framework is configured to support TEI in Northwest Nigeria.

The proposed DCMiTI Framework provides a set of prioritised guidelines for developing maturity across the 10 elements of capabilities. I have also developed an artefact that enables TEIs to conduct a self-assessment and generate a DCMiTI Assessment report. The assessment outcomes can either be reported as specific capability areas (sub-elements), clustered into domain elements highlighting relative strengths and weaknesses; or clustered as the whole domain reporting on the TEIs readiness and/or ability to deliver digital education.

9.6 Answer to Research Question 6: Is the proposed solution a reasonable one to support the implementation of digital education?

To assess the extent to which the solution addresses the research problem, I assessed the validity of the framework's constructs and tested for convergence on agreements that the constructs represented the domain completely.

Firstly, the breadth and depth of the literature review may be used as a measure of content validity, which I covered in depth by conducting a broad and extensive systematic literature review to identify the constructs for the proposed solution. This provided some indication of coverage of the domain. The results from chapter 5 and chapter 6 confirmed good translation of the constructs had been achieved, and the limited emergence of new elements that were not captured in the classification of DCMiTI, confirmed content validity had also been achieved. Therefore, suggesting the domain was well represented in the classification of DCMiTI.

The framework was thus populated based on valid and complete constructs. I evaluated the proposed DCMiTI Framework using an expert panel to assess the reasonability, applicability, and usefulness of the framework, as well as its suitability as a solution to the absence of a DCMiTI development structure.

Eight domain experts were surveyed by sharing the proposed Framework and supporting documentation (Appendix Y: The Proposed DCMiTI Framework v1.1) for review before inviting them to an online workshop to discuss their opinions. The results of the expert panel workshop showed that all experts agreed the content of the framework was reasonable for its intended purpose; all experts agreed the framework was useful for supporting the development of DCMiTI; and all experts agreed that the framework was applicable to supporting the implementation of digital education in TEIs. These results suggested construct validity had been achieved because experts were able to understand and agree with the constructs of the framework. Furthermore, experts agreed that the domain had been well represented. Suggestions were made on points to consider fitting into the existing framework or note in the guidance on scalability, flexibility of requirements, and recording supporting evidence. These suggestions are listed in the future work section 10.6 Future Work.

In this chapter I have offered my interpretation of the findings from each study and how it guided the research work. In the next chapter, I conclude my overall research findings, reflect on the limitations to the work I have presented and suggest ideas for future work.

10. CHAPTER TEN: CONCLUSIONS

This chapter concludes my PhD research. In this chapter I summarise the overall methodology and present the overall research output. I then discuss how my research has contributed to knowledge in digital capabilities and maturity modelling. Lastly, I present the limitations of my work and propose future studies to further extend the research effort.

10.1 Summary of Overall Research

10.1.1 Conclusions from Systematic Review

This PhD focuses on empirically investigating the success factors of Digital Capability Maturity (DCM) and using them to propose a Framework that supports effective and efficient digital education planning, delivery, and management. Before embarking on this detailed investigation, I conducted a systematic review of existing literature to explore the status of research on DCM and confirmed that such an investigation was necessary. My review confirmed the direct positive relationship between DCM and the success of digital education in TEIs. My review results also indicated that a limited amount of research was available where the success factors of DCM were considered holistically as proposed in this dissertation, with even less research attention given to DCM in TEIs. Only one existing Capability Maturity Framework from Jisc was identified in the review, which was primarily not an academic undertaking and did not appear in any peer reviewed literature but was included in the review due to its relevance to the research domain. The review showed that the individual elements contributing to DCM had been investigated, mainly in relation to eLearning, which is a subset of digital education, however no holistic effort was found where DCM was investigated to support digital education. This confirmed that conducting an empirical investigation on the elements contributing to a TEIs digital maturity with the focus on supporting digital education was a valuable research effort. In addition, the review showed limited research effort on even the individual elements of capabilities had been conducted in Nigeria, with no research reported from the Northwest geopolitical zones of the country. Therefore, I selected TEIs in this region as my case study.

10.1.2 Conclusions from Investigating Roles contributing to DCMiTI

Furthermore, a key finding from the review suggested that the level of significance given to some stakeholders may be impeding the implementation of digital initiatives in TEIs. Therefore, I conducted a study to investigate the level of significance of Educational Technologists in the development of DCMiTI. This study confirmed that the existence of a role with the responsibility of bridging the gap between technology and pedagogy was crucial to the success of digital education. The results of this study also confirmed the ongoing misnomer around technology enhanced learning roles and

suggested that when assigning Technology Enhanced Learning (TEL) roles towards Digital Maturity Initiatives, the focus should be on ensuring all the responsibilities are fulfilled, with less significance given to the titles because they may vary and transform as technology continues to evolve. This finding informed the assembly of the structure for TEIs wishing to developed DCM and/ deliver efficient and effective digital education.

10.1.3 Conclusions from Investigating DCMiTI in a UK University

I then Investigated DCMiTI in a UK University to substantiate the theoretical findings of my review with empirical evidence and confirm that candidate elements contribute to DCMiTI and that they have a positive effect on the digital maturity of TEIs. Firstly, my findings supported the universal classification of elements contributing to DCM and further confirmed that all elements have a positive effect on maturity if they are developed. Secondly, the results also confirmed that the elements are inter-related and further showed the extent of the cross-sectional relationships. In addition, the results showed some sub-elements cutting across multiple elements, which suggested the existence of a multi-dimensional dynamic. Lastly the results presented the emergence of sub-elements data-analytics and data visualisation, which were not captured in the original classification. This finding suggests that DCM is data driven and by extension DCMiTI. Therefore, towards the development of a support structure for DCMiTI, the role of data in driving maturity must be given consideration.

10.1.4 Conclusions from Investigating DCMiTI in a case study of Northwest Nigeria

Subsequently, I conducted a larger study investigating DCMiTI in Northwest Nigeria to extend the knowledge base to the Nigerian educational setting, and tailor the proposed solution to this environment. My findings from this study also supported the universal classification of DCMiTI, however I then found a contradictory result where wellbeing did not appear as an element of DCM. However, I concluded this speaks of the status of DCMiTI in the case study as opposed to suggesting it may not be an element. The results from this case study confirmed the need to calibrate any proposed framework to the education setting in which it is being applied, because of nuances such as difference in words used and other environmental peculiarities which may not be captured or well-understood. Therefore, I used this data to calibrate the proposed classification of elements to cater toward the development of DCMiTI in Northwest Nigeria. On the status of DCMiTI in the case study, the data showed a range of maturity levels across the various elements, notably, the existence of high-level digital tools which require electricity to run, and the lack of power supply or backup power meaning the digital tools could not be utilised. This scenario is indicative of skipping steps in developing maturity and as such, these findings confirmed that a DCMiTI Framework would be well suited to support the status of DCMiTI in Northwest Nigeria.

10.1.5 Conclusions from Developing a Proposed Solution

Consequently, I utilised the approved constructs and knowledge base to assemble a DCMiTI Framework calibrated to support the development of Digital Capabilities in TEI in Northwest Nigeria. The proposed Framework allows institutions to self-assess their level of digital maturity, reporting their strengths and weaknesses regarding specific elements and clustered as a whole. On identifying their 'as-is' capability, the framework provides a roadmap with guidance to achieving higher levels of maturity. Ultimately, the assessment may be used to support recommendations on a TEI's ability to deliver digital education. In proposing the guidelines for each level of maturity, my major considerations were complexity and specificity. The framework was designed with some level of complexity, drilling down the assessment to each sub-element in order to gain a deeper insight in the relative strength and weakness of an institution. This design permits targeting of specific improvement areas, thus enabling more efficient resource allocation. I also reflected on providing enough detail to offer clear guidance without presuming specific technologies or pedagogies. This level of detail was important to ensure the guidelines provide a meaningful assessment and provide value over a long period of time. Considering the instrument assembly was a subjective effort, it was necessary to test the proposed assessment instrument for validity and reliability.

10.1.6 Conclusions from Testing the Proposed Artefact

Given the limited duration of a PhD, I concluded the research by assessing the perceived validity and reliability of the proposed DCMiTI Framework with an expert panel. The assessment confirmed its face validity by suggesting the translations of the constructs had been achieved. Experts confirmed that good coverage of the domain had also been achieved, although additional sub-elements were suggested, which may be considered for future iterations. Furthermore, there was a difference of opinion regarding complexity and experts suggested the model may been seen as complex, however agreed that in order to capture the domain completely, this level of complexity was necessary. Experts also confirmed the usefulness of the framework for supporting DCM and approved its sufficiency in capturing a TEIs as-is position regarding DCMiTI. Lastly, experts provided their support that the proposed DCMiTI Framework is a suitable solution to support efficient and effective digital education and the affordances are not limited to Northwest Nigeria, since the structure can be calibrated to suite any environment.

10.1.7 Overall Conclusion

In conclusion, there are 10 elements contributing to DCM and the same set of elements apply to DCMiTI, with slight variation in the sub-elements. My research suggests the level of DCMiTI is directly associated with the capacity to deliver digital education and there is a role for such a detailed and

holistic framework to support TEIs wishing to deliver efficient and effective digital education programmes. In a continuously evolving world, driven by technology, the ability to assess a TEI's level of DCM holds many advantages.

The breadth and depth of this research has been valuable in providing a universal set of success criteria for DCMiTI, which is applicable to a range of TEIs. The DCMiTI Framework presented in this dissertation has been tailored to support capabilities development in TEIs in Northwest Nigeria, however the framework can be calibrated to support specific organisational or environmental needs.

The proposed framework has been built on validated constructs and experts have provided their support for the positive outcomes which the successful implementation of such an instrument would yield. Consequently, the prospects its offers are worthy of further research attention. Deploying the proposed framework for use in a TEI would provide further verification on the extent of the framework general acceptance and possibilities for standardisation.

10.2 Contributions to Knowledge

I present contributions in three distinct sections: knowledge, theory, and practice. Each section highlights the specific ways in which this research enhances understanding, advances theoretical frameworks, and provides practical solutions.

10.2.1 Knowledge

This research makes substantial contributions to the advancement of knowledge in Digital Capabilities, DCM research efforts in Nigeria, framework development, as well research methodologies.

Digital Capabilities

The research presents a robust and evidence-based framework referred to Digital Capability Maturity in Tertiary Institutions (DCMiTI). This DCMiTI framework effectively captures the holistic nature of digital maturity and institutional maturity within Technical Education Institutions (TEIs).

In contrast to existing studies and frameworks in the field (summarized in Table 3-8), which lack empirical foundation and fail to provide a maturity pathway, this research takes a holistic approach by considering the various elements that influence digital maturity as a cohesive whole, instead of addressing them individually as isolated solutions. The holistic perspective presented in the research offers TEIs a comprehensive assessment of their capabilities and maturity trajectory at a specific point in time. This enables easier identification of areas requiring improvement, supports decision-making processes, and aids in resource allocation.

The solutions proposed in this dissertation are highly flexible and valuable. The first three studies generate novel knowledge on DCMiTI as a generic structure, while the subsequent studies apply this knowledge in practical ways by populating a framework with tailored guidance to support the educational context in North-West Nigeria).

DCM research efforts in Nigeria

This research contributes to knowledge on Digital Capabilities in Nigeria and further reports on the status of research between 2012-2017. Furthermore, this research contributes the knowledge from the Northwest axis of the country where there is currently limited accessible research available. Lastly, this research reports the status of DCMiTI in Northwest Nigeria.

This research represents the first attempt in addressing the concept of digital maturity specifically in relation to TEIs in Nigeria. The research offers an alternative solution to technology utilisation, resource allocation and overall institutional maturity. It is the first attempt of using maturity modelling as a mechanism for support the implementation of digital education initiatives in Nigeria. It marks the first comprehensive study focusing on digital maturity within this context, providing valuable insights and contributing to the existing knowledge gap in the field.

Framework Development

This research contributes to knowledge in maturity modelling by offering a variant of the conventional way in which researchers have adapted the CMMI to different domains. Many researchers have argued about the usefulness of adapting the CMMI to improve organisational process, with the key criticism being the prescriptive nature of the model.

The DCMiTI framework proposed in this dissertation offers a maturity model that assesses a range of elements of TEIs, not limited to processes. Therefore, the framework provides a roadmap to maturity without being specific about processes which may change over time. The framework offers a complex structure with clear direction but limited prescription because no technologies, pedagogies or processes are assumed. By highlighting areas of strengths and weakness, TEI are given the evidence to direct them to elements that require attention, and with this information, they can make specific decisions for themselves based technological, academic, and social trends at the time. This handles the criticism of CMMI by providing guidance without presumption.

Research Methodologies

In addition, the research contributes to knowledge by employing a transparent methodology specifically designed to facilitate the exploration and development of new insights in the field of DCMiTI Table 2-2.

10.2.2 Theory

The research introduces two innovative theories, showcased through the introduction of two distinct contributions: the Ideal Digital Learning Environment (IDLE) model Figure 3-11 and the concept of Digital Capability Maturity in Tertiary Institutions (DCMiTI). These pioneering concepts signify significant advancements in understanding and provide valuable theoretical support of future research in the field.

10.2.3 Practice

This research provides practical solutions that contribute to the application and implementation of practices in the field.

At its core, this research provides practical recommendations regarding the criteria for success that can be applied to evaluate the digital maturity of Technical Education Institutions (TEIs) in Nigeria. Additionally, it offers actionable steps that can be taken to facilitate the progression of TEIs from one stage to the next in their digital maturity journey.

Secondly, the research presents a prototype of The Proposed DCMiTI TOOL. This tool serves the purpose of demonstrating a comprehensive maturity assessment and facilitating reporting. Other researchers in the field can utilize this prototype as a foundation to build upon the findings presented in this dissertation. Moreover, TEIs in Northwest Nigeria can employ this prototype to translate the theoretical concepts into practical application.

Lastly, the research furnishes a meticulous protocol for each study. This protocol can be employed by other researchers as a valuable resource to replicate the study within a different population or to tailor the framework to an alternative educational setting.

10.3 Generalisability

Generalisability refers to the extent to which the proposed framework can be applied to different TEIs and furthermore, the extent to which the solution can be applied to domains beyond the TEI landscape for which it was developed.

In chapter Three, I offer a set of universal elements which formed the structure of the proposed framework; and theory suggest that the structure is widely applicable outside the TEI domain. The

proceeding chapters then proceed to add detail to the structure and calibrate it to the TEI landscape in Northwest Nigeria. However, in the design of the proposed DCMiTI framework, the broader applicability of the elements and sub-elements were considered and as such the underlying principles, concepts and methods used to develop the framework were based on sound theoretical and empirical evidence as reported in Chapter SEVEN as such the framework exhibits high generalisability as it can be effectively used in various TEI setting in different environments. Furthermore, the proposed reporting has been designed to produce meaningful insights and solutions that can be adopted in any TEI/ environment.

The extent to which calibrating the framework would yield consistent and reliable results is dependent on further real-world implementation, testing and validating across of range of TEIs in Northwest Nigeria; followed by re-calibration of the framework to multiple TEIs and environmental settings.

The guidance offered in the proposed framework is limited to TEI, however the structure of the framework is highly generalisable and can be re-engineered across multiple domains.

In summary, the structure upon which the proposed solution was built upon, offers the capacity for high generalisability beyond the domain for which it has been developed. The proposed DCMiTI Framework extends beyond the structure to offers guidance on how to further develop capabilities across the progressive level of maturity. The guidance offered in the proposed DCMiTI framework is limited to the TEI domain; although it offers flexibility and adaptability which offers the capacity for applicability across various institutions with the domains.

10.4 Reflexivity

In this section, I discuss how my own personal background, beliefs and experiences as the researcher, have shaped my perspectives and choices; and examine how my personal biases may have influenced data collection methods, analysis techniques and interpretation of results.

It is important note, these solutions proffered in this dissertation are subject to the researcher's personal biases, assumptions, values and positionality in the field; therefore, below I reflect on the research journey undertaken and critically assess the extent to which these factors may have influenced the research process and findings. I also consider the potential influence of personal, social, and cultural factors on the research process.

10.4.1 Self-awareness

Self-awareness involves reflecting on my personal background and experiences and how these may have influenced my perspectives as the primary researcher. Being British educated and with both learning and teaching experience in the UK Tertiary Education landscape; I am originally of Northern-Nigerian descent. I was already familiar with the culture and practices of the country, with over seven years of teaching in Nigerian TEIs. While this entire research effort was motivated by my personal experiences in academia, I recognised the familiarity as an avenue of unconscious bias which I was aware of from inception and able to mitigate through peer-review and reflection.

In **Chapter Two**, I briefly explain my philosophical beliefs of constructivism which emphasizes the active role of individuals, including the researcher, in constructing knowledge. Constructivist theories suggest the nature of knowledge is such that all knowledge is subject to the individual's interpretation of it; therefore, the choice of methods, analysis and interpretation of my findings are all subject to unconscious bias.

The SLR in Chapter Two is a good example of how my personal experiences influenced the analysis of results and resulted in an additional enquiry to clarify new knowledge. I noted the absence of Educational Technologists based on my anecdotal experiences which another researcher with a different background and experience may not have noted. As a result, I extended the investigation to include the study into the roles that impact the phenomena of enquiry as presented in Chapter Four. Both the findings from the SLR and the data presented in Chapter Four were disseminated at a conference for peer review by both academics and Educational Technologists to provide a sanity check on the trajectory of the research. **Error! Reference source not found.** presents additional c onsiderations of bias and mitigating actions taken to limit the impact of personal un-conscious bias on the research process.

I report further on the impact of personal biases and other limitation on the research findings in section 10.5.

10.4.2 Positionality

Researchers should consider their position and social identity in relation to the participants and the research context. Factors such as gender, race, class, and cultural background can influence power dynamics and interactions within the research setting.

Coming from the same cultural background as many of the research participants may have had a positive effect in helping respondents feel comfortable sharing their opinion on elements that impact

DCMiTI. There is also the flip side where respondents may have felt that coming from the same cultural background meant I could not offer a different solution although I suggest the former is the case because 5 participants asked me if I could explain the survey to them in their native language. Survey was conducted and administer in English alone for the purpose of consistency in understanding across participants, therefore I stuck the same words in English as explained in 6.3 Methods. There is a likelihood that race had the same influence as cultural background, and the same actions apply to mitigating it. Other possible factors such as social class, had no notable impact on the research process.

The power dynamic and interactions during focus groups and interviews were mainly influenced by my position as a researcher in the field and further impacted by the positions of the various respondents. This dynamic was managed by conducting a pilot study to ensure the researcher was able to hold a non-biased position during qualitative enquiry by adding no personal opinions and limiting discussions by continually referring to the line of enquiry.

10.4.3 Reflexive Journey

A manual reflective journal was kept recording thoughts at the end of each research day, reflections and lessons learnt from each pilot study conducted, and thoughts and emotions throughout the research process. In doing this, I was able to exercise caution against excessive exploration or delving too deeply into unrelated areas of the research driven my passion or opinion. The journal helped to ensured that all methods and analysis techniques were scientifically underpinned – this also ensued replicability.

10.4.4 Peer debriefing

Participating in weekly debriefings with three Supervisors provided continuous opportunities to gain external perspectives and question the researcher's assumptions. Such dialogues facilitate a critical examination of the researcher's own role and inherent biases continuously throughout the research process, thus proactively addressing and minimising the researchers' personal biases.

10.4.5 Impact of the COVID-19 Pandemic

This research was commenced in October 2017, and during data collection the final study in February 2019 the COVID-19 pandemic ensued, which had a significant impact on myself as the primary research as well as the research process. Below I list the ways I which the pandemic impacted this investigation:

1. **Data Collection was disrupted**: Despite the protocol initially projecting a three-month data collection period, the data collection came to an abrupt halt within two weeks due to the lockdown measures implemented. Anticipating the rumours of the pandemic in January, I took pre-emptive measures to mitigate the potential disruption to my activities. Consequently, I modified the data-collection protocol accordingly and opted to gather data in large groups. As a result of this mitigation, I was able to gather my entire sample. However, the process was expedited, and it limited the opportunity to engage participants from a broader range of departments across the TEIs. Since there was no observed correlation between the participant's subject area and the responses provided, any influence of this factor on the research would have been minimal.
2. **Remote working**: the pandemic necessitated a swift transition to remote work, which posed specific disadvantages, especially considering that the research lab's well-equipped workstation was optimized for processor-heavy software like SPSS and NVivo. Working from a personal computer at home resulted in a slower research pace and prolonged the duration of the analysis.
3. **Funding challenges:** Due to the prolonged timeline of the research, it exceeded the originally stipulated funding period for the project. Consequently, partial funding was obtained, and the remaining period was self-funded. Additionally, the economic impact of the pandemic imposed financial constraints, necessitating part-time work to support the remaining research process. This further extended the overall duration of the research.
4. **Well-being challenges:** The pandemic had negative effects on the mental health and well-being of many researchers, including myself. The presence of personal challenges, feelings of isolation, and the pervasive uncertainty all contributed to increased stress levels and burnout, which had an adverse impact on productivity and timelines.
5. **Networking and Dissemination of findings**: In addition to the decline in productivity and the limited ability to produce conference papers, the imposed travel restrictions and social distancing measures presented notable obstacles to collaboration and networking. Conferences and other networking events were abruptly halted before transitioning to virtual platforms, affecting the planned research dissemination, including the intended attendance at the ASCILITE Conference. Nevertheless, amid the pandemic, findings were shared at a virtual conference. Furthermore, the restrictions constrained the establishment of research networks, which had previously played a crucial role in fostering motivation and facilitating scholarly connections.

In summary, the COVID-19 pandemic resulted in an extended duration for the research project and tested my resilience by introducing unforeseen challenges. Nevertheless, it also provided

opportunities for personal growth and development that would not have emerged under normal circumstances.

10.4.6 Transparency

The reflections above offer the reader of this dissertation a more nuanced understanding of the research context and findings. By being transparent about my own background, positionality, and potential conflicts of interest in this research, readers were able to evaluate the potential influence of my perspectives on the findings.

10.5 Limitations

While I strived to minimise limitations throughout the research process, there are still some weaknesses which I acknowledge in the section below:

10.5.1 Researcher bias

The scope and depth of discussion in this dissertation are limited to my knowledge and experience as a researcher. In section 10.4.1, I discussed self-awareness followed by position in the context of this research; and share my thoughts on the possible bias that maybe have been introduced into the research process due to my background and preconceived notions of the research topic.

It was important to recognize and minimize researcher bias to ensure objectivity, validity, and reliability of the research findings. I adopted various strategies to mitigate bias, such as using rigorous and scientifically underpinned research methods, seeking diverse perspectives by engaging a range of stakeholder; receiving constant review from the supervision team and disseminating findings at conferences for peer-review; and lastly transparently reporting methods and results Table 10-1 summarises the potential areas of bias and measures taken to ensure they did not adversely affect the findings of the research effort. I further explore the biases of each study in section 10.5.3 Limitations of .

Table 10-1: Potential researcher bias a mitigating action

Type of Bias	**Potential Research Bias**	**Mitigation**
Confirmation bias	The tendency to interpret data that confirms personal pre-existing beliefs while unconsciously disregarding contradicting evidence.	- Using methodological and systematic analysis techniques. - Constant peer review by engaging in supervision. - Dissemination of findings at conference for peer-review.

Selection bias	The possibility of choosing participants or samples that align with desired outcomes which would lead to a biased representation of the study population.	- Variety of stakeholders engaged from different regions to ensure a spread of results and limit potential bias. - Triangulating the findings.
Reporting bias	Unconsciously reporting or emphasizing certain findings to support pre-conceived ideas while downplaying contradictory results.	- Constant peer review by engaging in supervision. - Dissemination of research findings for peer review.
Interpretation bias	Interpreting data in a way that supports preferred explanations and potentially overlooking alternative interpretations.	I used scientific analysis techniques for systematically analysing qualitative data. Then shared the analysis and findings at conference for peer review.
Experimental bias	Unintentional behaviour or cues during focus groups, interviews and handing out questionnaires which may influence participants responses leading to biased outcomes.	I piloted all experiments to test my own moderation skills and avoid introducing my personal biases into the study. I also used a focus group/ interview schedule with set questions and unbiased cues to guide conversations in the same way for all experiments.
Cultural. Value bias	Cultural, social or personal values that may influence the research design, data collection or interpretation, potentially leading to biased conclusions.	The use of scientific methods in each study, helped to avoid introducing personal biases into the research design. Actively engaging with the supervision team to receive guidance, feedback and support in identify personal biases throughout the research journey.

10.5.2 Limitations of Sampling Strategies

A sampling strategy was used to identify participants for Study 2, Study 3, Study 4 and Study 5. The purpose of artfully selecting study participants is because it is impractical to collect data from entire population of interest, thus the sample allowed me to select a representative sample to draw conclusions about the larger population. The sampling strategies varied from study to study, therefore table xx summaries each study, the sampling strategy adopted and the limitations of use.

Table 10-2: summary of limitations for sampling strategies used in each study

Study	**Sampling Technique**	**Analysis Techniques**
Study 1: SLR	Custom search string	Thematic analysis
Study 2: Investigating Roles contributing to DCMiTI	Purposive	Content analysis
Study 3: Exploratory study of DCMiTI in UK	Purposive/ Probability	Descriptive statistics/ content analysis
Study 4: Investigating DCMiTI in a case study of Northwest Nigeria	Purposive – Proportional and Probability	Descriptive statistics/ content analysis
Study 5: Validating the proposed DCMiTI Framework	Purposive	Descriptive statistics/ content analysis

Each of these sampling techniques comes with its own set of limitations that I acknowledge below:

Purposive sampling, although a useful sampling technique in research, is not without its limitations. One significant limitation is the potential for researcher bias in participant selection. Since the researcher has control over the selection process, there is a risk of consciously or unconsciously favouring certain participants who align with their preconceived notions or desired outcomes. This can introduce bias into the study and compromise the objectivity of the findings.

Another limitation of purposive sampling is the limited generalizability of findings to the larger population. Since the sample is deliberately selected based on specific criteria or characteristics of interest, the findings may not be applicable or representative of the broader population. This can restrict the generalizability of the research findings and limit the ability to draw broader conclusions or make inferences about the population.

Furthermore, purposive sampling can result in limited diversity and representativeness within the sample. By intentionally selecting participants who meet specific criteria, there is a risk of excluding individuals who do not fit those criteria. This can lead to a lack of diversity in the sample, potentially resulting in a narrow range of perspectives and limiting the richness of data collected.

Despite these limitations, purposive sampling can be valuable in certain research contexts where the focus is on specific subgroups or phenomena of interest such as this research where the focus was on DCMiTI, and the stakeholders has been identified through an extensive review of literature. It allowed for targeted recruitment and in-depth exploration of DCMiTI and the elements contributing to it. To mitigate the potential bias I conducted a series of studies, amongst a variety of stakeholder, using a variety of sampling techniques and triangulated the findings.

Probability sampling (also known as random sampling) also has its own limitations, there is a potential for sampling error, which occurs when the selected sample does not accurately represent the larger population. This can lead to biased or unrepresentative results, as the sample may not capture the full range of diversity and characteristics present in the population.

Another limitation of random sampling is the assumption that all members of the population have an equal chance of being selected. However, in practice, achieving true randomness can be challenging. Factors such as non-response, inaccessible individuals, or lack of complete population information can affect the randomness of the sample.

Study 3 in which I explored the opinion of stakeholders in a UK university was particularly subject to both sampling error because I failed to calculate the total population and select a representative

sample size. This was primarily since the study was initially designed as a pilot study which yielded results worth of further exploration; however, I note that there is limitation to the findings reported in Study 3/ Chapter Five. The study may yield more accurate results if replicated with a larger proportional sample.

Proportional sampling relies heavily on accurate and up-to-date information about the proportions of different subgroups within the population. If the available information is inaccurate or outdated, the resulting sample may not accurately reflect the desired proportions, leading to potential sampling biases.

Secondly, proportional sampling assumes that the proportions of subgroups in the sample should match the proportions in the population. However, this may not always be necessary or appropriate and this was a limitation for Study 4, where I attempted to survey the various stakeholder groups in Nigerian TEIs. Although due to limited participants of the stakeholder groups, the quantitative data only represented the opinion of learner. If this study were to be replicated, I would suggest exploring a different sampling approach that prioritizes certain subgroups or oversamples specific groups.

Lastly, proportional sampling has been known to face feasibility challenges in certain research settings. For example, when the target population is small or the subgroups of interest are rare or difficult to identify, it may be challenging to achieve proportional representation.

In summary, despite using a range of sampling techniques for various phases of the research, these limitations among other limitations would have affected each study in a different way.

10.5.3 Limitations of Studies

Each study included in this dissertation, had its own limitations:

10.5.3.1 Limitations of Systematic Literature Review

To uncover the body of knowledge on DCMiTI and assemble the initial constructs used to build the proposed framework, I conducted a systematic literature review. The review was limited to papers published in only once source due to the length of the automated search string used to conduct the study. The length of the search string was primarily because of the limited amount of research data available on the concept of DCM, I therefore included a range of synonymous terms to ensure full coverage. However, this means there may be papers published in other databases, that have not been captured or included in this research.

Particularly in the literature used to answer RQ4, where the status of DCMiTI in Nigeria was reported, the data suggests limited research on DC in Nigeria with significantly less data reported from the Northern axis of the country. However, there is a possibility that more research has been conducted than what my review uncovered and that papers are available on other databases, or possibly have not been shared in accessible online repositories.

In addition, the terms used were limited to the knowledge available at the time of the review and only report data published on DCMiTI between 2012-2017, with RQ4 being extended to 2023. Furthermore, the subjective nature of the review process and data extraction required an inter-rater reliability test which I had planned but could not conducted due to limited time and resources. I mitigated this by validating the review findings with multiple audiences to add credence to the results.

Finally, the breadth of the investigation meant only a limited amount of information was provided on individual elements and the focus was on capturing the elements that represent DCM as a whole. As a result, the information provided on individual elements may not be exhaustive.

10.5.3.2 Limitations of the Proposed DCMiTI Framework

The proposed DCMiTI framework is complex in comparison to existing frameworks which have generally been accepted in various domains. Complexity is arguably one of the most significant considerations in designing models/frameworks. However, in a complex domain such as a DCMiTI, it was a trade-off between complexity and completeness. The proposed framework presented in this dissertation is considered to have captured complete coverage of the domain, and for this reason it may be seen as complex.

10.5.3.3 Limitations of Validating the proposed DCMiTI Framework

While the proposed framework has undergone expert validation, its practical application within a TEI in Nigeria is yet to be realized, making it primarily theoretical in nature.

This section has acknowledged the limitations of the research work presented in this dissertation, in the next section, I propose areas of the research that maybe extended in future work.

10.6 Future Work

This section discusses the possible future work that may be conducted to extend this research.

10.6.1 Investigate each element in depth

This research has focused on broadly investigating the contributing factors to DCMiTI with empirical support that the correct set of elements are being investigated, and experts have agreed that successful implementation of the proposed DCMiTI framework would be beneficial to the Tertiary Education landscape. If time and resources were not a factor in this PhD, I would have investigated the key activities, processes, and resources in each element to provide more meaningful reporting and recommendations.

10.6.2 Investigate the relationships in depth

This research presents a set of relationships between elements. Future work may involve validating the individual relationships and effects in details, thus enabling more accurate prioritisation. If these relationships can be fully operationalised, then in the future, machine learning algorithms can be used to make informed suggestions on resource allocation.

10.6.3 A Multi-dimensional representation of DCMiTI

This research suggests that the concept of DCM extends beyond a two-dimensional concept, so an important piece of future work would be to attempt to build a multi-dimensional representation of the DCM/DCMiTI.

10.6.4 Deploying the Framework in a TEI for Independent Feedback

The proposed DCMiTI has been adjusted to suite the educational setting in Northwest Nigeria. The next step would be to deploy the proposed framework to TEIs in this region independent of the institutions involved in development and testing. Such an exercise would provide independent feedback on the usability and verify the extent of the model's generalisability.

My recommendation would be to first be deploy the framework in a single department, then extended to more departments with each interaction until eventually an assessment of the entire institution is compiled. The lessons learnt from this exercise must be well documented and used to improve the framework where necessary. This allows the framework and whole assessment process to be tested at scale, starting with smaller business units before expanding the whole TEI. The evaluation of each iteration will be more exhaustive, and the lessons learnt will be easier to identify.

The framework can then be deployed in other entities with the region to start inter-institution comparisons. Once the framework is standard for one region, the next step would be to re-calibrate the framework for other regions and following the same process to deploy and refine the framework to support other regions.

Generalizability can lead to general acceptance of the model by various entities within the domain, including government bodies. This often leads to wider acceptance and improves the likelihood and success of standardisation, although this process can only happen over time with rigorous and robust acceptance testing.

Furthermore, it is important to note that the full affordances of the proposed framework may only be seen over time, therefore at least 3 to 5 years period will be required to provide a full evaluation of the benefits of such a model.

10.6.5 Convert the Maturity Assessment into a Survey

This research provides a means by which TEIs can self-assess their levels of DCM by providing success criteria for the various levels of maturity. Once the framework has been deployed, additional iterations of testing may involve documenting questions that self-assessment teams are asking to arrive at a decision as to which criteria they satisfy. This list will grow as the framework is deployed to multiple entities and eventually an exhaustive list of questions may be compiled. This list of questions can be used to support maturity assessments for easier use and to ensure repeatability. Eventually the list may become standardised. Once the framework reaches the stage of intra- and inter-institutional comparison, rateability becomes crucial to ensure accurate and useful comparison are made.

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Appendix A: SLR References

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Appendix B: Protocol for Systematic Review

Protocol for a Systematic Literature Review into the Key Elements that contribute to Digital Capability Maturity in Tertiary Institutions

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(Version 1.1)

Preamble

Digital capability is crucial for tertiary institutions of learning to have the capability to develop their processes and procedures as technology continues to evolve. The proposed study looks at current literature in the field of capability maturity and aims to summarise the current status of this literature guided by a set of research questions. The outcome of this literature search is intended to inform the development of a digital capability maturity framework for tertiary institutions of learning.

1 Introduction

The proposed study aims to gather published works in the field of digital capability with specific regard to tertiary institutions by following the guidelines of a systematic literature review as outlined by (Kitchenham, 2004). The Literature review aims to summarise research studies in the field in a way that is fair, rigorous, and auditable.

The justification of this sub-study is to lay the groundwork for building a maturity framework for Tertiary Institutions. By underpinning the elements that constitute capability in this context, we can consider ways of improving each of these elements: hence building maturity. However, the concept of maturity is complex and will not be covered in this review.

The more immediate implication of this systematic literature review is to determine the key contributing elements in digital capability of tertiary institutions. Furthermore, to identify the role each element plays in the capability of the institution as a whole. These elements will then be weighted according to the evidence-based research. Although the elements may vary between publications, the frequency of recognition given to each element can be used as an indication of its significance.

The review will be guided by a set of strategically constructed research questions as explained in the next section.

2 Research Questions

2.1 Four Research Questions

To determine the key factors that contribute to digital capability in tertiary institutions, the following question have been proposed:

RQ1: What elements contribute to digital capability maturity?

RQ2: How do these elements affect the digital capability of tertiary institutions?

RQ3: What is the current status of research in digital capability maturity of tertiary institutions?

2.2 Method for constructing search strings

Strategy for constructing search terms:

a. Derive significant terms from the questions by identifying the population, intervention, and outcome.
b. Identify alternative spellings and synonyms for significant terms.
c. Check the keywords in any relevant papers we already have;[3]
d. When database allows, use the Boolean OR to incorporate alternative spellings and synonyms.
e. When database allows, use the Boolean AND to link the significant terms from population, intervention, and outcomes.

2.3 Search Terms

Using the PICO technique, details of Population, Intervention, Comparison and Outcomes of relevance, which was used to form the basis for construction of suitable search terms later in the protocol. No comparisons were identified for this study.

RQ1:

[What elements]	*OUTCOME*
[contribute to]	*INTERVENTION*
[digital capability maturity]	*POPULATION*

[3] Used the dictionary to find synonyms that did not distort the meaning of the research question.

RQ2*:*

[How do these elements affect] *OUTCOME*

[the digital capability] *INTERVENTION*

[of tertiary institutions] *POPULATION*

RQ3:

[What is the current status* of research] *OUTCOME*

[in digital capability] INTERVENTION

[of tertiary institutions] *POPULATION*

*Note that while 'current status' is an outcome it has not been considered as a keyword because it is an outcome derived by the researcher.

Search Strategy

3.1 Identifying Keywords, alternates, and synonyms

For clarity, terms for each research question are provided separately:

RQ1: Elements, contribute, digital capability, maturity

RQ2: Elements, affect, digital capability, tertiary institutions

RQ3: Current status, research, digital capability, tertiary institutions

KEYWORDS SUMMARY

	Keyword	**Alternate words**	**Synonyms**
1	Elements	Dimensions, attributes	Characteristics, constituents, components, factors, items, facets, aspects
2	Contribute	Affect	Add, furnish, aid, assist, benefit, help, impart, extend, offer, cause, change, influence, sway, impact, strike Give-rise-to, Chip-in, pitch-in, lead to
3	Digital Capability	Digital literacy, ICT Literacy	Electronic capability, electronic literacy, e-learning, digital skills
4	Maturity	Improvement	Growth, ability, capability, maturation, sophistication, development, matureness, readiness, ripeness
5	Tertiary Institution	Tertiary education, higher education, Polytechnic	Education, college, university, tertiary, institution,
7	'Research'	Study	Research effort, review, literature, search, analysis, exploration, examination, investigation, inquest, groundwork, body-of-knowledge, research-and-development, R-and-D

3.2 General Search Strings

Elements: (elements OR attributes OR characteristics OR constituents OR components OR factors OR
item OR facets OR aspects)
Contribute: (contribute OR affect OR furnish OR aid OR assist OR benefit OR help OR impart
OR extend OR cause OR influence OR sway OR impact OR strike OR “give-rise-to” OR
“chip-in” OR “pitch-in” OR “lead-to”)
Digital capability: (“digital capability maturity” OR “digital capability” OR “digital literacy” OR “ICT
literacy” OR “electronic capability” OR “electronic literacy” OR “e-learning capability” OR
“digital skills”)
Maturity: (“maturity” OR “improvement” OR “growth” OR “ability” OR “capability” OR
“sophistication” OR “development” OR “readiness” OR “ripeness”)
Tertiary Institution: (“tertiary institution” OR “tertiary education” OR “higher education” OR
“polytechnic” OR “education” OR “college” OR “university” OR “tertiary” OR “institution”)
Research: ("research" OR" research-effort" OR “review” OR “literature” OR “search” OR “study” OR
“analysis” OR “exploration” OR “examination” OR “investigation” OR “inquest” OR “groundwork” OR “body-of-knowledge” OR “research and development” OR “R-and-D”)

3.3 Resources to be searched

This systematic review will consider publications from a single databases source, SCOPUS. The initial plan was to use multiple sources to search for literature, and to do so the exact search string would need to duplicate in all included databases. Other sources that were considered, truncate the search string after 15 strings. Given the length the search string required for this literature search, Scopus was among the few databases that would take such a complex instruction. Furthermore, Scopus is the largest abstract citation database, indexing over 5,000 publishers across all research fields and thereby reasoning that it is sufficiently powerful resources to use for the purpose of this literature review (Elsevier, 2014).

Other sources: *

- Education and Information Technologies
- International Journal of Information and Communication Technology Education
- Journal of Computing in Higher Education
- ACM Transactions on Computing Education
- ASCILITE, Annual Conference of the Australian Society for Computers in Tertiary Education

*This is a primary list of other sources, the list will be verified and amended during validation using the Quasi-Gold standard technique as described in section 3.8.2 of this report.

3.4 Inclusion and Exclusion Criteria

The papers identified by both the manual and automated search will be subject to further analysis by applying the following inclusion/ exclusion criteria:

Table 3.4 Inclusion and Exclusion criteria

Inclusion Criteria	**Exclusion Criteria**
1. Papers published in the last five years (between October 2012 to October 2017)	1. Exclude papers that were not that initially written in the English language
2. Paper answers at least one or more of the research questions	2. Incomplete papers or abstracts of an unfinished paper
3. Focuses on the elements of the digital capability framework	3. In the form of books and overhead presentations
4. Defines the elements that contribute to digital capability	4. Opinion pieces or viewpoints
5. Relate to any capability maturity model used in an educational environment	

4 Search Process

4.1 General Search

The first part of the search will start by performing a general search across many different search engines to establish the availability of information in the research area. This includes examining grey literature as well as open access material to get a clear understanding of the common terms that are used in relation to the field. Through this search, venues that will used during the validation process may be identified. This manual search had no limitations on publication dates.

4.2 Automated Search

Based on the research questions, and the papers found during the manual search, search strings for the manual search were constructed.

4.2.1 Resource Dependent Search Strings

Search strings need to be coded to fit the syntax requirements and capability of each search engine. The following syntax is specific to Scopus:

RQ1:
(TITLE-ABS-KEY (*elements* OR *dimensions* OR *attributes* OR *characteristics* OR *constituents* OR *factors* OR *items* OR *facets* OR *aspects*) AND TITLE-ABS-KEY (*contribute* OR *affect* OR *add* OR *furnish* OR *aid* OR *assist* OR *benefit* OR *help* OR *impart* OR *extend* OR *offer* OR *cause* OR *influence* OR *sway* OR *impact* OR *strike* OR *"give-rise-to"* OR *"chip-in"* OR *"pitch-in"* OR *"lead-to"*) AND TITLE-ABS-KEY (*"digital capability"* OR *"digital literacy"* OR *"ICT literacy"* OR *"electronic capability"* OR *"electronic literacy"* OR *"e-learning capability"* OR *"digital skills"*) AND TITLE-ABS-KEY (*"maturity"* OR *"improvement"* OR *"growth"* OR *"ability"* OR *"capability"* OR *"maturation"* OR *"sophistication"* OR *"development"* OR *"matureness"* OR *"readiness"* OR *"ripeness"*)) AND PUBYEAR > *2011*

RQ2:
(TITLE-ABS-KEY (*"leading"* OR *"pioneering"* OR *"state-of-the-art"* OR *"ranking first"* OR *"foremost"* OR *"number-one"* OR *"primary"* OR *"preeminent"*) AND TITLE-ABS-KEY (*"research effort"* OR *"research"* OR *"effort"* OR *"attempt"* OR *"endeavour"* OR *"study"* OR *"analysis"* OR *"exploration"* OR *"examination"* OR *"interrogation"* OR *"search"* OR *"seek"*) AND TITLE-ABS-KEY (*"digital capability maturity"* OR *"digital capability"* OR *"digital literacy"* OR *"ICT literacy"* OR *"electronic capability"* OR *"electronic literacy"* OR *"e learning capability"* OR *"digital skills"*) AND TITLE-ABS-KEY (*"tertiary institution"* OR *"tertiary education"* OR *"higher education"* OR *"polytechnic"* OR *"education"* OR *"college"* OR *"university"* OR *"tertiary"* OR *"institution"*)) AND PUBYEAR > *2011*

RQ3:
(TITLE-ABS-KEY ("research" OR "study*" OR "research effort" OR "review" OR "literature" OR "search" OR "analysis" OR "exploration" OR "examination" OR 'investigation' OR 'inquest' OR 'groundwork' OR 'body-of-knowledge' OR 'research-and-development' OR 'r-and-d') AND TITLE-ABS-KEY ("digital capability" OR "digital capability maturity" OR "digital literacy" OR "ICT literacy" OR "electronic capability" OR "electronic literacy" OR "e-learning capability" OR "digital skills") AND TITLE-ABS-KEY ("tertiary institution" OR "tertiary education" OR "higher education" OR "polytechnic" OR "education" OR "college" OR "university" OR "tertiary" OR "institution")) AND PUBYEAR > 2011

4.3 Refinement

Once the papers have been identified using the search strings, they will undergo a two-phase refinement process. This process aims to eliminate papers which are not related to the research.

4.3.1 Phase One Refinement (Screening)

This phase of refinement aims to eliminate papers easily identified as unrelated to the subject area. Screening involves reading the title and abstract of each paper and deciding to mark it as ‘accept', ‘reject', or ‘not sure' according to the inclusion and exclusion criteria (Table 3.1). The ‘accept' and ‘not

sure' papers will be reviewed with research assisting in the study to arrive at a final set of paper to be included in the peer review process, while rejected papers will be excluded.

4.3.2 Phase Two Refinement (Eligibility)

In the second phase of refinement, papers will be shared with two or three other researchers. This phase of the refinement aims to exclude papers from the remaining set which do not answer the research questions. Unlike the first phase of refinement, in this second phase, researchers read the whole research paper in detail. The result set of this process will leave us with the final set of papers that adequately addresses the research questions and conform to our inclusion criteria.

4.4 Validation

As a final step to validate the results of the papers found techniques will be used to give credence to the outcome.

4.4.1 Reliability Test

Reliability test will be performed to test the reliability of the primary reviewer's judgements. This process involves other researchers also performing the eligibility phase of refinement. Then a statically analysis will be performed to test the reliability of the judgements made, adding credence to the results and verifying that the results are truly the elements of digital capability, and they were not just identified by chance.

4.4.2 QGS

Applying the QGS at the beginning of the search process assumes previous knowledge of the topic area (Zhang et al., 2011), which is not the case. For this reason, the GQS will be used as a validation technique at which point, I have already identified the appropriate venues from the general search.

4.4.3 Expert Panel

An expert panel will be used to validate the results of the literature review as described by (Beecham et al., 2005). This process involves getting independent feedback from experts in the field of digital capabilities, to tell us how well the results answer the research questions.

4.5 Results and reporting

On completion of the analysis, the results from the study will be used to identify current informed opinion as to the key contributing elements to digital capabilities. Recommendations will be made on

the effects of these element in tertiary institution, followed by a summary on the current status of research in the area.

The results of this study will inform doctoral research on proposing a framework for development of digital capability maturity in tertiary institutions of learning.

5 Future Work

A snowballing approach may be undertaken to add credence to the methodology. In addition to the manual and automated searches, all references in the refined results will be checked, including papers citing these papers to identify further relevant studies, if any. This will be dependent on progress made towards the plan for the study and any time constraints.

6 Making changes to the protocol

There may be a need to apply changes to this document as the study progresses and in the event of applying these procedures in a different situation. While some of these changes will be useful to improve the current process as documented, other changes will be necessary to suite to context of the situation in which the protocol is being applied. All changes will be recorded, and the protocol will be updated accordingly using version control.

7 References

1. Beecham, S., Hall, T., Britton, C., Cottee, M., & Rainer, A. (2005). Using an expert panel to validate a requirements process improvement model. *Journal of Systems and Software, 76*(3), 251-275. doi:https://doi.org/10.1016/j.jss.2004.06.004

2. Elsevier, S., *Scopus content coverage guide*. 2014, Updated August 2017, Page 3.

3. Kitchenham, B. (2004). Procedures for Performing Systematic Reviews. *Keele University and National ICT Australia Ltd*, 1-28.

4. Zhang, H., Babar, M. A., & Tell, P. (2011). Identifying relevant studies in software engineering. *Information and Software Technology, 53*(6), 625-637. doi:https://10.1016/j.infsof.2010.12.010

Appendix C: Search Strings

Initial Search Strings

RQ1:

((*elements* OR *dimensions* OR *attributes* OR *characteristics* OR *constituents* OR *factors* OR *items* OR *facets* OR *aspects*) AND (*contribute* OR *affect* OR *add* OR *furnish* OR *aid* OR *assist* OR *benefit* OR *help* OR *impart* OR *extend* OR *offer* OR *cause* OR *change* OR *influence* OR *sway* OR *impact* OR *strike* OR *"give-rise-to"* OR *"chip-in"* OR *"lead-to"*) AND (*"digital capability"* OR *"digital literacy"* OR *"electronic capability"* OR *"electronic literacy"* OR *"ICT literacy"* OR *"eLearning"* OR *"e-Learning"*) AND ("maturity" OR "improvement" OR "growth" OR "ability" OR "capability" OR "maturation" OR "sophistication" OR "development" OR "matureness" OR "readiness" OR "ripeness"))

RQ2 and RQ3:

((*elements* OR *dimensions* OR *attributes* OR *characteristics* OR *constituents* OR *factors* OR *items* OR *facets* OR *aspects*) AND (*contribute* OR *affect* OR *add* OR *furnish* OR *aid* OR *assist* OR *benefit* OR *help* OR *impart* OR *extend* OR *offer* OR *cause* OR *change* OR *influence* OR *sway* OR *impact* OR *strike* OR *"give-rise-to"* OR *"chip-in"* OR *"lead-to"*) AND (*"digital capability"* OR *"digital literacy"* OR *"electronic capability"* OR *"electronic literacy"* OR *"ICT literacy"* OR *"eLearning"* OR *"e-Learning"*) AND ("tertiary institution" OR "tertiary education" OR "higher education" OR "polytechnic" OR "education" OR "college" OR "university" OR "tertiary" OR "institution"))

Original Search string for RQ3 (Not used due to limited time and vast results set):

((research OR research effort OR review OR literature OR search OR study OR analysis OR exploration OR examination OR investigation OR inquest OR groundwork OR "body-of-knowledge" OR "research-and-development" OR "R-and-D") AND (*"digital capability"* OR *"digital literacy"* OR *"electronic capability"* OR *"electronic literacy"* OR *"ICT literacy"* OR *"eLearning"* OR *"e-Learning"*) AND ("tertiary institution" OR "tertiary education" OR "higher education" OR "polytechnic" OR "education" OR "college" OR "university" OR "tertiary" OR "institution"))

RQ4: (string last run March-2018)

(TITLE-ABS-KEY ("research effort" OR "research" OR "review" OR "literature" OR "search" OR "study*" OR "analysis" OR "exploration" OR "examination" OR 'investigation' OR 'inquest' OR 'groundwork' OR 'body-of-knowledge' OR 'research-and-development' OR 'r-and-d') AND TITLE-ABS-KEY ("digital capability" OR "digital capability maturity" OR "digital literacy" OR "ICT literacy" OR "electronic capability" OR "electronic literacy" OR "e-learning capability" OR "digital skills") AND TITLE-ABS-KEY ("tertiary institution" OR "tertiary education" OR "higher education" OR "polytechnic" OR "education" OR "college" OR "university" OR "tertiary" OR "institution") AND TITLE-ABS-KEY (nigeria)) AND PUBYEAR > 2011 AND PUBYEAR < 2019

RQ4 Updated: (string last run Septmeber-2023)

(TITLE-ABS-KEY ("research effort" OR "research" OR "review" OR "literature" OR "search" OR "study*" OR "analysis" OR "exploration" OR "examination" OR 'investigation' OR 'inquest' OR 'groundwork' OR 'body-of-knowledge' OR 'research-and-development' OR 'r-and-d') AND TITLE-ABS-KEY ("digital capability" OR "digital capability maturity" OR "digital literacy" OR "ICT literacy" OR "electronic capability" OR "electronic literacy" OR "e-learning capability" OR "digital skills") AND TITLE-ABS-KEY ("tertiary institution" OR "tertiary education" OR "higher

education" OR "polytechnic" OR "education" OR "college" OR "university" OR "tertiary" OR "institution") AND TITLE-ABS-KEY (nigeria)) AND PUBYEAR > 2011 AND PUBYEAR < 2024

Extended search strings

Extended String for RQ1

(TITLE-ABS-KEY (*"digital capability"* OR *"digital capability maturity"* OR *"digital literacy"* OR *"eLearning"* OR *"e Learning"* OR *"ICT literacy"* OR *"electronic capability"* OR *"electronic literacy"* OR *"elearning capability"* OR *"digital skills"*) AND TITLE-ABS-KEY (*elements* OR *dimensions* OR *attributes* OR *characteristics* OR *constituents* OR *factors* OR *items* OR *facets* OR *aspects*) AND TITLE-ABS-KEY (*contribute* OR *affect* OR *add* OR *furnish* OR *aid* OR *assist* OR *benefit* OR *help* OR *impart* OR *extend* OR *offer* OR *cause* OR *change* OR *influence* OR *sway* OR *impact* OR *"give-rise-to"* OR *"chip-in"* OR *"pitch-in"* OR *"lead-to"*) AND NOT TITLE-ABS-KEY (*sem* OR *"semantic web technologies"*) AND NOT TITLE-ABS-KEY (*moodle*) AND NOT TITLE-ABS-KEY (*tam* OR *"technology acceptance"* OR *"behavior"* OR *"behavioral"* OR *"intention"* OR *"intentions"*) AND NOT TITLE-ABS-KEY (*"machine learning"*) AND NOT TITLE-ABS-KEY (*mooc* OR *"massive online open course"*) AND NOT TITLE-ABS-KEY (*fuzzy* OR *logic* OR *"fuzzy logic"* OR *"fuzzy inference"*) AND NOT TITLE-ABS-KEY (*"learning style"* OR *"learning styles"*) AND NOT TITLE-ABS-KEY (*"electronic emulator"*) AND NOT TITLE-ABS-KEY (*fluid* OR *mechanics* OR *"fluid mechanics"*) AND NOT TITLE-ABS-KEY (*readiness* OR *"elearning readiness"* OR *"e-learning readiness"*) AND NOT TITLE-ABS-KEY (*gamification* OR *gaming* OR *game* OR *games* OR *"digital games"* OR *"game-based learning"* OR *"game-based"*) AND NOT TITLE-ABS-KEY (*"mobile technology"* OR *"mobile learning"* OR *"M Learning"* OR *"M-learning"*) AND NOT TITLE-ABS-KEY (*distance* OR *"distance learning"* OR *"distance learners"*) AND NOT TITLE-ABS-KEY (*"data mining"* OR *mining*) AND NOT TITLE-ABS-KEY (*"student perspectives"* OR *perspectives*) AND NOT TITLE-ABS-KEY (*"student motivation"*) AND NOT TITLE-ABS-KEY (*gender*) AND NOT TITLE-ABS-KEY (*circuits* OR *analogue*) AND NOT TITLE-ABS-KEY (*language* OR *linguistics*) AND NOT TITLE-ABS-KEY (*paediatric* OR *paediatric* OR *gastroenterology* OR *hepatology* OR *nutrition*) AND NOT TITLE-ABS-KEY (*"Open source software"* OR *"open source"*) AND NOT TITLE-ABS-KEY (*nursing* OR *"nursing skills"*) AND NOT TITLE-ABS-KEY (*"online course"*) AND NOT TITLE-ABS-KEY (*imaging*) AND NOT TITLE-ABS-KEY (*"virtual reality"* OR *"virtual institutions"*) AND NOT TITLE-ABS-KEY (*"renewable energy"* OR *energy*) AND NOT TITLE-ABS-KEY (*probabilities* OR *algorithm* OR *mathematics* OR *algorithms*) AND NOT TITLE-ABS-KEY (*electrical* OR *"electrical engineering"*) AND NOT TITLE-ABS-KEY (*"web 2.0"*) AND NOT TITLE-ABS-KEY (*"cultural psychology"* OR *"culture"* OR *"psychology"*) AND NOT TITLE-ABS-KEY (*"cardiopulmonary resuscitation"*) AND NOT TITLE-ABS-KEY (*aircraft* OR *"aircraft maintenance"*) AND NOT TITLE-ABS-KEY (*"teacher* experiences"* OR *"student* experiences"* OR *"perceptions"* OR *"student perceptions"*) AND NOT TITLE-ABS-KEY (*"virtual learning"*) AND NOT TITLE-ABS-KEY (*power* OR *"power systems"*) AND NOT TITLE-ABS-KEY (*"student engagement"*) AND NOT TITLE-ABS-KEY (*politics* OR *"political"* OR *"political engagement"*) AND NOT TITLE-ABS-KEY (*relational* AND *database*) AND NOT TITLE-ABS-KEY (*"extreme learning machine"* OR *"ELM"*) AND NOT TITLE-ABS-KEY (*ANN* OR *"artificial neural network"*) AND NOT TITLE-ABS-KEY (*"learning algorithms"*) AND NOT TITLE-ABS-KEY (*"regression analysis"*) AND NOT TITLE-ABS-KEY (*"M-learning"* OR *"augmented reality"*) AND NOT TITLE-ABS-KEY (*"medical education"*) AND NOT TITLE-ABS-KEY (*microelectronics*) AND NOT TITLE-ABS-KEY (*transportation*) AND NOT TITLE-ABS-KEY (*ontology*) AND NOT TITLE-ABS-KEY (*psychological* OR *psychology*) AND NOT TITLE-ABS-KEY (*"simulation training"*)) AND PUBYEAR > *2011* AND PUBYEAR < *2018*

Extended search string for RQ2 and RQ3

(TITLE-ABS-KEY (*"digital capability"* OR *"digital capability maturity"* OR *"digital literacy"* OR *"eLearning"* OR *"e Learning"* OR *"ICT literacy"* OR *"electronic capability"* OR *"electronic literacy"* OR *"elearning capability"* OR *"digital skills"*) AND TITLE-ABS-

KEY (*elements* OR *dimensions* OR *attributes* OR *characteristics* OR *constituents* OR *factors* OR *items* OR *facets* OR *aspects*) AND TITLE-ABS-KEY (*contribute* OR *affect* OR *add* OR *furnish* OR *aid* OR *assist* OR *benefit* OR *help* OR *impart* OR *extend* OR *offer* OR *cause* OR *change* OR *influence* OR *sway* OR *impact* OR *"give-rise-to"* OR *"chip-in"* OR *"pitch-in"* OR *"lead-to"*) AND TITLE-ABS-KEY (*"tertiary institution"* OR *"tertiary education"* OR *"higher education"* OR *"polytechnic"* OR *"education"* OR *"college"* OR *"university"* OR *"tertiary"* OR *"institution"*) AND NOT TITLE-ABS-KEY (*sem* OR *"semantic web technologies"*) AND NOT TITLE-ABS-KEY (*moodle*) AND NOT TITLE-ABS-KEY (*tam* OR *"technology acceptance"* OR *"behavior"* OR *"behavioral"* OR *"intention"* OR *"intentions"*) AND NOT TITLE-ABS-KEY (*machine* AND *learning*) AND NOT TITLE-ABS-KEY (*mooc* OR *"massive online open course"*) AND NOT TITLE-ABS-KEY (*fuzzy* OR *logic* OR *"fuzzy logic"* OR *"fuzzy inference"*) AND NOT TITLE-ABS-KEY (*"learning style"* OR *"learning styles"*) AND NOT TITLE-ABS-KEY (*"electronic emulator"*) AND NOT TITLE-ABS-KEY (*fluid* OR *mechanics* OR *"fluid mechanics"*) AND NOT TITLE-ABS-KEY (*readiness* OR *"elearning readiness"* OR *"e-learning readiness"*) AND NOT TITLE-ABS-KEY (*gamification* OR *gaming* OR *game* OR *games* OR *"digital games"* OR *"game-based learning"* OR *"game-based"*) AND NOT TITLE-ABS-KEY (*"mobile technology"* OR *"mobile learning"* OR *"M Learning"* OR *"M-learning"*) AND NOT TITLE-ABS-KEY (*distance* OR *"distance learning"* OR *"distance learners"*) AND NOT TITLE-ABS-KEY (*"data mining"* OR *mining*) AND NOT TITLE-ABS-KEY (*"student perspectives"* OR *perspectives*) AND NOT TITLE-ABS-KEY (*"student motivation"*) AND NOT TITLE-ABS-KEY (*gender*) AND NOT TITLE-ABS-KEY (*circuits* OR *analog*) AND NOT TITLE-ABS-KEY (*language* OR *linguistics*) AND NOT TITLE-ABS-KEY (*paediatric* OR *pediatric* OR *gastroenterology* OR *hepatology* OR *nutrition*) AND NOT TITLE-ABS-KEY (*"Open source software"* OR *"open source"*) AND NOT TITLE-ABS-KEY (*nursing* OR *"nursing skills"*) AND NOT TITLE-ABS-KEY (*online* AND *course*) AND NOT TITLE-ABS-KEY (*imaging*) AND NOT TITLE-ABS-KEY (*"virtual reality"* OR *"virtual institutions"* OR *"virtual learning"*) AND NOT TITLE-ABS-KEY (*"renewable energy"* OR *energy*) AND NOT TITLE-ABS-KEY (*probabilities* OR *algorithm* OR *mathematics* OR *algorithms*) AND NOT TITLE-ABS-KEY (*electrical* OR *"electrical engineering"*) AND NOT TITLE-ABS-KEY (*"web 2.0"*) AND NOT TITLE-ABS-KEY (*"cultural psychology"* OR *"culture"* OR *"psychology"*) AND NOT TITLE-ABS-KEY (*"cardiopulmonary resuscitation"*) AND NOT TITLE-ABS-KEY (*aircraft* OR *"aircraft maintenance"*) AND NOT TITLE-ABS-KEY (*power* OR *"power systems"*) AND NOT TITLE-ABS-KEY (*politics* OR *"political"* OR *"political engagement"*) AND NOT TITLE-ABS-KEY (*relational* OR *database* OR *"relational database"*) AND NOT TITLE-ABS-KEY (*elm* OR *"extreme learning machine"*) AND NOT TITLE-ABS-KEY (*ANN* OR *"artificial neural network"*) AND NOT TITLE-ABS-KEY (*"learning algorithms"*) AND NOT TITLE-ABS-KEY (*"regression analysis"*) AND NOT TITLE-ABS-KEY (*"augmented reality"*) AND NOT TITLE-ABS-KEY (*"microelectronics"*) AND NOT TITLE-ABS-KEY (*"transportation"*) AND NOT TITLE-ABS-KEY (*"ontology"*) AND NOT TITLE-ABS-KEY (*psychology* OR *psychological*) AND NOT TITLE-ABS-KEY (*"simulation training"*) AND NOT TITLE-ABS-KEY (*medical* AND *education*)) AND PUBYEAR > *2011*

Extended search string for RQ3

(TITLE-ABS-KEY ("limitations" *OR* "gaps" *OR* "drawbacks" *OR* "shortcomings" *OR* "restraints" *OR* "disadvantages" *OR* "restrictions" *OR* "reservations" *OR* "obstructions" *OR* "confines" *OR* "limits" *OR* "extent" *OR* "boundary" *OR* "boundaries" *OR* "cap" *) AND TITLE-ABS-KEY (* "current search" *OR* "research" *OR* "current" *OR* "ongoing" *OR* "present" *OR* "prevailing" *OR* "existent" *OR* "prevalent" *OR* "state-of-the-art" *OR* "up-to-date" *OR* "leading-edge" *) AND TITLE-ABS-KEY (* "digital capability" *OR* "digital capability maturity" *OR* "digital literacy" *OR* "ICT literacy" *OR* "electronic capability" *OR* "electronic literacy" *OR* "elearning capability" *OR* "digital skills" *)) AND PUBYEAR >* 2011 *AND PUBYEAR <* 2018

Appendix D: Screening documents

RQ1 Screening
RQ2 and RQ3 Screening & analysis v0.12
RQ4 Screening and analysis 0.3
RQ4 Updated Screening and analysis

Appendix E: Data Extraction

RQ1 Data Extraction 0.7

Appendix F: Data Synthesis and Consolidation

RQ1 Consolidated

Appendix G: Harmonised data

External Factors	External factors Minstry	Factors that are external to the digital environment cannot be overlooked. The environment may not have a direct impact on them but these factors do play a role in how the environment operates. These includes geogrphic location, socio econmic issues, social and cultural norms, socialization, and diversity and cultural of the external environment. Acknowledgement of the role of the Ministry of eduaction in maintaing eduactional policies and guidelines while assuming a leadership role.
Stakeholder	Stakeholder Learner Teacher	Stakeholders in a digital setting would include the learners, teachers, administartors, management of the institution and in some cases the ministry of eduaction and the government.
Personal skills	Skills Interpersonal skills	Personal skills are the ability of an individual (stakeholder). These skills include interpersonal skills, techinical and IT skills and competencies, as well as problem solving abilities, attitude towards learning and use of digital technology and self efficay. Socialization and readiness/ willingness of the stakeholders to imrpove their abilities also plays a major role. The indivduals level of eduaction, professiona and transition to digital, as well as demographics are factors that come into play here. Personal abilites can be enhanced with training and development.
Digital Identity & wellbeing	Wellbeing Support	Digital identity is part of the foundation of self actualisation, as association/ belonging to a community. Well-being is the ability to achieve personal goals and benefits while mainintaing a healthy work-life balance in a digital environment. This includes health and safety, relationship management, self-motivation and self-management. Avoiding excessive multi-tasking, fragmentation of daily time and overconsumption of new media which pose a threat to individuals well being and providing techniques to cope with digital overabudndace. An itegral part of this well being is a support framework, that involves managemnet support from the organisation, technical support in learning skills for new media, and family support are all part of mainintaing the balance. The assurance of security and privacy gives users comfort in adopting new technology.
Organisation	Organisation	The organisation can be seen as the learning environment, within which all the other elements operate. Considers the organisational structure, size, facilities. mission develepment frameworks, corporate strategy, leadership any inclsive organisational goals and practice guidlines that the organisation may have set out. Cultural and social values, ethical guidleness, accountability measure and how they play a part in the organisations environement. Division of labout, organisational rewards, recognition of skills, adoption of best practices and creating a teachinge excellence culture are all factors that are specific to the prganisation itself. manageability, sustainability and finances are all part of the organisation aswell.
Infrastructure	Infrastructure Connectivity Technology Usability	Infrastructure is the ability to support a digital environment with relevant network, technology, hardware, software and any others tools required to perfrom digital tasks efficiently. Connectivity is having access to the networks both locals and externals that support the digital infrastructure of the organisation. In using digital technology, usbaility plays a role because use rexperience in using technology has a direct impact on their willingness to continue using it.
Learning, training & development	Learning Pedagogy Training & development	Laerning and teaching practices and methodologies are key part of digital capabilities. It is only through learning and development that capabilities can be improved. Learning involves peadagocial methodologies, gamification, and use of social networks, assessment of learning outcomes, evaluation, reflections, reporting and learner feedback. competencies and confidence of both the learner and the teacher would have a direct impact on the learning experience.
Resources, tools & content	Resources Tools Content social networks	Resources tools and content include learning resources such as digital libaries and learning management systems. Digital content availablity and management and the use of social networks as a learning tool.
Digital creation & Innovation	Innovation Content	Digital creation and innovation is the ability to create new ideas, project and digital content. Digital content could include media production such as images, audio, video, applications, websites and more. This process would require an understand of innovation in the organisational context.
Collaboration	Communication Collaboration Social networks	Collaboration is an important process in a digital environment for both learning and knowledge management. Collaboration involves working as park of a team to achieve set goals. Collaborative working, collaborative learning, collaborative teaching, collaborative tools. The drivers of collaboration are participation, cooperation and this can only be facilitated through a good communication and connectivity to the digital.

Appendix H: Table of elements and supporting literature

	Theme	Consolidated elements	No. of elements	Total weighting	No. of papers	Serial Numbers of papers
1	**External Factors**	External factors	26	54	32	M2, M4, M18, M23, M24, M29, M30, M34, M40, M42, SN30, SN31, SN65, SN126, SN132, SN169, SN226, SN304, SN344, SN428, SN432, SN450, SN467, SN571, SN590, SN628, SN635, SN643, SN648, SN687, SN695, SN704
		Ministry	11	24	21	M4, M6, M34, M41, M42, SN8, SN33, SN55, SN65, SN83, SN150, SN171, SN438, SN445, SN448, SN451, SN552, SN599, SN635, SN687, SN736
2	**Stakeholder**	Stakeholder	1	13	13	M18, M21, M22, M42, SN50, SN140, SN158, SN159, SN344, SN436, SN505, SN552, SN619
		Learner	3	55	53	M14, M21, M22, M28, M30, M32, M34, M38, SN10, SN12, SN44, SN50, SN61, SN65, SN83, SN126, SN128, SN150, SN157, SN158, SN226, SN235, SN285, SN287, SN296, SN304, SN319, SN340, SN383, SN411, SN428, SN436, SN438, SN450, SN467, SN507, SN512, SN516, SN539, SN571, SN590, SN599, SN628, SN632, SN756, SN663, SN683, SN699, SN704, SN724, SN736, SN747, SN795
		Tutor	9	54	47	M4, M14, M16, M18, M21, M22, M28, M30, M34, M38, M41, M42, SN10, SN12, SN23, SN44, SN50, SN61, SN65, SN83, SN128, SN132, SN150, SN158, SN235, SN236, SN285, SN296, SN335, SN340, SN411, SN423, SN434, SN450, SN470, SN507, SN516, SN569, SN572, SN628, SN647, SN648, SN663, SN695, SN699, SN704, SN736
		Others	21	38	20	M1, M18, M21, M28, SN50, SN55, SN65, SN83, SN140, SN150, SN158, SN304, SN344, SN467, SN502, SN505, SN507, SN552, SN569, SN654
3	**Personal skills**	Personal skill set	45	114	63	M7, M18, M23, M24, M29, M38, M40, M41, M42, SN7, SN30, SN44, SN60, SN83, SN96, SN126, SN128, SN132, SN150, SN155, SN157, SN158, SN163, SN185, SN191, SN198, SN226, SN235, SN236, SN287, SN304, SN335, SN340, SN344, SN412, SN423, SN438, SN442, SN445, SN451, SN454, SN506, SN507, SN512, SN539, SN540, SN571, SN590, SN599, SN620, SN621, SN628, SN635, SN643, SN647, SN654, SN663, SN672, SN687, SN704, SN720, SN724, SN788
		Technical skills	18	39	28	M14, M21, M22, M23, M24, M38, M41, M42, SN8, SN28, SN44, SN51, SN158, SN159, SN304, SN412, SN441, SN506, SN507, SN570, SN571, SN590, SN628, SN654, SN683, SN713, SN720, SN724
4	**Digital Identity & wellbeing**	Wellbeing	12	26	19	M2, M21, M22, M40, SN31, SN33, SN54, SN61, SN126, SN140, SN185, SN226, SN319, SN335, SN434, SN454, SN512, SN570, SN5671
		Support	6	69	53	M1, M4, M6, M14, M21, M22, M24, M25, M28, M30, M38, M41, M42, SN23, SN33,

						SN126, SN132, SN150, SN155, SN158, SN159, SN171, SN185, SN191, SN198, SN226, SN241, SN285, SN335, SN344, SN423, SN445, SN451, SN454, SN506, SN512, SN540, SN552, SN570, SN571, SN572, SN619, SN620, SN621, SN628, SN635, SN647, SN657, SN672, SN702, SN713, SN720, SN788
5	**Organization**	Organization	84	188	76	M1, M2, M4, M5, M6, M8, M14, M16, M18, M21, M22, M23, M24, M25, M28, M29, M30, M31, M32, M34, M38, M40, M41, M42, SN1, SN8, SN10, SN33, SN60, SN65, SN83, SN126, SN140, SN150, SN155, SN157, SN158, SN171, SN185, SN198, SN241, SN287, SN304, SN340, SN344, SN412, SN438, SN442, SN445, SN448, SN451, SN470, SN512, SN516, SN539, SN540, SN570, SN571, SN599, SN604, SN619, SN620, SN621, SN628, SN635, SN643, SN647, SN648, SN654, SN657, SN672, SN687, SN720, SN724, SN747, SN788
6	**Infrastructure**	Infrastructure	13	32	25	M14, M18, M21, M22, M24, M29, M40, M41, SN10, SN65, SN126, SN155, SN158, SN159, SN171, SN191, SN198, SN304, SN344, SN451, SN467, SN502, SN695, SN788, SN795
		Connectivity	14	31	21	M2, M23, M24, M41, SN5, SN10, SN28, SN33, SN51, SN159, SN185, SN191, SN226, SN304, SN344, SN412, SN436, SN502, SN540, SN654, SN720
		Technology	45	131	70	M2, M4, M5, M14, M16, M18, M21, M22, M23, M24, M25, M29, M30, M31, M34, M38, M40, M41, M42, SN7, SN8, SN10, SN23, SN30, SN33, SN61, SN83, SN126, SN128, SN155, SN159, SN185, SN191, SN193, SN226, SN304, SN319, SN340, SN344, SN383, SN432, SN434, SN436, SN438, SN442, SN448, SN451, SN467, SN502, SN505, SN506, SN516, SN540, SN552, SN569, SN570, SN571,SN587, SN599, SN619, SN632, SN648, SN657, SN687, SN699, SN702, SN713, SN720, SN736, SN747
		Usability	7	14	11	SN10, SN423, SN434, SN436, SN438, SN450, SN540, SN570, SN571, SN619, SN795
7	**Learning, training & development**	Learning	50	158	79	M1, M2, M4, M6, M7, M14, M21, M22, M24, M28, M30, M31, M32, M34, M38, M40, M41, M42, SN10, SN23, SN44, SN55, SN61, SN96SN126, SN128, SN150, SN155, SN157, SN158, SN163, SN185, SN193, SN226, SN235, SN236, 287, SN304, SN319, SN335, SN412, SN423, SN434, SN441, SN442, SN445, SN448, SN50, SN454, SN463, SN470, SN506, SN507, SN512, SN516, SN539, SN563, SN569, SN571, SN572, SN587, SN590, SN599, SN604, SN620, SN628, SN632, SN635, SN643, SN648, SN654, SN672, SN683, SN695, SN704, SN724, SN747, SN788, SN795
		Pedagogy	11	41	26	SN1, SN23, SN126, SN132, SN150, SN157, SN185, SN193, SN335, SN423, SN450, SN451, SN516, SN563, SN599, SN620, SN628, SN635, SN643, SN687, SN702, SN736, SN747, SN795

		Training & development	21	114	81	M4, M14, M18, M21, M22, M23, M24, M28, M29, M30, M31, M34, M38, M41, M42, SN5, SN7, SN8, SN10, SN23, SN30, SN31, SN33, SN50, SN58, SN60, SN61, SN63, SN65, SN76, SN83, SN96, SN126, SN140, SN150, SN155, SN157, SN159, SN163, SN171, SN191, SN198, SN226, SN235, SN236, SN241, SN304, SN319, SN335, SN340, SN411, SN412, SN423, SN428, SN438, SN445, SN450, SN451, SN470, SN505, SN506, SN512, SN539, SN540, SN570, SN571, SN590, SN599, SN604SN620, SN621, SN635, SN654, SN663, SN672, SN704, SN713, SN724, SN736, SN788, SN795
8	**Resources, tools & content**	Resources & tools	34	114	70	M2, M4, M7, M8, M14, M18, M21, M22, M23, M24, M25, M28, M29, M30, M31, M38, M42, SN5, SN7, SN10, SN96, SN126, SN128, SN132, SN140, SN155, SN157, SN159, SN163, SN185, SN193, SN226, SN236, SN304, SN335, SN383, SN411, SN412, SN428, SN436, SN438, SN441, SN448, SN451, SN454, SN470, SN502, SN506, SN507, SN512, SN540, SN552, SN563, SN572, SN590, SN599, SN604SN620, SN621, SN628, SN635, SN657, SN663, SN672, SN687, SN695, SN702, SN747, SN788, SN795
		Content	13	39	33	M14, M18, M21, M22, M29, M30, SN10, SN44, SN128, SN171, SN185, SN226, SN235, SN236, SN296, SN304, SN335, SN344, SN383, SN424, SN438, SN441, SN506, SN570, SN619, SN620, SN621, SN628, SN695, SN704, SN720, SN788, SN795
		Online communities	25	77	48	M2, M14, M21, M22, M23, M24, M29, M30, M34, M38, M41, M42, SN1, SN10, SN23, SN30, SN51, SN63, SN76, SN83, SN126, SN140, SN157, SN169, SN185, SN226, SN235, SN296, SN304, SM319, SN335, SN454, SN502, SN507, SN572, SN587, SN620, SN628, SN632, SN647, SN654, SN657, SN672, SN695, SN699, SN713, SN738, SN795
9	**Digital creation & Innovation**	Innovation	6	27	24	M114, M21, M23, M34, M38, M42, SN55, SN169, SN185, SN241, SN296, SN428, SN432, SN441, SN445, SN450, SN506, SN570, SN604, SN628, SN654, SN663, SN704, SN713
		Contents	13	39	33	M14, M18, M21, M22, M29, M30, SN10, SN44, SN128, SN171, SN185, SN226, SN235, SN236, SN296, SN304, SN335, SN344, SN383, SN424, SN438, SN441, SN506, SN570, SN619, SN620, SN621, SN628, SN695, SN704, SN720, SN788, SN795
10	**Collaboration**	Communication	8	50	40	M14, M21, M22, M23, M24, M30, M34, M38, SN1, SN5, SN7, SN10, SN23, SN50, SN126, SN140, SN155, SN157, SN163, SN185, SN226, SN236, SN285, SN287, SN296, SN335, SN344, SN434, SN436, SN438, SN441, SN450, SN506, SN507, SN628, SN632, SN672, SN699, SN720, SN788
		Collaboration	9	59	47	M4, M5, M21, M24, M30, M31, M34, M38, SN5, SN10, SN23, SN28, SN50, SN58SN63, SN76, SN96, SN126, SN157, SN159, SN185, SN226, SN235, SN287,

						SN296, SN335, SN383, SN450, SN470, SN505, SN512, SN516, SN572, SN587, SN590, SN620, SN628, SN632, SN635, SN654, SN657, SN663, SN683, SN695, SN702, SN788, SN795
		Online communi-ties	25	77	48	M2, M14, M21, M22, M23, M24, M29, M30, M34, M38, M41, M42, SN1, SN10, SN23, SN30, SN51, SN63, SN76, SN83, SN126, SN140, SN157, SN169, SN185, SN226, SN235, SN296, SN304, SM319, SN335, SN454, SN502, SN507, SN572, SN587, SN620, SN628, SN632, SN647, SN654, SN657, SN672, SN695, SN699, SN713, SN738, SN795

Appendix I: Synthesis of RQ2 Data in a narrative

In this section we consolidate the body of knowledge built upon evidence from the systematic review process. Explaining the effects of DCMiTI as follows:

In reporting my interpretation of the concept of DCMiTI, I discuss the concept in two parts, first, the stakeholders, who may be seen as the actors in a digital environment, and the TEI itself, which may be seen as the Ideal Digital Learning Environment (IDLE) as shown in Figure 3-11 where learning occurs. An IDLE is the vision for modern TEIs.

1.1 Stakeholders

Stakeholders assuming their roles and responsibilities positively impacts DCMiTI. The level of these responsibilities is suggestive of a hierarchy of stakeholders. From a bottom-up approach, governments are required to assume their responsibilities for institutions to equally assume their own. Administrators must then take care of all administrative aspects of the institution, ensuring the infrastructure is in place for tutors to develop the necessary technical and pedagogical skills to facilitate the teaching process. It is at this point that learners can fully actualise their responsibility of taking active charge of their own learning.

Ideal levels of lower-level responsibilities facilitate the learner in a successful learning process. This hierarchy of stakeholders supports modern learning environments where the learner is the pinnacle of the learning and teaching process.

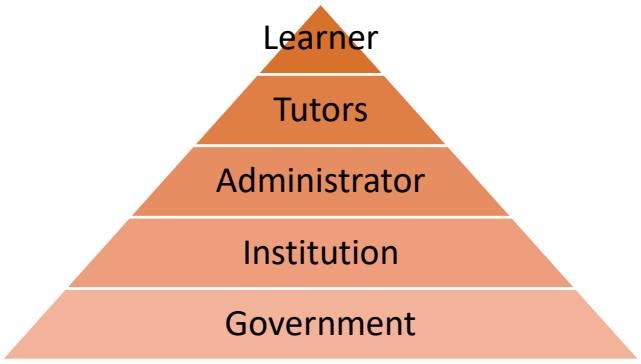


Figure: Hierarchy of responsibilities for a mature institution of learning

1.1.1 Government

A government that assumes the role of a stakeholder for Digital Capability programmes, impacts positively on that programme. In effect, when the government takes on such a role, it is able to introduce initiatives to drive the programme. It is also able to gain buy-in from other stakeholders because, as a custodian of tertiary education in countries, it will be viewed as sanctioning such a programme. The government can also deliver its education agenda through tacit support of such DC programmes.

Government or dedicated Ministries of Education (MoE) taking responsibility for effective communication between stakeholders, and in such a pursuit defining joint priorities between themselves. Ensuring that all stakeholders understand each other's needs, that is what they each must gain from a digitally capable and mature institution, as well as understanding the overall vision.

1.1.2 Learner

Learner's recognition that their compliance with government and institutional policies would be unequivocally assisting the progress towards achieving improved quality and standards in DC programmes, which would eventually prepare them for post-graduate success.

1.1.3 Tutor

Tutors' compliance would veritably shape their future careers and equip them with necessary skills for a career in industry, even outside their current job.

1.1.4 Administrator

Administrators as stakeholders are entitled to professional development opportunities and can also be considered as part-time learners in an institution. However, they also play a very vital role of

facilitation between other stakeholders. In this role, they may be considered responsible for administrative duties and documentation of both learners and tutors. Furthermore, they hold the responsibilities of administrative compliance of both governmental and institutional policies. Adherence to these responsibilities guarantees continuous compliance of documentation related to policies, processes, and procedures, thereby safeguarding a cooperative space for successful implementation of DCMiTI.

1.2 Tertiary Education Institution

Undoubtably, Institutions bare relatively greater responsibilities than other stakeholders as the awarding body of academic degrees. In assuming its charge of the responsibility of imparting knowledge on members of the community at large, it would be realising some of its own goals and objectives while supporting the external environments agenda. Multiple digitally capable and mature institutions in a country would surely improve the standard of education in that country, thus making a positive macro-economic contribution.

1.2.1 Well-being

A learning environment that considers the identity and overall wellbeing of its members by providing a safe, secure, and comfortable learning space would stimulate learner's involvement and encourage active participation in the learning process. In addition, a safety net in the form of technical support would provide extra comfort in knowing that if unable to progress, there is help available. It is very much a hierarchy of needs, if an institution takes care of its learners by realising their policies and providing basic needs, then the learners are able to take care of themselves and achieve self-actualisation. Actualisation of immediate learning objectives, and long-term community objectives - paving the road to maturity.

Furthermore, having a digital presence and belonging to a group, for example as a learner of an institution you may belong to a social network group for members of the institution. That sense of belonging again fulfils some basic human need and positively impacts the learner's sense of well-being, and by design improves their willingness to contribute to online collaborative discussion. Increasing the likely hood of co-creation of digital content and consequently improving collaboration and the quality of such content.

On the flipside learners who overindulge in digital technology are susceptible to negative effects which could result in lower productivity. However, institutions hold the ability to minimise these effects by

empowering them with knowledge of best practise, and further supporting that with institutional policies around safeguarding the wellbeing of members of the institution.

1.2.2 Active and frequent participation

Learners that are encouraged by the institution, to improve the frequency of their involvement, develop better participation skills, and an increased confidence and willingness to participate in collaborative learning opportunities. This imbibes a sense of empowerment that could manifest in a positive attitude towards getting involved and even taking ownership of their own learning.

1.2.3 Infrastructure

Institutions hold the responsibility of ensuring adequate and effective infrastructure, providing a fluid environment and minimising potential barriers to successful DCMiTI. Infrastructure is inclusive of hardware, software, and communication tools. Inadequate internet connectivity would result in poor usage, while fast and reliable access promotes knowledge sharing among peers and between learners and tutors.

An institutions management must be aware that their choice of digital tools and infrastructure would severely impact usage, in making these choices it is necessary to consider a vast range of issues from physical engineering, functionality, usability, personalisation, anonymity, the pedagogical situation and financial implication to reach an informed decision.

1.2.4 Resources, tools, and content

Capital investment is essential for the successful implementation of DCMiTI. For instance, choosing collaborative teaching tools that offer self and peer reflection functions would provide the institutions with the ability to assess and review learner feedback. This enables sustainable and continuous development of teaching by using feedback to improve teaching styles, techniques, and assessment methods.

An institution whose management team support the learning process by continuously assessing themselves and listening to learner and tutor feedback, can provide the tools and services that are required, and potentially optimise them. Through this process an institution can achieve higher levels of maturity.

1.2.5 Learning, training & development

It is evident that in a digital learning environment, tutors, administrators, and management all assume the role of learner, in addition to their other responsibilities. A DLE is required to continuously provide innovative and sustainable learning opportunities through training and professional development programmes, allowing learners to keep up with the skills required in today's dynamic economy. Communication, collaboration, and critical thinking within a supportive learning environment cultivates higher cognitive skills, consequently impacting positively on DCMiTI.

1.2.6 Collaboration

Collaboration is the most powerful tool in a mature institution. Influenced by individual learning styles and work ethics accumulated from the external environment. If the necessary collaborative tools are available to support collaborative learning and working, this encourages participation and allows for development of higher order thinking and cognitive skills. A DC institution would promote an open and collaborative environment with continuous evaluation and feedback loop, by that supporting professional development to ensure maturity and growth.

1.2.7 Personal skills

There is a lot of emphasis on the role of the tutor, and the transformation of responsibilities from traditional learning. In digital learning environments, tutors are no longer considered the holders of knowledge since learners have access to open education resources (OER) that provide vast amounts of information. A learner with cultivated information literacy skills has the ability to navigate the digital landscape, although having the skills is often not enough and they may not embrace those skills without the necessary support and motivation.

A tutor in an ideal DLE assumes the role of a facilitator in supporting learners to navigate the necessary content and cultivate the correct skills to assist their learning. Pedagogical skills development can be used by institutions as a method to improve learners' attrition and contributing to the teaching excellence culture.

Notwithstanding, there is a limit to how much control institutions have because learning is also influenced by cognitive, emotional, psychological, and behavioural factors that can vary for all individuals. Typically, this is developed through accumulated stock of cultural repertoire, external to the learning environment.

1.3 Summary

While assuming individual responsibilities, stakeholders are essentially supporting each other in actualising their individual goals, while realising a collective objective that may be seen from a global level as improving competitiveness of the external environment, by developing the society as a whole.

In this study it is evident that digital technology has transformed learning. The trend of DCM in 2017 studies can be narrowed to four key points: Firstly, the learning environment should be learner centric. A learner centric space with the correct development of skills provides a good learner experience. Secondly, institutions are required to place emphasis, and as much as possible to support and encourage learners to actively and frequently participate in collaborative activities, considered to improve the overall quality of the learning process. Thirdly, encouragement of collaborative learning and working to promote co-authoring and co creation that would result in better quality content. Finally, management's responsibility for making well informed decisions during acquisition of tools that support the learning process and provide a comfortable and fluid environment for collaborative learning. Albeit the study concludes that all the 10 themes do contribute to DCMiTI.

This paradigm shift in learning has resulted in a learning philosophy heavily grounded by constructivism, placing the learner at the centre of the learning environment while considering all stakeholders as learners at some point in time. Promoting an open learning environment that capitalises on cultural capital, and the potential of learning outside the learning environment while placing wellbeing at the core of its objectives.

Appendix J: Ethics Approval Notification for Study 2

University of Hertfordshire UH

HEALTH SCIENCE ENGINEERING & TECHNOLOGY ECDA

ETHICS APPROVAL NOTIFICATION

TO	Fatima Zarah Bello
CC	Nathan Baddoo
FROM	Dr Simon Trainis, Health, Science, Engineering & Technology ECDA Chair.
DATE	12/11/2018

Protocol number:	**COM/PGR/UH/03493**
Title of study:	Role of Educational Technologist in Implementation of Digital Capabilities in Tertiary Institutions.

Your application for ethics approval has been accepted and approved by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

This approval is valid:

From: 15/11/2018

To: 30/05/2019

Additional workers: **no additional workers named.**

Please note:

If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and your completed consent paperwork to this ECDA once your study is complete. You are also required to complete and submit an EC7 Protocol Monitoring Form if you are a member of staff. This form is available via the Ethics Approval StudyNet Site via the 'Application Forms' page http://www.studynet1.herts.ac.uk/ptl/common/ethics.nsf/Teaching+Documents?Openview&count=9999&restricttocategory=Application+Forms

Any necessary permissions for the use of premises/location and accessing participants for your study must be obtained in writing prior to any data collection commencing. Failure to obtain adequate permissions may be considered a breach of this protocol.

Approval applies specifically to the research study/methodology and timings as detailed in your Form EC1A. Should you amend any aspect of your research, or wish to apply for an extension to your study, you will need your supervisor's approval (if you are a student) and must complete and submit form EC2. In cases where the amendments to the original study are deemed to be substantial, a new Form EC1A may need to be completed prior to the study being undertaken.

Should adverse circumstances arise during this study such as physical reaction/harm, mental/emotional harm, intrusion of privacy or breach of confidentiality this must be reported to the approving Committee immediately. Failure to report adverse circumstance/s would be considered misconduct.

Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Students must include this Approval Notification with their submission.

Appendix K: Study 2 Protocol

Protocol for Qualitative Study, November 2018

Proposed title: The Role of the Educational Technologist in Implementation of Digital Capabilities in Higher Education Institutions

Proposed Conference Paper Title: Educational Technologist – The Misnomer

Protocol for a Qualitative Study on the role and impact of Educational Technologists in Implementation of Digital Capabilities in Higher Education Institutions

Introduction

An Educational Technologist (ET) is a specialist role that sits at the intersection of two fields: technology and education. The use of technology in higher education has now become the norm. Consequently, the need for highly qualified educational technologist in their roles has become vital.

The proposed study is an investigation into the impact of the role of the ET. In a study by Bello, (2018) on the elements contributing to Digital Capability Maturity in Tertiary Institutions (DCMiTI), a systematic review was undertaken on 140 papers, published in Scopus, between October 2012 and December 2017 (Bello, 2018). Scopus offers a broad and integrated coverage of peer-reviewed literature, from over 5,000 publishers across all research fields. It is the largest abstract citation database, indexing publishers from other databases including Elsevier, IEEE, Science Direct, SAGE, Taylor & Francis among others. Nevertheless, the existence of ETs in academic literature was not found. A number of stakeholders and roles were reported in the study as contributing to the effectiveness of DCMiTI. Lecturers, teachers, instructors, tutors, educators, facilitators, ICT enabled teachers, training organisers, managers and administrators were all featured. The assumption was that ET would feature in relation to research on Digital Capabilities (DC).

Anecdotal experiences in higher education settings, have informed us of the pertinent role of an ET in implementation of digital capabilities and facilitating the process of technology adoption and utilization in the learning environment. This knowledge guided the research work and justified the assumption that, if the level of significance given to ETs in practice, mirrors what research has uncovered, then this may be impeding the implementation of DCMiTI.

There are several possibilities for the reason why ET are not prominently featured in academic literature. This research aims to reveal the discrepancies between research, anecdotes, and current practice.

Background

The proposed study is concerned with a crucial but under emphasized role in higher education – the Education Technologist.

ETs are trained in the field of educational technology to analyse and evaluate situational processes related to teaching and learning. They are also responsible for the design, development, and implementation of solution optimisation. Essentially, ETs bridge the gap between students and content, through sound pedagogy and training tutors, to use the right tools for their job.

Job titles identified as synonymous to ETs are: Learning experience (LX) specialist, Instructional designer, instructional technologist, learning designer, learning technologist, among others. Furthermore, Lorenz et.al highlights the overlap with the job descriptions of ICT support specialists and ICT managers (Lorenz et. al., 2014).

The roles and responsibilities of educational technologists vary, from organisation to organisation. The job may differ from government to ecommerce, or education settings, amongst others. Furthermore, the role may alter along with specific organisational policies. In this study we examine the role of the ET specifically in higher education institutions.

Study Questions

This study aims to investigate the role and impact of ETs in implementation of Digital Capabilities in tertiary institutions (DCMiTI). The aim has been constructed in the form of research question(s):

Study Question 1: What is the role of the educational technologist?

Study Question 2: What Impact (if any), do ETs have on implementation of DCMiTI.

The study will use qualitative techniques to investigate whether the theoretical findings reflect the current state of practice. The objectives of the study are as follows:

To explore the key functions of the ET in practice.

To identify the impact the role of ET has on implementation of DCMiTI.

To explore how the implementation of DCMiTI is affected by the absence of an ET.

To explore possible reasons why this role may be absent in academic literature.

The findings will shed light on the discrepancy between theory and practice. Furthermore, it will bring attention to the significance of the role of ET. The results will also enable recommendations to be made about how best to employ this role, with reference to implementation of DCMiTI.

Methodology

The methods used to investigate the role of ET and its impact on implementation of DCMiTI will be data analysis, FGD, questionnaires and interviews among experts. The research is based on grounded theory methodology (Glaser and Strauss, 1960).

The study will be executed in phases, where the outcome of each phase will be used to inform the next phase.

Phase 1**:** FGD to understand the role of ET in a higher education setting. ETs at the University of Hertfordshire will be used (see details of FGD in section 4). The main themes that result from the transcription of this phase will be coded and used to construct questionnaires for phase 2.

Phase 2: Questionnaires will be produced based on the outcomes of the FGD to further clarify the ideas raised. These questionnaires will be distributed to educational technologists and possibly some tutors and students.

Phase 3: Interviews will be conducted with experts in the field, to verify the findings of the study and uncover any oversights.

The four stages of the study will provide information that can be used to answer the overarching research question(s).

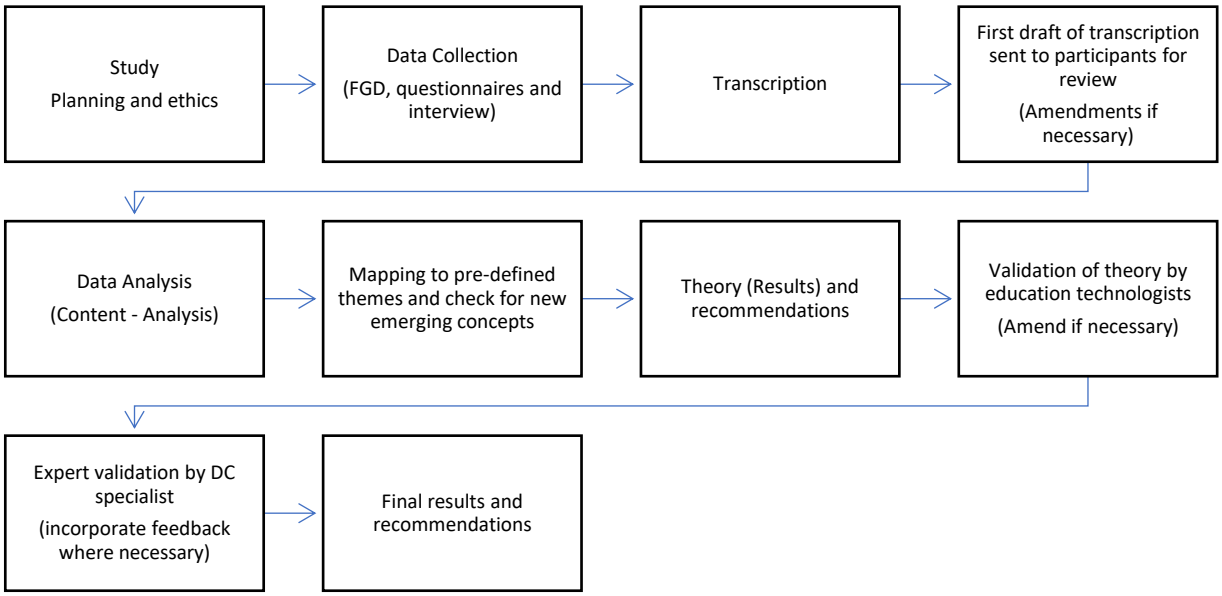


Figure 0-1: Process of crafting and refining the study

Phase 1: Focus Group Discussion

FGDs are a qualitative technique, typically used to understand an issue at a deeper level than you can assess through a survey or other means. FGD are used to add meaning and understanding to existing knowledge or getting the 'why' and 'how' of the research question.

The primary goal of this FGD is to answer the research question. RQ: What are the reasons for the absence of the role of the educational technologist in academic literature, and the impact the role has on implementation of DCMiTI.

In order to guide the study, the focus group will hold discussions around the following six questions:

Probe question

How would you describe the role of educational technologist?

Follow - up questions

How instrumental are Educational Technologists in the effectiveness of Digital Capabilities?

Are there any other roles in the institution which may be synonymous to that of the Educational Technologist?

Why might the role of educational technologist be under-represented/absent in published literature?

What effects may the absence of this role have on the implementation of Digital Capabilities in HEI?

Exit question

Is there anything else you would like to say about the role of Educational Technologist with regards to implementation of digital capabilities in higher education?

Length of FGD

The length of the FGD will be 60-90 minutes. However, the recorder will continue running until the participants leave the room. Typically, FGD that last longer than 90 minutes can become unproductive.

Sampling frame

ETs working in higher education institutions.

Selecting participants

Opportunity sampling will be used to recruit participants for the study.

The following list of personnel from the University of Hertfordshire have been identified as potential participants:

	Participant	Role
1	Zarah Bello	Moderator
2	Anonymous participant 1	Education technologist
3	Anonymous participant 1	Education technologist
4	Anonymous participant 1	Education technologist
5	Anonymous participant 1	Education technologist
6	Anonymous participant 1	Education technologist
7	Anonymous participant 1	Education technologist

Date

The Date of the focus group is yet to be confirmed (targeting November 2018).

Participants demographic data will be collected because gender, age and hierarchy are all factors that affect the quality of information gathered during an FGD.

Data Collection Tools

Data will be collected using a number of tools, namely forms, questionnaires, interviews (see appendix) from a sample of participants, along with contextual information.

Relevant data about extrinsic matters, source data, historical background, documented effects etc.

Contextual information can emerge from comprehensive literature review

Can also emerge through audience surveys, or interviews with the sources, looking at historical data.

Helps justify inferences made from the intrinsic data analysis.

Reflective journal/ field notes/ observations.

Pilot Study

Due to time limitations of the study, the FGD will not be piloted. However, the interview schedule will be piloted amongst a random sample of participants with some knowledge in the study area.

Ethics Approval

The nature of the data that will be collected requires ethical approval to be sought from the ethics committee of the University of Hertfordshire. The study will adhere to all the guidelines set out by the ethics committee.

Participants will be informed both verbally and in writing about the details of the study, and that participation is solely on a voluntary basis, and participants are free to withdraw from the study at any time. In addition, written consent to participate will be obtained from volunteers.

Raw data, transcripts and audio recordings will be stored securely in accordance with requirements of the ethics committee and in line with the GDPR (2018).

Proposed Data Analysis Technique

The study will employ a pragmatic data analysis technique, heavily based on content analysis.

6.1 Content Analysis

Content analysis will be used to interpret the data through a systematic evaluation of the audio recording. The analysis will compare different participant opinions. Further comparing the role of ETs

in literature to the 'real world' scenario. Observations will be recorded on what participants talk about the most, and how themes relate to each other.

Following the content analysis, we will be looking to see if the emerging themes fit in with the pre-identified themes [1]. Although, the results will also take note of those themes that fit outside of the existing theory.

6.2 Data Synthesis

The synthesis process will bring together all the findings reported from the data collection. The process aims to identify the following:

Answers to each of the six questions

Categorise the findings from the FGD

Identify the differences/similarities between the FGD categories and the themes for Digital capabilities

Following the synthesis of phase 1, the results will be used to inform the second phase of the study. Subsequently, the results of phase 2 will be used to further inform the questions in the expert interviews in phase 3.

Validation

Over the course of this study, numerous validation steps will occur to ensure reliability and credibility of the data collection and reporting processes.

The full duration of the FGD will be audio recorded. The recording will be transcribed verbatim by the moderator.

Circulate transcribed data amongst participants for review.

Consider evidence-based software engineering checklist for peer-review of a protocol.

Allow a digital capability expert to review and comment on the results of the study.

Circulate the results of the study to all participants for review and comments.

Limitations of the study

As with all data collection techniques, there are limitations and possible threats to the validity of the study. Identification of the potential problems that can arise in FGD can be mitigated through mere knowledge and awareness. Below is a list of some of the possible issues:

- Provide a safe open space, being mindful of comfort to promote interaction and group dynamic.
- Use open ended questions.
- Avoid leading questions - allow respondents to shape the discussion.

- Avoid power differentials.
- Avoid giving examples, to avoid leading participants.
- Running a pilot study of the FGD may not be possible for 2 main reasons:
- Limited number of education technologist available in the boundary area
- Time limitations of the project
- Furthermore, some disadvantages of using content analysis have been considered as listed below.
- Cannot determine the truth of an assertion.
- Difficult to evaluate the aesthetic qualities of messages.
- Establishing cause is tricky.
- Interpretations of meaning can be biased.
- Reliability may be compromised if trained coders are not used.

However, the benefits of using this method to support the theory outweighs the cost. Triangulation can also be easily applied to both quantitative and qualitative content analysis, and for these reasons, content analysis has been deemed the appropriate choice for this study.

Strengths of the study

Despite the limitations, the study has numerous strengths that if conducted successfully would make it a creditable contribution to knowledge:

Self-transcription limits transcription errors and reduced the chance of misunderstanding the context.

To counterbalance this limitation of not pilot the FGD, the interview schedule will be piloted amongst a purposive sample of participants with some background knowledge of the subject area to practice moderation skills and flow of the discussion to ensure the questions are acceptable and understandable to the target participants for the main study.

Avoiding power dynamics to ensure we get the most out of the discussion – careful selection of participants.

Multiple validation steps will be taken to add credence to the results – transcription review by participants/ review of results by participants/ expert review of overall results.

Using participants from the same institution - removes context specific extraneous variables.

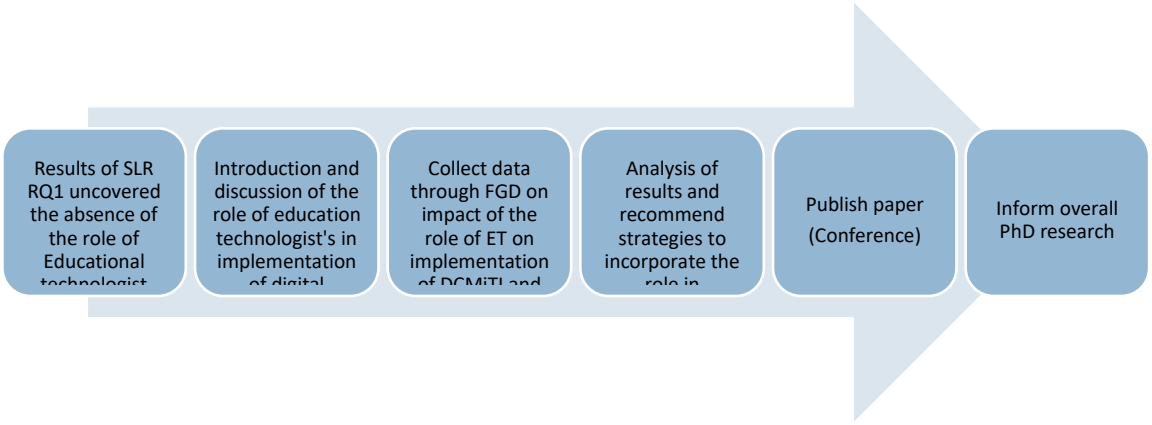
Use of multiple data collection tools

Reporting

On completion of the analysis, the results from the study will be used to suggest some of the reasons why this role of ET may be absent in academic literature. Recommendations will be made about how best to employ this role, with reference to implementation of DCMiTI, based on the results from this study.

The results of this study will further inform the overall doctoral research on proposing a framework for development of digital capability maturity in tertiary institutions of learning.

How does this study fit into my overall PhD plan?



Making changes to the protocol

There may be a need to apply changes to this document as the study progresses and in the event of applying these procedures in a different situation. While some of these changes will be useful to improve the current process as documented, other changes will be necessary to suite to context of the situation in which the protocol is being applied. All changes will be recorded, and the protocol will be updated accordingly using version control.

Dissemination plan

The results of this study will be published as a conference paper. The conference that has been targeted for this publication will be the Association for Learning Technology (ALT) conference (commonly referred to as ALTC). The conference usually takes place around September (2019) and is befitting for this study, because it is the UK's main conference for Learning Technologists.

This protocol will be included as part of the online appendix for this publication to provide the necessary transparency into the process and final report.

_____End of Protocol _____

References

- Baddoo, N. and T. Hall, De-motivators for software process improvement: an analysis of practitioners' views. Journal of Systems and Software, 2003. 66(1): p. 23-33.
- Bello, Z et.al. Protocol for uncovering the elements of digital capabilities. Pending publication, 2018.
- Berelson, B., Content analysis in communication research. 1952.
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- Lorenz et. al., 2014.

Draft of participant recruitment letter

To be sent the participants after they have agreed to participate in the study, and shortly before the day of the FGD (via email).

Dear [Name of participant]

Thank you for accepting our invitation to take part in the focus group discussion. We will be talking about the job roles and description of educational Technologists, and how they impact implementation of digital capabilities in a higher education setting. There is no right, or wrong answer and it does not matter how much you know about digital capabilities. We are interested in the views and opinions of all Ed. Techs working in higher education. The group will be held:

Date: TBC

Time: TBC

Location: TBC

It will be a small group of about six people. If for any reason you won't be able to join us, please do inform me as soon as possible. If you have any questions, please do not hesitate to contact me via the details under my signature below.

I look forward to meeting you.

Yours sincerely,

Zarah Bello

(Focus Group Moderator)

Mini Focus Group Session Schedule and Moderator guidelines

Moderator Guidelines for Conducting Mini Focus Group

October 2018

Moderator tips:

- Avoid giving examples.
- Avoid leading questions.
- Avoid asking why.
- Avoid using closed questions.
- Set ground rules from the beginning.
- Learn and use participant names throughout the session.
- Encourage equal participation – not allowing one person to dominate.

Introduction

Aims:

- Gather information to inform this study on the role of educational technologist.
- The greater the exchange of information and views, the better
- The value lies in your wide range of expertise and experiences.
- Not seeking 'right' answers (or 'wrong') - looking to capture the range of views so please speak freely.

If you consent, this interview will be recorded, although the recording will only be accessible by me. The reason why I would like to record, is so that I may accurately type up our conversation. After which, the audio will be deleted. Copies of the transcripts will be sent to you following the interview so that you can provide your feedback (if any).

*Collect EC3 and EC6 Forms from each participant at this point

If there's anything that you want to talk about off the record, please feel free to let me know and I can pause/stop the audio or will not transcribe this information. You are also free to stop the interview at any time; be it for a break or to end the interview process. You don't have to answer any questions that you don't want to.

Do you have any questions you want to ask me?

If you are happy to begin, I will turn the recorder on.

****RECORDER TO BE TURNED ON****

Thank you for agreeing to participate in this study. Before I tell you what the study is all about in a bit more detail, let's start by introducing ourselves and one by one in a clockwise direction starting from me.

My name is Zarah, and I am a postgraduate research student. Studying DCMiTI…

Moving to the right… who's next?

…..

That was great. Thank you so much for all agreeing to participate in this study. Before we start, I will give you a quick overview of what my research is about.

(5-minute PowerPoint presentation)

Next the discussion will be guided by a list of questions just to kick off the conversation.

We'll go round the table again in a clockwise direction, and I would like to hear from each of you, how you would describe:

1. ***How would you describe the role of educational technologist?***

……

For the next questions we don't need to go round the table, just feel free to answer freely, remember our rules.

Follow - up questions

2. ***How instrumental are Educational Technologists in the effectiveness of Digital Capabilities?***
3. ***Are there any other roles in the institution which may be synonymous to that of the Educational Technologist?***
4. ***Why might the role of educational technologist be underrepresented/ absent in published literature?***
5. ***What effect would the absence of this role have on the implementation of Digital Capabilities in HEI?***

Exit question

6. ***Is there anything else you would like to say about the role of an Educational Technologist with regard to implementation of digital capabilities?***

If the discussion comes to a natural end/ or we reach 90 minutes, then I will prompt a close.

END – RECORDER TO BE TURNED OFF

At the end of the discussion, the moderator will reiterate what will happen to the information you've shared (i.e., how it will be analysed, anonymised, and added to the PhD project as well as how it will appear in presentation/papers).

We will then agree what email address the participant would like transcripts to be sent to. Participants will be given an estimate of when to expect transcripts and reminded that they'll have 2 weeks upon receiving transcripts to suggest any changes.

Participants will also be reminded of their right to withdraw.

Appendix L: Reflections for the RoET Pilot Study

Date: Wednesday 5th December 2018

- Put mobile phone on flight mode and turn off Wi-Fi connection
- Book room for 3 hours. Arrive 30minutes before to prepare and leave time at the end to clear out instead of being kicked out (this gives a lag at the start and end of the session)
- Set up PowerPoint before they arrive and leave on Welcome screen
- Email participant information before hand
- Print and place consent forms on the table before they arrive (make sure they fill all details on consent form, not just signature)
- Get a better white boards eraser or carry some water to wet it
- Consider adding a slide to say I'm focusing on teaching and learning process in HE
- Are instructional designer the same as educational technologists?

Appendix M: Mini Focus Group Transcript

Date: February 2019
Time:
Location: University of Hertfordshire, Hutton Hub, Meeting Room C457
No. of Participants: 2 Educational Technologists + 1 Librarian + 1 Moderator

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P1: Institutional transformation
Moderator: Yeah
P2: It will be interesting to see what it is that typically people miss out of these elements…
Digressing a little
Moderator: I think one of the key things that I found was that Digital Identity and Well-being (DI&W) had the least weight in literature. I found a couple of papers quite interesting, that indicated… well they won me over, because the argument was that DI&W is not necessarily a standalone theme, but digital identity is an individual skill, and if you consider it as an individual skill that the stakeholders have. So when I say stakeholders, I mean that learners would need to possess that skill, the tutors would need to possess that skills and the organisational management would need to posses that skills, and if they are all informed on the effects and impacts of digital wellbeing and technology over abundance and all the issues that are related to using technology every day in the workplace. And the management are informed about it in terms of making management decisions, in terms the colours that they paint the walls, in terms of infrastructural choices then DI&W is not really an element its own but rather an ability of individuals to understand the impact that their choices are having on the learner's ability to learn.
Jane: But it's also very closely tied in with the service layers if you like, the infrastructure I guess and around the resources aspect because If you don't have good systems maintenance, good data management, good identity management at a technical authentication layer then that's where the problems around digital identity and theft of identity, and we know everyday there are stories about this.
And that fact, you know, there are some claims that actually we've all lost our identities anyway, that actually all of us have had our identities cloned because of all the different services that we subscribe to somewhere along the line, and somebody's ….
Moderator: Security and infrastructural issues.
So with that it kind of fits in, like you said, infrastructure fits into organisational practices even, and then into individual skills. So maybe doesn't really warrant being theme in itself but rather can kind of be split up into…
John: It makes more sense when were talking about individuals. Definitely!
Jane: Because there's your individual, your behaviour if you like, your own awareness of say how you manage your identity within particular social media channels, there's that aspect of it, and just good etic ate, good practice, and abiding by you know, just common sense a lot of the time, which a lot of people don't..
Moderator: Which isn't so common
Jane: then there is this, the whole cyber security aspect of it which I just mentioned about which I think is exercising many, the system themselves aren't supporting us as individuals to actually manage our own identity and the data of ourselves well.
Moderator: Is that a bit infrastructural in terms of if the system doesn't support it! But if the system did support it then it would be available and again if the management were aware of these things in terms of deciding which systems to deploy within the organisation, that would then kind of…
Jane: and it would develop trust and think there is a whole area around trust to do with DI&W which I think, we haven't solved yet.
Moderator: Yeah, it's quite important
John: Within the organisational side, I'm thinking of the knowledge of individuals. The individual could be a big weakness in an organisation's security. It only takes one person to click on a link in an email, but in terms of digital identity I get a sense of people having a personal brand and being able to control how they come across digitally and that impacts on how effective their comms are. But also you have skills like understanding the audience of what you're producing digitally, so I think that all in DI because you need to be able to be a person with almost human properties as your conveying yourself. Hence people not realising, a lot of staff don't realise how important a profile picture is, it's essentially an avatar isn't it.

Jack: I think the notion of identity is very important with regards to the education sector in particular because a lot of these Digital Capabilities that were looking at they kind of relate to an individuals professionalism whereas within education its also very important that we have a good model of digital capabilities there were modelling for students, its not just about the individuals you know, you have to be able to demonstrate to students that this is the kind of practice that will be expected in a professional context, so when you see kind of sloppy applications of things being done it kind of sends a message to the students that this is acceptable that you can get away with this in a professional context, but you cant.
Moderator: modelling good behaviour
John: like incomplete profile page
Jack: yeah little things like that, if you put together a whole bunch of little kind of sloppy thing it adds up to something significant sometimes. Yeah I think it's important to think about modelling best practice to students as well as individual professionals when were talking of digital capabilities within HE.
Moderator: thank you, that's a good point.
End of digression – continues with the PowerPoint presentation…
Presentation ends.
Jack: I think the job title firstly, 'educational technologist' I don't think it's very good job title to be honest, I think a lot of institution are realising that and the educational technologist are being rebranded to some extent, there is often quite a lot of, like you mentioned instructional designer, that certainly one job title that does incorporate a lot of the skills that an ET would require though there is obviously unique attributes as skills that go with that as well but I think as a job title its particularly descriptive. Quite often I think learning I kind of becoming targeted these kind of job descriptions are being rebranded.
John: I think the name 'educational technologist' is symptom of the technology being the other, in this sector. I have come from outside and hear phrases like flipped learning, oh you got this big idea where your going to provide some digital resources and you give it a fancy name, its not something to bells and whistles or to do a song a dance about, it should be just 'what you do'! Does that make sense? I pick up on weird vibe about how it is another
Jack: It does, and I think ideally, we want to get to a stage where the technology and the user experience of the technology is such that it actually doesn't really require that much support, its more intuitive. At that point we start talking about educational user experience design and this kind of stuff, which is more kind of design and resources that can kind of support themselves to an extent, it that makes sense. I agree that the kind of technology is getting to point where its not gonna need this continuous support because ideally tutors and teachers will kind of themselves know how to apply this stuff because it will be more intuitive. I do have reservations about I don't particularly like that job title to be honest 'educational technologist'
John: If we look at, oh well… Have we started the discussion of have we just…
Moderator: Well we've kind of, we've started the discussion, I kind of like it when things just flow in their own direction.
… completes the presentation…
Focus group starts:
John: So, your accepting that there is a possibility that the functions of a ed. Tech could be well represented.
Moderator: Yes
John: But there's a weak.
Moderator: I have clearly missed them in my review, they haven't come up and I am wanting to understand why? So, if I could report on why they didn't come up in my literature
Jack: So, people conducting the research papers that you're looking at predominantly what's their background?
Moderator: Computer science.
Jack: So, their research is within the industry of Computer Science.
Moderator: yes, it within the industry of computer science.
Jack: because I'm just thinking, why is the role of educational technologist invisible to these people? Because we kind of suggested their perhaps in a specially elevated position or in a position where their not necessarily, quite often people that conduct research are not the people that are employed and involved in actually designed and developing the resources that their looking at and to me that's kind of suggestive of a disconnect, which I think perhaps is potentially something that's of interest to you as well.
Moderator: yeah

Jack: It's interesting to think that there this kind of invisible educational technologist role that you call it educational technologist or what ever job title, you know different institutions use different job titles
John: is it possible that someone in computer science views ETs as a technician?
Moderator: yes, I have heard a lot of people say that
Jack: I think sometime people don't even know what an ET is, people think I'm IT support quite often. Can you fix my printer? No! So I think quite often we might just be mistaken for you know, another role.
John: But if you were being a , yeah well talk about the grey area once we start but OMG.
Moderator: I think it could also be that there s a lag between academic literature a n practise, so in a couple of years time, the literature might catch up with what's actually happening in the real world.
Jane: its interesting you say this, because I was at the ALTC conference last year, last September and they were almost having a similar almost crises of confidence in terms of what their roles were, there was a lot of debate going on in the conference around what it meant and how successful or not they felt they were being in their organisations. And certainly a strong feeling was coming out around were they not achieving because people did not understand what the role was? And then having this, because they don't understand what the value of the role is
John: not even just individuals but I think sometimes often the institutions that employ ETs, they don't really know how best to utilise them. There not really given the full kind of range of influence that they could have.
Jane: yes it to have the change.
Jack: so I guess yeah that is another issue, that interesting you know
Moderator: so yes that's why were here today. Hopefully I will write something up on the misnomer around the educational technologist role to try to understand so that anyone else doing research in computer science or in any other field would not have the same questions that I'm having, so hopefully all of these questions we can answer and put something out there to kind of clear up the misconception around the role
John: Could you go back to your stakeholders slide, please because id like to reference it.
John: thank you. Because there are atleast four or five there that I am… *makes notes*
Moderator: I'm going to go up to the white boards, were gonna follow the questions now.
Jack: is it easier if we sit that side?
Moderator: I think its fine if your stay where you are, you may just have to turn your chairs around and I'll bring the recorder abit closer so we don't miss anything.
?: Cool
Moderator: Its only for the first questions: the question how would you describe the role of the educational technologist? Im just gonna jot it down on the board so we don't miss anything. Errrmmm,
John: do you wanna sit there, and I'll sit there?
Jack: I'm fine here!
Moderator: feel free to throw some descriptions at me. Just how would you describe the role? What do you do on a day-to-day basis?
John: so, I would say the educational technologist does the 'doing' of technology, they are operational
Moderator: What do you mean by operational
John: In that they are actually using technology to produce outcomes, ermm, depending on the efficiency of the organisation, they will either be focusing on stuff that only they can do, or if they are not being used efficiently, they will be doing almost entry levels stuff to do with technology. Depending on their ability to influence and push back.
Moderator: so that operational depending on their ability. So my handwriting isn't the best.
Jack: well I would define what I would like my role, what I think my role should be it isn't necessarily, particularly on a bad week how my role is necessarily. But I would say ideally what an ET should do is kind of promoting the best use of technology with regard to student experience, so its not about supporting staff, its about helping staff to provide the best user experience possible to students via the mediated use of technology, ermmm, quite often what happens is that you just get caught up in stuff of people that are having particular problems and things that are not working well, so sometimes it kind of about looking at bad practise and trying to kind of make people work in a more effective way and perhaps looking at the technology and resources that their using as well and thinking how they might be able to do things differently or do things better.
John: that was the flip side to the coin that I was suggesting, yeah, so you've got the when you actually are using technology ideally because you have a specialist set of skills but just because of I guess your only one person and you doing everything Is not scalable then absolutely for you to be as impactful as you can be, you have to be influencing as many staff members to improve their use of technology and the impact it has on the student experience. You have

to be influencing in everyway you can, be that with comms, one-to-ones, workshops, your trying to lift the ability of staff to not just use technology but to spot the right technological solution for a given scenario
Jack: and quite often its kind of encouraging or discouraging people from using something if you think it's not going to lead to the outcome that they have imagined or are anticipating, so probably communication is as big a part of it as the actual technological competence.
John: yeah, absolutely. The part that I find fascinating is, I add most value not where im just teaching where a button is in a UI its where I'm modelling how to approach and create a digital project even, or how to approach a project where you involve technology to some degree as a solution. I was doing it this morning; I was helping a meeting actually be productive rather than try and do things in the wrong order. They were about to be very very waterfall as it were and I was teaching them, I was modelling how to be lean which I suppose is important for every organisation lean and agile you know but important for every organisation and it's not just technology which uses those kind of organisational management styles, sort of modes of producing something anymore, but a lot of good practice comes from tech and its particularly relevant when your using tech because obviously you have to be careful about delivering something that takes a while to produce. I don't want to be too in a echo chamber though, because I would imagine that in academia you probably have to have produced some pretty efficient means of producing just what's required to do the job, or is the definition of academia that you have the room to actually not be tied to productivity, perhaps for example science is about curiosity and exploration where as when your trying to produce say a tech solution to something, its about efficiency and productivity, anyway those are things I come across daily.
Moderator: would you say I have kind of covered all the points on the board?
Jane: speaking as a librarian here, I find that really fascinating because I find these current run definition quite limiting because I think theres a lot of elements that many of those people on you stakeholders list will cine and say, we actually do that too.
Jack: Yes
John: I wrote down 1, 2, 3, 4, 5, 6, 7 or 8 people there that I feel as though I overlap with.
Jack: yeah I could kind of, yeah!
John: 7 yeah!
Jane: I just think its really interesting that this role of the educational technologist has obviously morphed out of a requirement otherwise it wouldn't exist, so somewhere along the line, some you know not just one person but a whole raft of factors have come together to say we need this type of role because this type of role is missing. And yet many of those role actually touch and feed into each other around this whole area. So I mean I think you know, speaking from my own perspective here, this is something that is typical, it impinges everybody and that's why it's a tricky one.
Moderator: yeah
Jane: digital capabilities is a really tricky area because it can be so big and yet ?? if we are going to develop, we know there is a missing set of skills, we know ere not going as fast as we could or should be, and if we don't escalate this, if we don't get on board and come together and not worry so much about the boundaries about these roles but actually focus on what we need to be doing and the skills we need to be developing all together, I think that would certainly help with the maturity model. How does the culture of the organisation actually go past these boundaries and rethink and redesign and redefine how people work together across these areas in order to achieve change quickly.
John: We've missed something, which a big part that I've seen the ed tech do in organisations is responsible for being the stakeholder or company contact for third party providers, vendors of tech solutions. That's a big job that the ed tech is given.
Jane: In our instance a lot of IT service staff in LCS do that too.
John: Here where I mentioned that there is a slight overlap with IT infrastructure because typically the ed tech could be responsible for the procurement of educational technology solutions so were not talking about infrastructure IT, so I would make a difference there, a division
Jack: I think if you look back historically at ETs though, I think if you look at the Open University and the Institute of Educational Technologists then there traditionally the ET would be an expert in pedagogy, ultimately and the technology would be a kind of means of implicating that,
John: yeah they still have that
Jack: … Now a days the technologist is seeing much more of a technology centred approach and there not that kind of pedagogic grounding in the role, but I think historically there was and I think that's something that slowly becoming kind of eradicated from time.

Moderator: That's what I was expecting to find in literature when I was looking at DC in education and how they would support pedagogical practices along with suggesting the right IT, like you just said, the right solution in a given scenario. For people who are new to technologically and don't use it everyday wouldn't necessarily know, so your kind of pointing them in the right direction and showing them the best solution for doing what your trying to do. Because they could be doing something that's taking them hours, you know still using Microsoft word to do things that they could use more specialist software to do. So that's what I was expecting but I didn't see any of that…
John: I completely agree with that, because when I was at the OU, I detected that culture still there, that it is about pedagogy
Jack: is that the first… I'm thinking historically who were the first educational technologists, I'm suspecting the origins are with the OU but I'm not 100%.
John: don't know. But the ed tech were really, I think their pedagogy first still, that the impression I got. I wish my colleague doe had the time to come here because his is a pedagogy first ed tech because he was a tutor first but he was tutor is computer science/ engineering and because of his abilities then by default, this is probably how it evolved right.. you've got somebody who's a tutor to start with but a tutor in a digitally literate field who then realises they've got a niche or they could be very helpful, so I think that research, using that kind of research into learning and teaching Is definitely there and I think you'll find some ed tech who really believe it's the most important that thing we do: bridging the gap but bias towards pedagogy.
Jack: you need to have an awareness of the pedagogic side of things and the technology because otherwise what you get is this technology centric approach to doing things. Technology in itself cant really do much, it has to be applied properly.
John: and how would you otherwise know, you know if your purely technological how would you know how to prioritise your endeavour, your not going to be informed, you'll just produce a generic web 2.0 user interface refer to what you know, you wont be guided.
Jack: People are often so influenced by the marked around the latest what ever it is and all the promises that are offered, when you know, if you don't, quite often there is advanced to using a specific resource but you have to be aware of the limitations and how to use it to best effect within a learning experience otherwise its just tech for the sake of tech.
Jane: do you have other aspects, like budget management or anything like that with the role or is this purely around trying to develop example user experience you can to deliver learning?
John: well a senior ed tech would be quite involved and would be a budget holder, yeah
Jane: are you also involved project wise or is it more a project basis or it is actually operationalising it.
John: that why eve got both side, I mean your bound to have project work and your also bound to have day to day operational elements. You'll have both because, well my thinking was always because of the nature of you've got a useful skill that a project needs, you should probably have good project management skills as well, definitely, because if you don't your not going to be as useful when you've got a solution that requires anything more than a week to work on, you have to work up, so a stakeholder management as well is more senior. So, all those sort of skills there, you've got to have too.
Jane: I was just thinking of some of the elements we discussed earlier as well about having the rest of it there to enable it. Because we've all seen this where projects have happened and the project might have been successful in terms of delivering particular outcomes but then they get passed over to someone else and then there like nobody budgeted for it, and that's a factor in the maturity model again. Because if you don't have that exit strategy and that agreed way forward about what happens, rather thinking about it at the end of the project actually it something one has to think about right from the very start.
Jack: It happens so much with technology centric projects as well because something will be positioned as new and alternative as so it will be attractive and appealing at the start but as time goes on interest will slowly fizzle out but you'll be left with this resource that has had this considerable amount of time and money and energy put into it and the shininess has eroded a little bit but its still there and quite useful and quite valid but its just not supported anymore and I think, I say institutional buying Is really important in making sure that, that buy into a particular resource is sustained through time as well, like you said I think that often gets over looked
Jane: So I mean thinking about the future if the role is actually quite pivotal in terms of the kind of overall, rather than just be pulled in on a project basis, actually the role of the ET should be represented in some of those more strategic planning decisions so that you can see something and you understand what the impacts are for supporting it and costs are.

Moderator: Yeah
Jack: Yes
Moderator: are there centralised ed techs and then are there localised, are you assigned to specific departments, because I'm assuming if they were centralised they would take part in more the management stakeholders type tasks and then the ones that are localised in specific departments would be more responsible for the pedagogical aspect of sup[porting the teaching of that particular subject.
Jack: Yeah so, ermm
John: Yup
Jack: I think the point it exactly as you put it.
John: Although just, if your local embedded in a school, I spend probably much more of my time, face-to-face, 1-to-1, every day I walk around the building and if anyone sees me and says: oh! I know they want me to approach and they have technical email that they probably would have emailed about, they probably would have avoided, they wouldn't have developed.
Moderator: do you get people approaching you with problems that are more technical, rather than education and technical?
John: *nods head*
Moderator: So does that overlap between technicians and educational technologists, so that people…
Jack: No actually, its funny, just to amend what you said in terms of the locals ed. Techs being focused on pedagogy. Im more focused on basic digital literacy, that is my 100% focus, that is what I spend every day doing, trying to improve. But my colleague Rupert, because he is less interest in that, well that to him I boring because hes really good with technology. Hes interested in big complex technical solutions to bigger problems and probably interested in pedagogy because he was a a tutor. So there is that kind of, difference you get even at a local level, but I do feel as though because I have those relationships I add value where I know someone well enough to push them to develop where they would be avoiding, so I think the digital capability side is important. The opportunity for me to influence pedagogy is more around when I encourage them to brief to me well what I need to create something. Often people don't realise a scenario where technology can even help, so I'm there listening to what their problems are and spotting where we can collaborate. And then I help the pedagogy, I think most where I say: give me what I need to know, say your my client, give me brief don't think anyone knows how to brief us with the information we need to then go away and.. like they don't see things… I don't think I work with any creatives. You know, because there not spotting the use case or the scenario as beneficial and they don't know how to populate something with an idea that lets say lets the technology sing and dance. Anyway I'm waffling, that's my experience every day.
Moderator: no but its really relevant, it actually sparks. Because you mentioned about the overlap of rolls and well that one of the key things about collaboration isn't it.. because you might automatically see a certain aspect of something that if I looked at it I'd see a different area so if we came together collaborated we'd get a better results and almost feel like the overlap in roles is more of a positive.
Jane: well it can be positive, but also at a political level it can also create tensions and territorial issues, and that where I think looking at your maturity model where does that fit in the culture? If you have a really mature culture, they I think there would be less issues around territorial issues and yes your would come together and your would hot house together, irrespective of who you were and then you would come out with a great solution hopefully which also involved users and is well tested. And I don't think that's where the innovation needs to happen, and the change, the cultural change. So if you are going to move towards a digitally capable culture, everybody is valued, everybody is invested and prepared to come together and contribute those things and its less about territorial unit and all that, its actually focusing on the excellent student experience and that what matters.
Moderator: yes
John: im interested to know how you would characterise what you do centrally in terms of like what you spend most of your time doing or what you think you should be doing or what your supposed to be do. Probably differs to what I just said.
Jack: I mean I would say that consultancy is a big part of it.
John: Yeah, you've got a consultancy role don't you.
Jack: So 50% consultancy, 50% development, no probably 25% training as well. So probably, id say training, consultancy and development, equal really. More or less.
John: that interesting. I mean it's a natural extension of geography isn't it. Yeah. Sorry to complicate matters, but there also the fact that for the local ed tech for models of delivery, of which my philosophy vastly differs to my colleague,

there's pros and cons of either. So in terms of 'models o f delivery', my colleague operates on a support hub, ICT support, someone brings up the problems and then everything's dropped so he goes and fixes it, so its kind of 1st line IT support.
Jack: what I just said is completely irrelevant because everyone's just firefighting at the moment because we've got this management system that just been rolled out, so that's kind of the one the average…. 100% firefighting all day.
lots of laughter and giggles
Jack: looking back historically to the good all days, this is how it was before.
John: But yeah in terms of models of delivery, you've got that kind of 1st line ICT support.
Jack: yeah
John: for not very digitally literate staff, and then we fix (we do the doing) we fix all the problem, so we are just problem fixers. Verses, my here's an opportunity to develop staff – I wont do it for you model. But I will provide better learning resources for you, for you to self help model. Do you see what I mean?
Moderator: so its more of a support model rather than I'll do it for you model
Jack: more of a guide rather than do
John: I think we are in agreement about what's best use of our time and I loathe to do the doing unless someone cant, because then im using the skills that im paid for. And also one is scalable and one isn't. its not scalable for two ed. Techs to fill in a digital literacy gap by doing the doing (when its like could you make a spreadsheet). But you could argue both are valid, the money pot for my role locally exists is because they realise there's a need for just basic extra support using technology. Often it is fire fighty, and this thing is broken just now and there students in front of me. Or the hand in date is tomorrow and the portals broken, so I can see the reason for that but I'm lot he to get sucked into firefighting and I want to think much more strategically and I think that's the ed techs best role is to be strategic and whatever you do, it has to be scalable otherwise your not going to make an impact.
Jack: I suppose if an educational technologist is being used to best effect, you wont get these situations where people are spending all day firefighting especially with specific problems so I guess that's, comes down to institutional culture again. Are we having influence at the right levels? are we at the right meetings and being consulted by?
John: my ability to do what I want though, to do what I feel strategically, where I add the most value relies on my interpersonal ability to push back, and stakeholder manage and influence and it's a big part of my job. If I cant do that successfully, im sucked into rescuing panicky stuff.
Jack: is this helpful for your research?
John: sorry, taking your on a bit of ferris wheel
Moderator: I'm writing everything down because I'm recording to transcribe, so I'm kind of just putting down the key points about the role.
Jack: I think from this discussion alone its quite easy to understand why the role is sometimes seen as invisible particularly in the research literature because it's so multi-faceted
Moderator: but it's crucial, it's a really crucial role
Jane: well as I said, this was coming out strongly in a conference at the association of learning technologist last year, and how crucial it is and yet it's not recognised almost, just how pivotal a role it is.
Jack: I think lack of any effective technical, you know, technicians are quite often overlooked. Are they?
Moderator: but is really a technical? Its more of a pedagogical role? If there's no ed. techs they who is going to bridge that gap? And then how do expect the maturity unless your just training staff in training sessions. Who then has that role? Which leads us straight into the next question: if there are any roles that are synonymous to that of the ed.tech. because I would be curious to see if the synonymous role would cover all of these things an dim thinking that the roles that would be synonymous would cover some but there would be some tasks that would just be left in the lurch.
John: yeah, so I wrote down a digital champion, IT service staff, curriculum team, instructional designer, digital specialist, staff development.
Jane: well you see, and you would be surprised to hear me say this, but if you look at my team in the library, if you look at my team there are several of them who have got HEA accreditations and they create content digitally, they communicate digitally, they collaborate on projects digitally, they've got elements of project management there, they are often influencing staff. They have responsibility for resource procurement, there a… they also because they come traditionally from library backgrounds, they also still are holding onto some of those more traditional roles, although increasingly less so as were moving forward.
John: oh, we've missed out from what we do… were coordinators. I mean Lucy, her role is coordinating but I've seen, interesting different organisation and different sectors and you always have the coordinator role who's multi-

disciplinary and a generalist. So, we are generalists but obviously we, all of us have a speciality, I mean you specialise. I mean we have to be quite generalist, typically there's an area that your most into, you know, that your best at discipline wise, skills wise but generally I think in any organisation you've got that tension between multi-disciplinary teams or departments that are siloed a bit. You don't get the specialisation, the staff development unless you get a group of a particular discipline together so that's why would want sorry of separate teams, sort of separate discipline but then again you don't really communicate and collaborate well when you're all siloed off and often projects need multidiscipline to work together very well, so that why you need that kind of generalist to bridge the gap. I guess I've seen it in other, the generic term for it's a coordinator or a project manager but I think coordinators more operational. So, I see the ed tech as possibly just these sectors answer to that need in any organisation, maybe. Sorry
Moderator: no its fine. This great stuff
John: what was your question though?
lots of laughter
Moderator: it was about the roles that are synonymous. Would you like me to write them down? Well were running a bit short of time, so I think we'll just push on.
So the next question is, oh I skipped the second question, which was: how instrumental are educational technologist in the effectiveness of digital capabilities. So, if you think about DC in terms of the definition I gave earlier, which was: the extent to which the culture and policies of the institutions would help support digital practices.
Jack: I feel like culture is probably the operative word, in the description you just gave. I think its about modelling best practice and helping staff to model best practice towards their students, so in that respect I'd say it's certainly influential in that kind of setting.
John: I would say that we are as effective as we are able to devote time to those longer term improving digital capability yeah.
Jack: You kind of have to be a bit forward looking as well, because digital capabilities, what is kind of considered somebody who is digitally capable today, if they don't keep with emerging trends and horizon scanning, there not going to be digitally capable tomorrow.
Moderator: I always look at it as, if you look at this CMM, I look at it as step of ladders, or an escalator, so it keeps moving and even if you get to level five, if your not walking up the steps, you kind of fall off and get left behind because you need to keep moving up with the escalator. So what at level 1 now, in 5 years' time it will probably be at level 4 and so and so for, its continuously maturing.
John: so, in answer to the question then, given the function you've described, I would say if an education technologist is able to do the modelling and the training and the influencing then yes, but if an ed tech is more an operation and doing the doing with technology and involved in just being the stakeholders or the main contact for a vendor then less so. It depends on the ratio of what they are able to do.
Moderator: anymore on that? How instrumental?
Jane: I think that a tricky one because that's another area where I think were increasingly struggling with in terms of how we measure effectiveness anyway in what we do. As you know were currently obsessed by surveys and results and all this and how get pushed from league tables from one end to another and I think how do you measure this? Is it on an individual basis, if you've got someone who's a serial digital dodger and it doesn't matter what you want to do, they still won't take your advice or won't help themselves and they constantly come back to you and they just won't change their practise no matter what you do. Or is it just generically like looking across the past and saying, we all do this, we look at the number of modules that have been translated into canvas from the previous system. So, and then that might look impressive in the numbers game but how effective, how much of that transformation or migration…
John: that a very difficult thing to quantify
Jack: yeah, it not something that easily broken down.
John: we can give you some proxy indicators, but we can't give any detail
Jane: so everybody recognises the key potential of this role and it need. The ned to have it.
Moderator: and we recognise the roles that are synonymous to it and overlap between those roles.
Jane: the measuring effectiveness, I think I s a tricky one.
John: ok, there's a funnel. I would see it as a funnel, like a conversation funnel. So, say I get a classroom and through marketing and targeting my emails, I actually get 6 and may a stick and my carrot from the association of learning and teaching say we get 8 people to come to a workshop on some software. Of that, probably I get probably follow up

queries from 3 or 4, which mean there using it and they need a bit more help but there also consolidating. So there probably, there may be that 1 or 2 continue to use it long term and are independent, so id say that about a quarter isn't it.
Moderator: yes, 2/8
John: yeah, of people that I've given a new skill to.
Jane: or changed their practice, influenced that practice.
Jack: so coming back to digital capabilities, I think at that point the technology is working for them, they are no longer working for the technology. When you get people in there struggling all day trying to combat, you know because there slides have become corrupted so they can't do this an can't do that, for those people, there working for the technology, there trying to resolve issue that should be there
John: yeah absolutely! Another way to quantify is time saved. Efficient productivity gains. Right, what you doing there? I'm just manually entering all these numbers. Why don't you autofill? You know and if you imagine that was something that was done weekly and took them an hour and now it just takes them a minute. That does multiply out hugely – its very difficult to quantify though. But I see it anecdotally every day, the impact that digital capability has on productivity. So you've got the extra productivity in time saved and its hours and hours if you managed to get people to learn the new skill that save times, and we do that at scale I think. Little by little and it save hours and hours. But they you've also got, if you can't manipulate data, you're not making the best forward decisions on how you operate strategically as well, you save time but you also inform decisions if you allow people to use technology because they can do a little bit of quick data analysis. You know there making forward decisions. So those are two ways I think we definitely make an impact.
Jack: that true and that could quite easily be quantified I think
Moderator: Fantastic! So, what the next question? We already touched on this earlier on, but why might the role of education technologists be underrepresented or absent from published academic literature?
Jack: I think we've kind of touched on these areas quite a lot, but I think a: like we've suggested, the role itself is sometimes represented in different ways, so the term educational technologist might not necessarily be used in one organisation where there's still people doing you know, various components of that role and also because the role is so multi-faceted, its kind of like, were not a definite link in the chain. There's various level of influence that happening in various levels, in various departments that I suppose there's a tendency that were perhaps invisible to people that are actually conducting research because were not seen as such a definite link in the chain if so speak. The involvement that we have is perhaps more subtle.
Jane: I think also, its coming back to this territorial thing. You know the discipline specific view. So you have the very active ALT but again there a community of practice, so its almost that the literature would almost reside within the communities of practice.
Jack: and territorial things within research as well. So, the researcher will see you know the questions his territory, he's going to have a very specific things that he or she wants to represent as an outcome.
John: Really interesting. I would see it through a recruitment eye, so if you look at the numbers through eye, probably vary from institution to institutions but I reckon you don't get many applications for an ed. Tech role when you think about the numbers of people that have broadly that mix of skills. All of these people here (points to list of synonymous roles in front of him) have a similar mix of skills to an ed tech. Forget the side of semantics because were not talking about oh why don't they say the name that much, are we talking about institutions investing lots of money in that function within the organisation? Or.. I'm just pushing that back?
Moderator: So, we are talking about institutions implementing digital capability frameworks, so for example if we consider the Jisc framework, trying the implement the Jisc framework, use the tools, encourage staff to use the tools. How instrumental would you say the role is, in terms of doing that?
Jane: I would see that its crucial, I think! Because of the position of where the role individuals are and whether that's in a central unit or whether its in the school directly, I think it's a position of influence in making more awareness of those requirements.
Jack: there is also just for the sake of playing devil's advocate that the educational technologist could also have a negative impact on digital capability. In the sense that in there in a kind of support capacity and members of staff are coming to them and seeing them as the solution to the problems there having rather than taking ownership of those solution themselves. I think there is a potential where an educational technologist could have detrimental effect on digital capabilities which is.
John: Enabling avoidant behaviour, in terms of development.

Jack: Just for sake of providing a counter argument.
John: there also, just to finish off the point I was trying to think in my head. I think that there's a cannibalisation as well, like you say slightly political within the organisation, but I would say that there are quite a few people in the organisation have a broadly a similar set of skills as the ed tech. and interest but there cannibalised by other departments, possibly, in terms of recruitment, maybe. Then the dedicated ed tech that, but then again, the dedicated ed. Techs that's got that interest in education and technology and really overlaps, perhaps its either it's getting cannibalised or its actually quite a niche. There not many.
Jack: yeah! Sometimes you get digital capabilities as an approach to using technology to enable a more professional way of working, the educational technologist is, I'd say should be influencing that free modelling and best practise. As opposed to focusing on specific tasks, because those tasks there will be a better way of doing things, or a new way of doing things in two, three years anyway. So there not necessarily training people how to use software for example but by modelling best practise and demonstrating to people how to use technology in a way that is empowering, and I think yeah, they should be highly influential. In an ideal situation!
Moderator: Ok, so what effect would the absence of the role have on the implementation of digital capabilities? What if there were no ed. Techs? How do you think implementing digital capabilities would go?
John: just in terms of the premise of the questioning, are you saying that the literature search definitely discovered that there is a absence of people fulfilling the roles of an ed tech? or are you saying that not having ed techs is a proxy for the institutions not investing enough in..
Moderator: No no no, I might have worded the questions badly. So, are we talking about questions 4 or 5?
John: Generally understanding them both, as a workflow.
Moderator: So, question 4 was, I didn't mind them in my literature search, not to say that there not in literature but I am doing research on… my literature search was looking for things that affect or impact in digital capabilities. So, if educational technologists impact the implementation of digital capabilities in higher education, then they should have ideally come up, even if it was just once in my literature. But they didn't, there was a under representation of them, so… they could have been missing completely, or they could have been missing in the journals or the areas that I looked, or they could have been called something else, or they could have just been underrepresented and if I had read 1,000 papers, I might have come up with some, because I only read 140. Now I'm not really giving a definitive reason, I'm exploring the reason why I didn't see them. Rather than saying that there not there. I'm suggesting maybe there underrepresented which may be why I missed them.
Jack: Perhaps there aren't enough educational technologists doing their own research and that's why there underrepresented.
Moderator: and so if they are missing in literature, their role is not given the significance that it deserves in other areas. Even if there are communities of practise, the role in itself is standalone but then even within Computer Science, were talking about development of new technologies and then who is going to use the technology, who's going to train people on how to use that technology. So if it's not there, then it kind of needs to be there. There need to be some mention, they need to be given that significance, it needs to be out there somewhere.
Jack: yeah
Moderator: So, what I'm saying is they haven't really been represented in the way I was expecting, and so what if they weren't there? What would then happen in terms of digital capabilities in higher education?
Jane: well I don't think it would go as quick as it… I think it should be going quicker than it is, but I don't think we would have even got this far without them… in this organisation. I think they have been very influential and will continue to be influential, and they continue to be valued within this organisation, in terms of what they do. And I think as the newer systems have been coming in as well and sharing good practise through things like the Learning and Technology conference that happens every year, people are able to see across all the different schools – good practise. Where people have involved the educational technologists in the planning and the development and the testing. So, I think the evidence based growing that they are having an impact and influence. Then we have a reward system here as well, I mean we recognise and reward good practise, so you'll see the VCs awards and those sorts of things and the Learning and Teaching Innovation Awards where you can actually bid for money to undertake a technology based project, but it has to have some learning impact, it has say how it would help us move forward with these approaches. So, I think if we didn't have them, I don't think we would be anywhere near where we are now.
John: I've processed the question now! And sort of got rid of the kind of philosophical red herring. I would say that you've got these functions that are going to happen regardless of the ed tech existing, but what your not going to do is have that person who spans different disciplines truly understanding the requirements. So he can understand the

tech and the capabilities or the kind of dependencies of the tech, but your not really gonna, no! No ones going to understand the requirements as well as an ed tech who know the pedagogy side and the institution and also knows most of the tech, I think that's where the ed tech… and so if there missed then it relies on really good… Really good communication. So, someone giving a brief to someone which we've established is not done well and an IT person who really gathers the requirements very well of what's required from the client, you know this other, this academic, and I've seen it go wrong more than I've seen it go right when you have these two different disciplines trying to work together, so yeah. Having someone who already spans that gap, is invaluable. Definitely! and I think that's what you'd miss if you didn't have that ed tech.

Jane: and the richness and the new ideas and I think part of your role, I see part of your role as well is not just helping people within the context of the institution but your ability to bring the broader perspective of what's happening out there, so and having part of your role that time isn't looking to the external environment so that its keeping the innovation fresh and its bringing the new ideas back into the organisation because for many instances other pressure on academics, there not given the time and the space, even though ideally we know nominally they should but they often aren't. So, there is confidence that if you've got an expert available then you can give them the freedom to do that.

Moderator: yeah

Jack: Academic take technology in a very reactive way and there's research evidence to support this so they don't really, historically an academic because of time constraints and stuff, they wont really embrace something new until the moment when they absolutely need to and at that case the whole experience can be very stressful, they've got other things they are trying to juggle so its kind of useful quite often to have someone there just have kind you know, a) to reduce stress because it can be stressful when your trying to get to grips with something new and you've got so much else going as well, so I think yeah just to provide that reassurance and help people as well. Because that's all a big part of digital capabilities as well, just you know, I guess trying to remain calm and not become phased by something that's new you. That's a big part of it I think, yeah.

Moderator: Yeah! Thanks! I think we've answered all the questions. Is there anything else that you would like to add or comment on about the role in terms of implementation?

John: just on that question 5, I've just realised that unless you have an ed. Tech. it won't entirely be the day job of any other discipline to make sure that the execution of good educational technology practices and systems is there. It will be an extra thing on someone desk that they may not, it may be an afterthought, you know it may be yeah. So, it's is a declaration of priority because of its, in terms of title and in the context of the whole organisation it is a specialisation, I know I drummed on about it being a generalist role but in the context of a big organisation it is a specialist role. So therefore, it kind of says this your responsibility to make sure this runs well. So, it's a declaration of priority, and depends on and how many you have as well! As such is possibly a little bit, disheartening your finding

Jane: the other thing you might like to look at Zarah, is the ALT have their own professional development framework called CMALT and that breaks down the types of skill set that a learning technologist would potentially have then if you go through the professional accreditation you have to provide evidence for those sorts of skills. So it might be useful as well, just think about this role and similar roles and we've all said more of less that the learning technologist is probably the closest to an educational technologist, it might be worth looking at the framework and seeing what, how they've broken that down and what professional bodies have kind of said they value or want to see in this.

Moderator: Ok. So just to round of then… I found this online (slide on definition of what LT do). So there trained in the field of educational technology, and the idea is for them to make learning new technology easier, and not even learning new technology only but even learning your discipline. So in terms of the students, so they continuously analyse, design, develop, implement and evaluate.

Jack: interesting that I've seen this exact same model applied to teaching, so in terms of curriculum design you can apply the exam same model and it reiterative.

Moderator: yes exactly.

Jack: So, after you evaluate, you go back to the analysis.

Moderator: yes!

John: but what the source of that? Interestingly.

Moderator: the source of this was, I think it was google, google scholar, it was a link on google scholar. I'm sorry I didn't reference that, that's very very poor practice on my part

John: that ok. That very interesting because I think we've touched on quite a lot of those issues anyway through the course of our discussion anyway, so that quite nice.

Moderator: the model, I read it and then broke it down in this way, I put this in myself but it has listed those five tasks and what stuck out to me the most was the analysis part. Because that sort of fits right in with digital capabilities and the fact that it's a constant, you have to check where your at to know whether you achieving, to know whether you need to move onto the next step. Can you then add a new skill to your existing, have you mastered those skills enough for you to add a new skill to your existing skill set? If you're not analysing where you are they our not really going to be able to climb up further. So that continuous analysis, and again in terms of software, so if your not analysing how efficient is this software for the purpose of the task that your using it for, then you wouldn't know when its time for you to switch to a new software
John: sort of cost-benefit
Moderator: yeah exactly! So that analysis is one that stuck out quite a bit for me.
Jack: computers won't be around in five years anyway, we'll all be on mobiles and tablets. I think its quite different because the way students are using technology – this kind of going beyond the scope of your study, but I do think there is sometimes a disconnect between what is actually a digitally capable person and what is perceived as a digitally capable person? Because a skill set of using computers and all this stuff, I think that's a little bit kind of becoming more and more, or less beneficial because I think as we move forward towards mobile technology and cloud computing and this kind of stuff. So, I think the way people evaluate digital capability in itself something that needs to be constantly you know.
Jane: well I've just be talking to the students. Hertfordshire business students, business IT because there a mixed ability group again and there desperate to get on top of their excel skills because of the financial analysis and data and all sorts of things that they want to do to develop their skills. And so they were interested to talk about their own development needs using Lynda.com which is an e-learning platform essentially. This was outside of the course that there actually taught in the university, as though they have formed a learning group and then there all at different abilities but then there using Lynda as a source of the content to develop these skills, cuz Lynda has different version of excel available within it, to teach them, and then their sharing their play lists and there actually helping each other in the evenings. Where they meet every fortnight. So again it's just interesting how people will pursue their own digitally capable journey, they've already assessed themselves and recognised that there at this mixed abilities, they got these needs, some want to go faster than others and so just going into one particular kind of form of module isn't enough for them. It's not delivering n their expectations around how digitally capable they want to be with that particular piece of software.
Jack: I suppose a big part of digital capability is how quickly you can adapt, and kind of evolve and get familiar with new ways of doing things, its not so much about specific skills the way I see it.
John: No. It's about coping strategies
Jack: yeah
Moderator: In addition, it's, the skills to be able to evolve. You know there's the skills that you need to do the work, but then there the continuous learning.
Jane: but then they still need to learn what those core functions are, they still need to know what the functionality is
Jack: we do need that granular, kind of procedural training from time to time but the big kind of digital capabilities as a kind of ideal, I think Is more about an approach than a specific kind of ..
John: Personally, I feel as though at scale that granular, step by step designed course is just, its not gonna work because where's the prioritisation? So really the cost benefit is done on a tiny scale daily is when its most functional. So, what I'm about to do? Quick sense check! Is it the most efficient way of doing it? No! google it! Develop a little bit! Move on because I've done just enough and if you try and aim too high, the justification for it starts to wither. It's actually a really iterative, tiny step by step process is when I think its most functional and efficient. And also, less anxiety related.
Jane: well you I think that the interesting thing about how their creating these playlists as well because they are, they don't want to do the whole 10hour course. There after the little bits, but then there all finding the little bits and then sharing them together. So there using the technology well. As an observer you know, looking at them, there actually interacting well with the content. There beginning to get on top of the product, there working together and their helping each other as well. Support wise, because some of them are very under confident and others are very confident. So, it's quite an interesting activity that's going on there and how they've almost taken things into their own hands because they feel that there not getting the support, they feel they want to develop those skills within the actual courses itself that their given.
John: I think they're going about it in the most functional way to achieve what they need. And I think the only thing… so that activity is what they should be doing, and I think it should just be encouraged an facilitated for them to do that.

That's the problem that they've taken it upon themselves, not what there doing. What there doing is what they should be doing but the facilitation and the encouragement and the kind of expectation that, that's what they should be doing. Because I don't think you can bake in the equivalent of that into a curriculum, very well. Can you? I don't know.
Jane: well.
John: you set time aside for that
Jane: I worry about them because they do need these skills, they need those particular skills right now. Just in terms of employability.
John: Yeah, I just taught a man how to use excel and that was bonkers. Because it's whatever your employer wanted me to have in hindsight, its bizarre why did I not… my IT teacher I would love to have a word with him.
Jack: I have a phobia of excel!
John: So, does my wife actually, excel just makes her angry if I say the word. It's like trigger word. She'd rather do it on paper, she's very funny but she calls me a grandad in other ways, so! She's much better at social.
John: Anyway, thank you so much! That was really very useful.
Moderator: Thank you so much! That was really useful for me. Got lots of useful information and I will stop the recording at this point.
John: sorry about the waffling, I find it very difficult to think of a thought and then condense it into bullet points. I'm a waffler.

_____ END OF AUDIO _____

Appendix N: Content analysis code book

Name	Description	Files	References
Creation & Innovation	**The collaboration culture: Collaborative working, learning, and teaching; driven by cooperation, participation and facilitated through communication, connectivity, and infrastructure**	**2**	**4**
Enabling creativity	The ability of the institution to provide an enabling environment for creation and innovation	2	2
Skills to create	The ability to create content, online materials, and resources (e.g., lecture slides, word document, excel spreadsheets, websites, video content, podcasts etc.)	1	1
External Environment	**The geographic region in which the institution is physically situated: country or city. Socio-economic and socio-cultural factors of the EE such as literacy level, the type of education system, social norms and structures, diversity and intercultural communication all contribute to DCMiTI. As well as economic condition such as political status, population mobility and growth; infrastructures and power supply. Cultural, natural, and informational capital alongside public policies on education and the role of government agencies and ministries.**	**1**	**1**
Individual skills	**An Individual's interpersonal and technical skills, and their readiness/ willingness to engage with digital tools and achieve their full potential. An individual's demographics, cultural capital, level of education, self-efficacy, problem solving abilities and attitude towards learning. Including a full range of ICT skills and competencies. Socialisation and readiness of individual to improve their ability. An individual's knowledge of wellbeing and understanding of the digital footprint. As well as a sense of belonging to a safe and secure institution. Individual's ability to achieve personal goals while maintaining a healthy work-life balance.**	**3**	**39**
Communication	The ability to successfully communicate your knowledge	2	3
Modelling best practise		1	1
Confidence	Confidence in using technology and understanding its dynamic nature. Acceptance that change is inevitable in the digital era. Confidence that things may break and cannot be fixed, adapted to suite your needs. Confidence to try and fail and resilience to keep trying until confidence is built in the fact that the technology works for us.	1	5
Cultural knowledge	The set of ideas that a student's comes into the institutions with based on their previous background.	1	2
Digital engagement	Learner's usage/ engagement with digital tools.	1	3
Digital footprint	Understanding one's digital footprint and online presence	2	2

Name	Description	Files	References
Digital skills	Competency in us using digital technology. The appropriate use of the appropriate tools and applications and being able to select the right tool for the job.	3	13
ICT Literacy	Internet searching skills, word processing skills, data organisation and other software skills.	1	5
Staff capability		3	5
Technology acceptance		1	1
Student capability		3	3
Disciplinary knowledge	Using digital technology within a specific field and ensuring that teaching is within the currency of the curriculum for learners within the discipline	2	2
Information literacy	The ability to find, select and use data	1	4
Own sense of development	A personal motivation to keep up to date with discipline-specific knowledge, pedagogical skills and digital skills associated with teaching such as assessment tools that may be used, classroom technologies, student engagement facilities.	3	8
Understanding of wellbeing	Understanding of one's online safety and the ability to manage a work life balance. Awareness of appropriate use of digital tools and resources and understanding of the adverse effects associated with excessive consumption.	2	5
Infrastructure	**The infrastructure that supports the tertiary institution in terms of basic physical structures, network infrastructure, connectivity, hardware, software, and usability. Also includes availability of technical and peer support.**	**3**	**27**
Accessibility		2	4
Connectivity	Connectivity between various technologies around the institution and the ability to communicate between different platforms and different departments/ schools within the institution.	3	4
Support	Technical support in using ICT infrastructures, hardware software and connectivity.	2	3
Technology (assets)	Technological assets belonging to the institution in the form of hardware, software, licensing etc.	3	3
Hardware	Physical hardware such as CPUs, laptops, printers, scanners, telephones etc.	2	5
Classroom equipment		1	3
Software	Software such as Microsoft office, resource management software, administrative software, OneDrive, VLE etc.	2	3

Name	Description	Files	References
Workspace and equipment	Workspace aesthetics and equipment such as desks, chairs, lamps, air cons, lighting, windows etc.	1	3
Institution	**An institution of learning in which tertiary level education is delivered (Level 4 and above). The extent to which the culture and infrastructure of an institution enables and motivates digital practices. Organisational structure, size, and facilities. Framework, corporate strategies, leadership, organisational goals, and practice guidelines. Internal cultural and social values, ethical guidelines, and accountability measures. This also includes division of labour, recognition reward schemes, adoption of best practices and teaching culture; financial capacity and sustainability.**	**3**	**13**
Commitment to TEL	Institution commitment to continuously supporting and enhancing TEL.	3	5
Communication	Ensuring that that all stakeholders are clear on what technology is, what it does and what it is available for.	1	2
Investing in tech		1	1
Feedback	Feedback from learners to understand how they experience learning from tutors. This information is used to improve the learning experience.	2	2
Financial commitment	Financial commitment to supporting Technology Enhanced Learning.	2	3
Institutional culture	The culture within the institution in terms of learning, collaborations, innovation etc.	3	6
Digitally capable culture	The extent to which the institution enable sand facilitates access and tools to support digital capability. Institutional assuming responsibility of ensuring that everyone is safe and well-trained and comfortable in that environment.	1	2
Learning culture		2	8
Institutional guidelines	Fundamental guidelines that govern the way the institution functions. Including policies and procedures for all process areas and guidelines on managing relationships among members.	2	3
Email etiquette		2	3
Occupational health	Awareness that your workspace has to be setup appropriately for you do your job without causing harm to yourself.	1	1
Policies		1	1
Social media usage		1	1
Staff training		1	1
Jisc framework	A sector bodies recommendations on digital capability	2	3

Name	Description	Files	References
Strategic plan	An indication of the direction of the institution, outlining long term goals and how they will be achieved.	1	3
Structure		2	2
Learning, Training and Development	**The Learning and teaching practices and methodologies aimed at acquiring new knowledge or skills. Teaching methods, practices and strategies and delivery techniques, pedagogical practices, and acquisition of new skills through a variety of learning options. Including assessment of learning outcomes, evaluation, and reflection, reporting and learner feedback.**	**3**	**25**
Learner experience	The experience of teaching and learning within the institution	1	1
Modes of learning	Different modes of learning to support individual learning style. Technology should not feel restricting but rather enabling and offering different mode of learning can support this process.	2	6
Classroom	-	1	1
Mentors	-	1	1
Online	-	1	2
Linda.com	-	1	2
Workshops	-	1	1
Pedagogy	Methods and practices of teaching	1	1
Staff training	Upskilling tutors on various skills to support the eLearning and teaching process. Includes ICT training, pedagogical skills, discipline related training and professional accreditations	3	6
Technology focused	-	1	1
RTC	**The learning resources, tools and content used to support learning/ institutional goals, including social networks. These are the resources used to facilitate learning and development. These include digital libraries, VLEs, LMSs and other digital educational resources. Social networks used for learning as well as administrative systems used within the institution for monitoring and management of the resources used.**	**2**	**11**
Assessment tools	Tools used for marking and assessment	1	1
Clarity on use	The ability of the institution to clearly communicate or make available information on what each resource is used for and how to use it and how.	1	3
Consulting stakeholders		1	3

Name	Description	Files	References
Guided learner journey		1	2
Procurement consideration		1	1
Accessibility		1	1
Usability		1	1
Wellbeing		1	1
Storage capabilities		1	1
Strategic implementation		1	1
Student engagement apps and facilities		1	1
VLE		2	3
Wellbeing	**General awareness of society as a whole. Understanding individual responsibilities and how to manage a health work-life balance. Ability to regulate access and usage.**	**3**	**13**
Health risks	An awareness of the physical and mental health risks associated with frequent use of digital media and the adverse effect of over-use	3	4
Mental health	Adverse effects of over consumption of media on mental health	0	0
Physical health	Flexible working conditions to suite staff. Ergonomically correct furniture and lighting.	0	0
Safety and security	An understanding of safety and security issues related to using online resources and digital tools.	1	1
Use of media platforms	An awareness of the social professional and ethics issues related to online media	2	2
Digital analytics	The ability to source, analyse and use data to draw out information that could be used to support students and infrastructure; and also support organisational efficiency.	2	3
Data analysis	Knowing where to get the data from, how to collect it and being capable of analysing data in various ways	2	4

Name	Description	Files	References
Data visualisation	Making use of data to draw out themes that can support various decisions and plans to improve organisational efficiency	2	2

Appendix O: Merge of Classification v0.1 and the Codebook

Definition and descriptions

Definition: *the ability of an organisation to sustain effective and efficient use of digital assets to support teaching, learning, and working through continuous evaluation, selection and adoption of new technologies and acquiring necessary skills for full utilisation.*

	Theme	Description	In relation to the Model	Things to consider	Additional notes to self
1	**Stakeholders**	Those with an interest or concern in the functioning of the institution. All levels of student, staff, and management roles within an institution. Includes the government agencies and ministries.	All stakeholders are learners – often as part of wider responsibilities within the institution. Some learners will hold additional roles such as tutor, administrator, and other institutional roles. Stakeholders are not represented in the model as they are considered the users of the model. However, their individual skills are represented in IS and through the learner experience feedback. Higher level stakeholders such as government agencies are also not represented despite their frequent appearance in literature.	Need to decide on how to represent the involvement of government agencies in institution. Division of roles into: - Technical staff - Non-technical staff - Academic staff - Administrative staff - Government - Public policy makers	▪ There should be a chapter on the various roles that impact the development of DCMiTI. Here I will present the results of my study on EdTechs – do a further scoping review on TEL roles and how they are divided and how they impact the model. ▪ Provide recommendation at the end of this chapter on: 1. Stakeholders and their impact on DCMiTI. 2. The role TEL roles on development of DCMiTI. 3. Recommendations for governmental bodies and policy makers. 4. Further recommendations for institutions who wish to embark on development of DCM.

2	**External environment**	The geographic region in which the institution is physically situated: country or city. Socio-economic and socio-cultural factors of the EE such as literacy level, the type of education system, social norms and structures, diversity and intercultural communication all contribute to DCMiTI. As well as economic condition such as political status, population mobility and growth; infrastructures and power supply. Cultural, natural, and informational capital alongside public policies on education and the role of government agencies and ministries.	The external environment is the area outside the institution which impacts the institutions capability. An external environment can consist of one or many institutions. It is represented and considered in the model but lies outside the scope of DCMiTI framework. It is important to note that there is a bi-directional exchange/ transfer of information, knowledge and skills that happens between the external environment and the institution. This process is represented in the assumptions of the model.	-	▪ A short paragraph on the external environment and the impact of the various aspects DCMiTI will be included in the literature review chapter of the study. It will then be classified as outside the scope of the study. ▪ In relation to the study in Nigeria, a short background will be presented on the EE (NW Nigeria) covering all the relevant economic and socio-economic issues. ▪ Possibly a similar paragraph will be written up in presenting the comparison study been DCMiTI in UK and in Nigeria.
3	**Tertiary Institution (Organisation)**	An institution of learning in which tertiary level education is delivered (Level 4 and above). The extent to which the culture and infrastructure of an institution enables and motivates digital practices. Organisational structure, size, and facilities. Framework, corporate strategies, leadership, organisational goals, and	The institution in the area within which learning, training and development takes place. The walls of the institution are porous and allows for the transfer of information, knowledge, and skills between the EE – TI, and even from one TI to another.	- Culture - Organisational structure - Capacity - Facilities - Leadership - Goals - Practice guidelines - Accountability measures - Division of labour - Recognition reward schemes - Adoption of best practices - Teaching culture - Financial capacity - Sustainability	▪ In terms of operationalisation, a lot of these are likely to be yes or no answers in a tick box. Documentation analysis will shed further light on this.

		practice guidelines. Internal cultural and social values, ethical guidelines, and accountability measures. This also includes division of labour, recognition reward schemes, adoption of best practices and teaching culture; financial capacity and sustainability.		(See data extraction table for full list of sub-elements to consider).	
4	**Individual skills**	An Individual's interpersonal and technical skills, and their readiness/ willingness to engage with digital tools and achieve their full potential. An individual's demographics, cultural capital, level of education, self-efficacy, problem solving abilities and attitude towards learning. Including a full range of ICT skills and competencies. Socialisation and readiness of individual to improve their ability. An individual's knowledge of wellbeing and understanding of the digital footprint. As well as a sense of belonging to a safe and secure institution. Individual's ability to achieve personal goals while maintaining a healthy work-life balance.	An institution is only as capable as the individual stakeholders that are part of it and as such Individual skills is one of the major components of DCMiTI.	List of personal attributes and technical skills that maybe operationalised? (See data extraction tables). Identity incudes: - social media presence - Use of avatars - active participation in the institution online communities	▪ Some of these will be a lot trickier to operationalise. ▪ Also consider health, safety, and security as well as relationship management, self-motivation, and self-management. Although note these things are difficult to quantify.

5	**Infrastructure**	The infrastructure that supports the tertiary institution in terms of basic physical structures, network infrastructure, connectivity, hardware, software, and usability. Also includes availability of technical and peer support.	Adequate infrastructure to support a fluid environment for successful use of technology within the institution.	- Hardware - Physical infrastructure - Network infrastructure - connectivity - Software - Availability - Accessibility - Usability - Technical support	▪ Infrastructure sub elements are likely to be operational and easier to assign values to than some of the other elements. Verify what is available during documentation analysis.
6	**Wellbeing**	The sense of belonging to a safe and secure environment. The institutions' ability to safeguard the well-being of members of the institution and support them in developing techniques to achieve a healthy work-life balance. Furthermore, the institutional policies, procedures and other institutional level management decisions also require some consideration of wellbeing.	Wellbeing is mostly a condition of the institution and a responsibility of the TI to ensure these conditions are being met to a satisfactory standard. *Note a large part of wellbeing relies on the individual's knowledge of the concept and the skills to regulate themselves. This is covered under knowledge of wellbeing as an individual skill.	Wellbeing of individual stakeholders needs to be taken into consideration in all aspects of infrastructure such as basic physical infrastructure, network infrastructures, connectivity, hardware, software packages and usability, furniture, and physical design. Support available: - Management support - Technical support - Wellbeing support	▪ An emerging concept that has taken up a lot of traction in the last 5years not only in education but all areas of life due to the frequent use of technology. ▪ In the discussion section it will be important to add references of current issues that have arisen with regards to this. ▪ Possibly look out for area where wellbeing has been considered in management decision making. ▪ Also, availability of wellbeing support services ▪ Take note on the potential bias of wellbeing from Study2 either due to institutional bias or researcher bias.
7	**Resources, tools & content**	The learning resources, tools and content used to support learning/ institutional goals, including social networks.	RTC is component of learning.	- VLE - LMS - Online libraries - Accessibility - Training - Ease of use	▪ Availability of these resources ▪ Access to them ▪ Knowledge of what they are for ▪ Training on how to use them

		These are the resources used to facilitate learning and development. These include digital libraries, VLEs, LMSs and other digital educational resources. Social networks used for learning as well as administrative systems used within the institution for monitoring and management of the resources used.			
8	**Learning, training & Development**	The Learning and teaching practices and methodologies aimed at acquiring new knowledge or skills. Teaching methods, practices and strategies and delivery techniques, pedagogical practices, and acquisition of new skills through a variety of learning options. Including assessment of learning outcomes, evaluation, and reflection, reporting and learner feedback.	Learning is the primary objective of the DCMiTI model and to achieve efficient and effective learning and teaching, the other area of the model must be satisfied. The key elements that impact learning are: - Individual skills (Tutors abilities + learners' abilities) - RTC - Institutional structure & support = Successful DCMiTI	- Self-directed - Traditional learning - Distance learning - eLearning - Staff training/ Professional development	▪ Measured through courses available, certifications, new skills acquired etc. ▪ Learner experience/ feedback loop is a very important point. Design a diagram and explain the concept and how important it is towards maturity. ▪ eLearning is often referred to as synonymous to TEL among other titles, this must be well understood, defined, and addressed in the write-up.
9	**Collaboration**	The collaboration cultures	Collaboration is not so much a theme as it is a culture that should exist within the institution.	There is also then the requirement to encourage, support and enable collaborative practices.	-

		Collaborative working, learning, and teaching; driven by cooperation, participation and facilitated through communication, connectivity, and infrastructure.		Provide RTC to support collaborative activities and the relevant training on how to use and best utilises such tools. Additional courses on the importance of collaborative working.	
10	**Creation & Innovation**	The creation and innovation culture Creation of digital content and media production. The ability to create new ideas, projects, and content. Design innovation and innovation of new approaches to the use of technology for learning & teaching.	C&I again is not so much a theme on its own but rather a practise that the organisation should enable and support. Some of these creative and innovative skills once acquired translate into individual skills.	Institutional support and motivation to encourage innovation. Encourage learner to engage in content creation. RTC to support C&I tasks. Technical support for more advanced innovations.	▪ Institutional funding for innovations. ▪ Guidelines/ regulations on content creation.

*** Initially digital identity was placed together as one element. However, after much consideration and following the interviews with management it became apparent that actually digital identity is an individual skill that includes knowledge of wellbeing, however, wellbeing itself is an element alone that is mainly a responsibility of the TI to ensure that they safeguard the wellbeing of individuals and ensure that all aspects of wellbeing as considered in managerial decision making.**

Changes from Model v1.1 to v1.2:

Changes	V1.1	V1.2	Reason
1	Collaboration (Co) represented as a theme	Co represented as a function/ responsibility of the Tertiary Institution (TI)	
2	Creation & Innovation (C&I) represented as a theme	C&I represented as a function/ responsibility of the Tertiary Institution (TI)	
3	Digital Identity & wellbeing represented as 1 theme	- Digital identity moves to an individual skill - Wellbeing represented a standalone	
4	-	Wellbeing moved into a subtheme of the institution	
Summary	9 elements	**6 elements:** 1. EE 2. TI - Wellbeing - Collaboration - Creation & Innovation 3. Infrastructure 4. LTD 5. RC 6. Individual skills	Wellbeing, Co, and C&I are all split between the institution supporting and enabling this culture which will ultimately help individuals cultivate certain collaborative and innovative skills. They are all represented by some individual skill. There they have been grouped under the theme of institution because the TI must offer services to support the practices.

Appendix P: ALT-C 2019 Conference Abstract

Digital Capability Maturity (DCM) is the ability of an institution to keep up with continuously evolving technologies while utilising them to achieve teaching and learning objectives. The use of digital tools and resources in Higher Education (HE) has become the norm, consequently, the need for highly qualified Educational Technologist's (ETs) has become vital. Anecdotal experiences HE settings, have informed us of the pertinent role of ETs in facilitating technology adoption and utilisation in the learning environment. A systematic review on the current body of knowledge on DCM in HE reported various stakeholders and roles contributing to the effectiveness of DCM including learners, tutors, facilitators, ICT enabled teachers, training organisers and managers among other technical and non-technical roles. However, the results did not feature ETs, giving rise to the possibility of similar roles, or a conceivable misalignment between theory and practice. This study is an extension to a greater PhD research towards developing a DCM Framework and was initiated by observations from the systematic review. The session will start with a summary of the outcomes from the systematic review followed by presenting the objective of this study: exploring the role of ETs and the impact of such a role in the effective implementation of Capability Maturity Frameworks. The study employed qualitative techniques guided by a set of research questions to investigate whether the theoretical findings reflect the current state of practice. An in-depth focus group was conducted with ETs, and the discussion transcribed verbatim for content analysis. The results were subject to review by experts in the field of digital capabilities. Preliminary findings support the anecdotal presumption that ETs play a pivotal role in the continuous development of capabilities in Tertiary Institutions. Their function varies depending on whether the ET is positioned centrally in the institution or locally (embedded in a school). Nonetheless, ETs are nuanced by the same ambiguity and complexity that is associated with many other Technology Enhanced Learning roles. The findings also suggest that as technology continues to evolve, educational resources will become more intuitive and ETs responsibilities will transition towards a focus on ensuring excellence in educational user experience; in fact, this journey has already begun. This study presents a case where practice informs theory and provides other researchers with an insight into how ETs in practice feel about their roles and the impact they have on the institution. The clarity offered informs institutional strategic development plans and contributes to narrowing the gap between theory and practise. It also sheds light on managing the tensions that exist between technologists and other institutional stakeholders, thereby empowering ETs to make significant contributions to tutors' performance; and consequently, teaching and learning. Furthermore, these findings inform the greater research work indicating that a Capability Maturity Framework would be well suited to ensuring continuous development in the learning environment. The proposed session supports digital education practices, although it is a 'wildcard' since it does not relate directly to any of the conference themes.

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Appendix Q: Ethics Approval Notification for Study 3

University of Hertfordshire UH

HEALTH SCIENCE ENGINEERING & TECHNOLOGY ECDA

ETHICS APPROVAL NOTIFICATION

TO Fatima Zarah Bello

CC Nathan Baddoo

FROM Dr Simon Trainis, Health, Science, Engineering & Technology ECDA Chair.

DATE 16/04/2019

Protocol number: **COM/PGR/UH/03737**

Title of study: Investigating elements contributing to Digital Capability Maturity in tertiary Institutions (DCMiTI)

Your application for ethics approval has been accepted and approved by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

This approval is valid:

From: 16/04/2019

To: 30/09/2019

Additional workers: **no additional workers named**

Please note:

If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and your completed consent paperwork to this ECDA once your study is complete. You are also required to complete and submit an EC7 Protocol Monitoring Form if you are a member of staff. This form is available via the Ethics Approval StudyNet Site via the 'Application Forms' page http://www.studynet1.herts.ac.uk/ptl/common/ethics.nsf/Teaching+Documents?Openview&count=9999&restricttocategory=Application+Forms

Any necessary permissions for the use of premises/location and accessing participants for your study must be obtained in writing prior to any data collection commencing. Failure to obtain adequate permissions may be considered a breach of this protocol.

Approval applies specifically to the research study/methodology and timings as detailed in your Form EC1A. Should you amend any aspect of your research, or wish to apply for an extension to your study, you will need your supervisor's approval (if you are a student) and must complete and submit form EC2. In cases where the amendments to the original study are deemed to be substantial, a new Form EC1A may need to be completed prior to the study being undertaken.

Should adverse circumstances arise during this study such as physical reaction/harm, mental/emotional harm, intrusion of privacy or breach of confidentiality this must be reported to the approving Committee immediately. Failure to report adverse circumstance/s would be considered misconduct.

Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Students must include this Approval Notification with their submission.

Appendix R: Protocol for Study 3

A Draft Protocol for: Investigating the Elements of Digital Capability in Tertiary Institutions.

A Perception Study (Version 1.0) - April 2019

Author: Zarah Bello. ORCID ID: https://orcid.org/0000-0001-8477-80

Protocol for a Qualitative Study on the elements impacting Digital Capability Maturity in Tertiary Institutions

1. Introduction

Digital capability maturity in the context of this study is defined as 'the ability of an institution to sustain effective and efficient use of digital assets to support teaching, learning and working, through continuous evaluation, selection and adoption of new technologies and acquiring necessary skills, for full utilisation'.

A systematic review was conducted to uncover the elements of digital capability, and how these elements affect the capability maturity in tertiary institutions of learning as precursor to developing a capability maturity framework. The results of the review found 498 elements of digital capability, aggregated to 10 themes. The main objective of this study is to substantiate the findings from the literature review using empirical research methods. The outcome of the study will provide a fair contrast between the real world and theory, providing a sound empirical basis on which the conduct the remainder of the research upon.

A combination of quantitative and qualitative research methods will be used to investigate the hypothesis, to determine whether there is sufficient empirical evidence to support the claim that the elements of digital capability (table 1), are truly the elements that contribute to digital capability maturity in tertiary institutions. Furthermore, evidence will be sought to support the assertion that maturing the elements of digital capability within a tertiary institution setting, will lead to continuous improvement of such an institution, and consequently improve the quality and education outcomes from such institutions.

2. Background

A systematic review was conducted, guided by the following four (4) research questions:

RQ1: What elements contribute to digital capability?

RQ2: How do these elements affect the digital capability of tertiary institutions?

RQ3: What is the current status of research on digital capability maturity?

RQ4: What is the current status of research on digital capability maturity in Nigeria?

The review involved 283 studies that reported 498 elements contributing to digital capabilities. These elements were aggregated to 10 general themes (table 1).

The distribution of weightings in terms of frequency of appearance in literature indicated that 18.7% of the literature is on learning, training & development, closely followed by resources, tools & content (13.7%), and then collaboration (11.1%). The least attention in literature given to digital creation and innovation with (3.9%), external factors with (4.7%) and then digital identity and wellbeing with (5.7%).

The review reported that if developed, all the elements identified have a positive effect on digital capability, consequently resulting in improved capability maturity of the institution as a whole. The relationship between elements are interrelated and described as a 'web' of elements (Figure 1). The elements/themes do not appear as mutually exclusive, indicating that only by considering a combination of the elements, can an optimal level of digital capability be achieved. This corroborates findings from Shengquan and Li's (2006) ecological systemic change theory and suggests that division of elements into separate parts without relationships will not necessarily lead to improvement. Therefore, if the role of capability maturity is to be used as a lever towards continuous improvement of institutional capabilities, the elements and themes must be matured in parallel to result in overall process maturity.

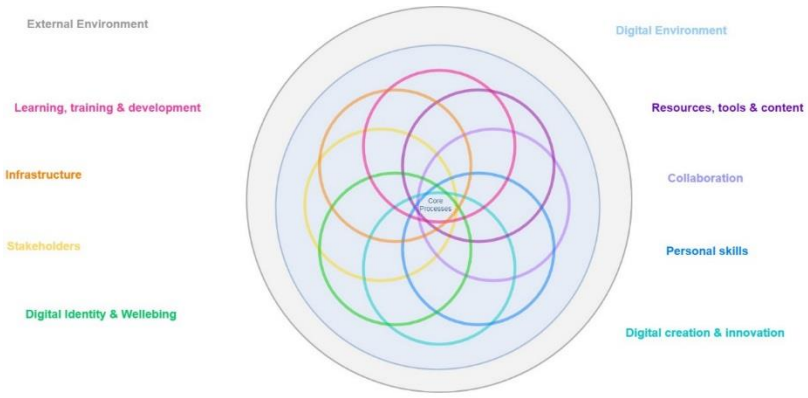


Figure 0-1: Relationship between themes of DC

Table: Description of elements aggregated into themes

	Theme	Description	Theme in practice/ the ability to…
1	**Stakeholders**	The stakeholders include the government agencies, ministries, all levels of students and staff roles within an institution	All stakeholders are learners – often as part of wider responsibilities within the institution (*For other key responsibilities refer to stakeholder responsibilities*)
2	**External environment**	The environment in which the institution is physically situated: country or city (T*his may differ for virtual institutions*)	Socio-economic and socio-cultural factors. Public policies on education and the role of the government agencies and ministries.
3	**Tertiary Institution**	The institution of learning in which tertiary level education is delivered (Level 4 and above)	Organisational structure, size, and facilities. Framework, corporate strategies, leadership, organisational goals, and practice guidelines. Internal cultural and social values, ethical guidelines, and accountability measures. This also includes division of labour, recognition reward schemes, adoption of best practices and teaching culture. Manageability, sustainability, and financial capacity
4	**Infrastructure**	The infrastructure that supports the tertiary institution	Basic physical structures, network infrastructure, connectivity, hardware, software, and usability
5	**Learning, training & Development**	The Learning and teaching practices and methodologies aimed at acquiring new knowledge or skills	Teaching methods, practices and strategies and delivery techniques, pedagogical practices, and acquisition of new skills that a variety of learning options: self-directed, traditional learning, distance learning, eLearning, and staff training. Assessment of learning outcomes, evaluation, and reflection, reporting and learner feedback.
6	**Individual skills**	An Individual's interpersonal and technical skills, and their readiness/ willingness to achieve their full potential	An individual's demographics, cultural capital, level of education, interpersonal skills, self-efficacy, problem solving abilities and attitude towards learning. Including a full range of ICT skills and competencies, level of technology usage. Socialisation and readiness of individual to improve their ability
7	**Digital Identity and Well-being**	Sense of belonging to a safe and secure institution. Individual's ability to achieve personal goals and benefits while maintaining a healthy work-life balance. Consider health, safety, and security as well as relationship management, self-motivation, and self-management.	Identity incudes social media presence and active participation in the institution online communities. Consider the institutions ability to safeguard the well-being of the community, through management support, technical support, and family support to help individuals with healthy techniques to achieve a healthy balance.
8	**Collaboration**	The collaboration culture	Collaborative working, learning, and teaching; driven by cooperation, participation and facilitated through communication, connectivity, and infrastructure.
9	**Creation & Innovation**	The creation and innovation culture	Creation of digital content and media production. The ability to create new ideas, projects, and content. Design innovation and innovation of new approaches to the use of technology for learning & teaching.
10	**Resources, tools & content**	The learning resources, tools, content, and social networks used to support institutional goals	Inclusive of digital libraries, LMS and other digital educational resources. Administrative systems used within the institution for monitoring and management of the resources used.

The review further reported that stakeholders identified are the members of the institution and their full commitment is required to motivate learners to actively and frequently participate in the teaching and learning process. Furthermore, the results of the study highlight the significance of the contributions of stakeholders to the success of institutions maturity initiatives.

Many solutions have been offered towards change management, process improvement and overall development of higher education quality and efficiency. This study is part of a larger PhD research work that aims to use the affordances of capability maturity frameworks to improve the quality and efficiency of tertiary institutions by developing a Digital Capability Maturity Model.

The last section of the review reported on the current status of research on DCMiTI in Nigeria. A limited number of studies were available in this context giving some indication as to the level of maturity of this area of research. All the literature reported stemmed from the southern axis of the country, indicating a gap in available academic literature from other areas of Nigeria.

The larger research work aims to develop a DCM model for tertiary institutions in Northern Nigeria as a means to developing institutional maturity and consequently improving the quality of educational outcomes. Towards the development of DCMiTI in Northern Nigeria, this study aims to assess the current status of DCMiTI in the United Kingdom (UK) and report on these results. Then further assess the status of DCMiTI in Northern Nigeria and report on such results. Finally, a comparative analysis of the two results will be used to calibrate a conceptual model of DCMiTI. Prospective future work will involve validation and operationalisation of the model.

3. Hypothesis

Based on the current body of knowledge of DCMiTI, and taking Bartos (1992), characteristics of a well-stated, researchable hypothesis into account, the characteristics for this study have been broken down as shown in table1 (Barton, 1992).

RQ1: What elements contribute to digital capability?

> *h1 = each of the elements in table1, have a statistical significance to digital capability*

RQ2: How do these elements affect the digital capability of tertiary institutions?

> *h2 = each of the elements in table1, significantly affect the digital capability maturity of tertiary institutions*

Table 2: Characteristics of a well-stated hypothesis

	Characteristic
What is being tested?	The contribution of each element(s) on DCM
Independent variable	Elements
Dependent variable(s)	Digital capability
Predicted effect	Positive/ negative impact
Context	TIs

This hypothesis will be tested using a correlation study in which the various elements are compared with DCM in the context of tertiary institutions to ascertain whether there is a statically significant relationship between digital capability and the elements identified in literature. The outcomes of the study will further substantiate the literature review that has been undertaken. However, the cause and effect between variables cannot be determined by the outcomes of a correlation study alone, therefore a series of additional studies will be undertaken. Details of the data collection and analysis techniques that will be used are detailed in the next section of this protocol.

4. Methodology

Mixed methods of both qualitative and quantitative techniques will be used to test the hypothesis. The study will be executed in three stages, where the first stage will involve collecting participant's perceptions on the outcomes of the literature review, with the sample limited to tertiary institutions in the UK. The second study will be collecting the same data among a sample of participants in tertiary institutions among the northern states of Nigeria. The final phase of the study will involve a comparative statistical analysis of the two sets of data and does not involve any additional data collection. Stage 1 and stage 2 are planned to take place concurrently and stand as a pre-requisite to phase 3.

Series of Studies:	
Study 2: (TI's UK) ▪ Phase 1: Surveys ▪ Phase 2: Interviews ▪ Phase 3: Observation analysis	**Study 3**: (TI's Nigeria) ▪ Phase 1: Surveys ▪ Phase 2: Interviews ▪ Phase 3: Observation analysis
Comparative analysis: comparing data from Study 2 and Study 3.	

Figure 0-2: Breakdown of the series of studies

Study 1: Perception study in the United Kingdom

This phase of the study is further divided in to three separate parts:

Phase 1:

The first part will involve the use of a semi-structured questionnaire to collect perception data from participants within UK tertiary institutions, the full questionnaire is available in (Appendix: Questionnaire).

Phase 2:

Interviews with management staff to discuss and further understand what the perceived contributions of the elements are from their perspective (Appendix: Interview Schedule).

Phase 3:

An observation analysis will be conducted through active examination of the institution's performance on various elements of digital capability to determine how the elements impact the digital capability maturity of tertiary institutions/ how elements impact learning.

Study 3: Perception study in Nigeria

Study three (3) will replicate study two (2) with the same phases, using the same data collection instruments to collect perception data from participants in TIs in Nigeria. Part C, an observation analysis will also be conducted on selected TIs in Nigeria. The outcomes of this phase will allow us to accept or reject the hypothesis in the context of Nigeria (which will eventually be our case study).

A provisional list of Institutions that could potentially be involved in the study have been identified in (table 3) below. The decision on how many institutions will be employed in the study will be dependent on the time it takes to collect, analyse, and report on Institution 1.

Table 0-1: List of potential institution to engage in the study

	UK	**Nigeria**
Institution 1	*******	*******
Institution 2	*******	*******
Institution 3	*******	*******
Institution 4	*******	*******

4.1 Data Collection

Data for the various parts and stage of the studies will be collected in a number of different ways:

Phase 1: A semi-structured questionnaire, aimed at producing responses that are related the study and would allow us to accept or reject the hypothesis. This data will be collected using onlinesurvey.com on dedicated tablets, solely for the purpose of this study. The target participants for this mode of data collection will be tutors, learners, administrators, and other technical staff.

A stand will be setup at strategic location of the Campus on various data, with some posters and a timetabling sheet to recruit participants willing to take part in the study.

For management, tutors and administrative staff, invitations to participate will be sent out via email.

Phase 2: An interview with various members of the management team will be conducted and audio recorded with the aim of collection their opinions on what elements impact digital capability and the effects that such elements have on the digital capability of the institution.

For management members, an invitation to participate will be sent via email and for interested participants, an interview date and time will be arranged.

Phase 3: An observation analysis will be conducted by actively examining various elements within the themes of digital capability to ascertain what impact they have on the digital capability of the institution. This examination will include data on network facilities, software, hardware, policies and procedures, well-being facilities, privacy, security, examination procedures, assessment methods, student grades, LMSs, collaborative facilities among others.

4.2 Population

The population in this study will UK and Nigerian tertiary institutions of learning. Since the population census is quite large, the study will employ only a selection of participants for data collection.

4.3 Sampling Frame

Below is a table (table 4) with the list of members of the population:

Table 0-2: list of population members

Members	**Inclusive of**	**Involvement**
Stakeholders	Management, government, Ministry of Education	Part A and Part B
Tutors	Tutors	Part A only
Learners	Learners	Part A only
Administrators	Administrators	Part A only
Others	Others	Part A only

4.4 Sample selection

Due to time and budget constraints, it will be impractical to try and collect perception data from the whole sample, since a reasonably large sample selected at random will typically be representative of the characteristics of the whole population.

Participants from the sampling frame will be selected using purposive sampling, whereby all members of the population have an equal calculable chance of being selected. The sampling will be performed in response to the groups of strata identified in analysis of the literature search (See Table 4: population members). Participants will then be selected at random within each stratum. This helps to ensure a valid and unbiased sample that adequately represents the whole institution.

4.5 Sample size

A random selection of participants from each stratum will be recruited for this study. The study will start by targeting the following sample sizes as shown in (table 5) below.

Table 0-3: Sample size selection for Survey

	Sample Size	
Strata	Study 2 (UK)	Study 3 (Nigeria)
Management	5	5
Tutors	30	30
Learners	60	60
Administrators	10	10
Total sample size for Phase 1	X = (100)	y = (100)
Total sample size for Phase 2	X = (5)	X = (5)

4.6 Dates

The data collection exercise will take place from April (upon receipt of ethics approval) and is estimated to take about 4 weeks, although the data collection process will be classified as on-going throughout the analysis stage in case additional samples may be required. The complete study should take no longer than four calendar months.

4.7 Data quality and management

Some of the issues that will be considered in terms of the quality and management of the data collected are Data management, measurement error, missing data, non-response, quality criteria, reliability, and validity.

4.8 Piloting the study

The questionnaire will be tested in a pilot study as soon as ethics application is approved and before the main study is conducted. This pilot will allow us to obtain feedback from a selection of the participant group using the intended administration method. The results of the pilot study will be reviewed, and the data collection tool refined in an iterative process until we arrive at a final set of clear and concise questions that would allow us to achieve the aims of the study. It is also a good chance to test the understand ability of the pre-questionnaire information sheet and the definition of the elements/ themes.

5. Ethics Approval

The nature of the data that will be collected requires ethical approval to be sought from the ethics committee of the University of Hertfordshire. The study will adhere to all the guidelines set out by the ethics committee.

Participants will be informed both verbally and in writing about the details of the study, and that participation is solely on a voluntary basis, and participants are free to withdraw from the study at any time. In addition, written consent to participate will be obtained from volunteers.

Raw data will be stored securely in accordance with requirements of the ethics committee and in line with the GDPR (2018).

6. Proposed Data Analysis Techniques

Since there are series of studies each involving different data collection techniques, the analysis techniques will involve a combination of qualitative and quantitative techniques.

For Study two (2) and Study three (3), the following data analysis techniques are proposed:

6.1 Phase 1: Mixed methods

The data collection tool uses ordinal scales and thus the data collected will be ordinal and non-parametric. This data will be exported to SPSS for non-parametric statistical analysis.

Question type 1: *Indicate your level of agreement that 'elements found in literature' are elements of digital capability (Using a 7-point Likert scale).*

Multi-variant factual analysis will be conducted to ascertain the contributions of each element to digital capabilities. A Friedman test will be conducted to measure rank order scores to test the level of agreement.

Question type 2: *Indicate your level of agreement that the 'elements found in literature' make a positive contribution to digital capability in tertiary institutions (Using a 7-point Likert scale).*

Friedman test will again be used here to measure the variation in rank sums and ascertain the contributions of each element to digital capabilities, allowing us to report on the distinction between theoretical perceptions and real-world perceptions.

Question type 3: *Rank the elements of digital capability in order of significance of their impact on digital capability in tertiary institutions on a scale of 1-10 (where 1 = least impactful and 10 = most impactful).*

Once again the Friedman test will be used to test the level of agreement each variable and those with the highest level of agreement will be ranked the most significant.

Question type 4: A*re there any other elements that may contribute to digital capability of tertiary institutions? If so, please indicate the elements and effect (Open-ended).*

The last question of the study involves an open-ended question asking participants to indicate if there are any other elements that may contribute to digital capability which have not been identified in the study. The results to this question will require content analysis.

6.2 Phase 2: Qualitative analysis

Interview with management will be audio recorded and transcribed verbatim. Content analysis will be used to analyse the transcription data using Nvivo.

6.3 Phase 3: Mixed methods

Observation analysis will be conducted using mixed methods.

6.4 Comparative analysis: Quantitative analysis

To perform a comparative analysis of DCMiTI in UK and Nigeria. The data from both studies will be used to find out if there is a statistically significant difference between the group means (Wilcoxon test).

The results of this analysis will be used to provide a distinction between the current status and perception of digital capability between the UK and Nigerian tertiary institutions.

Furthermore, the following assumptions have been made in anticipation of the hypothesis tests that will be run.

Assumptions:

1. We assume that DCM does not have a Normal Distribution.
2. We assume that stakeholders are chosen at random, and they are independent of each other (that is, the perception of one respondent does not affect the perception of another).

7. Disadvantages

Parametric tests have greater statistical power, meaning they are more likely to find a true significant effect and are thus the preferred option for analysis. However, non-parametric test are also known to perform well with non-normal data (data that does not assume a normal distribution), especially when there is a sufficiently large sample size. For this reason, non-parametric analysis is considered appropriate for the purpose of the study.

8. Reporting

On completion of this study, the results will be reported to either accept or reject the hypothesis and ratify the claim that the elements of digital capability listed in (table 1), are those that contribute to DCMiTI. The results of the statistical analysis will be presented in the form of tables and/ or graphs that convey the information necessary for the intended audience to understand the data. Being mindful of the ease of misinterpreting graphs, descriptive data analysis techniques will also be used to provide a supporting narrative of the results, emphasising the key points. Furthermore, a reflection of the study will be documented, highlighting any threats to validity of the data, and concluding with suggestions for future work.

The results of this study will further inform the overall doctoral research on proposing a framework for development of digital capability maturity in tertiary institutions of learning.

9. Making changes to the protocol

There may be a need to apply changes to this document as the study progresses and in the event of applying these procedures in a different situation. While some of these changes will be useful to improve the current process as documented, other changes will be necessary to suite to context of the situation in which the protocol is being applied. All changes will be recorded, and the protocol will be updated accordingly using version control.

10. Communication and dissemination plan

The results of this study will be published as a conference paper. The conference that has been targeted for this publication will be ASCILITE 2019. The conference is schedule to take place in Singapore, 2-5 December 2019. Key dates related to submissions, registrations and other important activities for this conference are not yet available. However, the title for the conference is: 'Practice and Research in the Use of Educational Technologies in Tertiary Education'.

In the event that the results of this study are not available to meet the requirements/ deadlines for this conference, a conference plan has been drawn up. In light of positive impact that contributions of peer review and conference feedback have on academic research, various options for disseminating the on-ongoing outcomes of this overall PhD research work can be identified (See Conference Plan in Appendix).

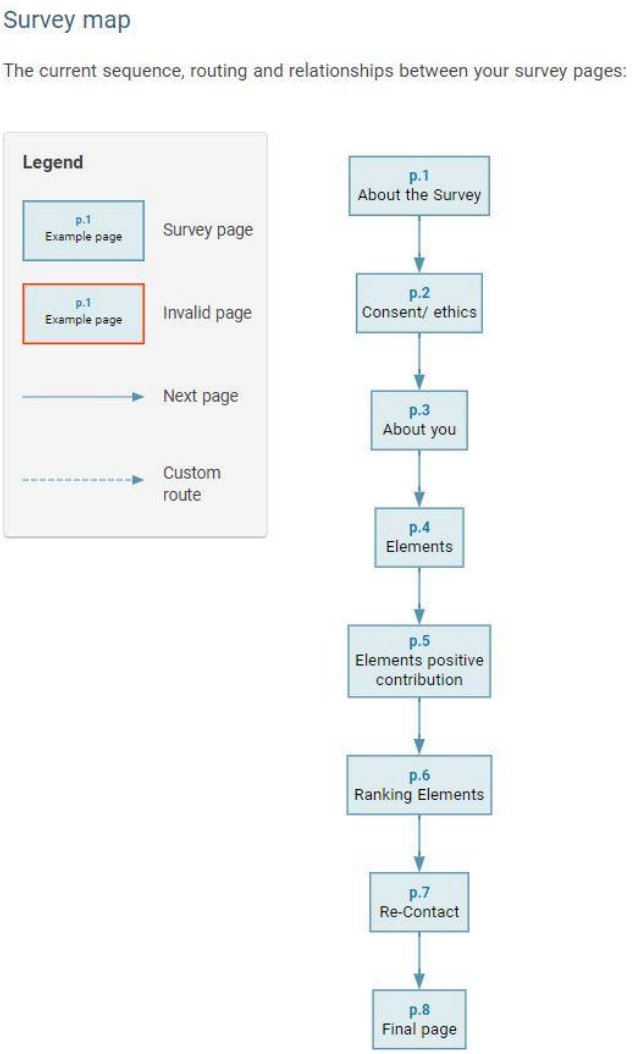
Finally, an edited version of this protocol will be included as part of the online appendix for this publication to provide the necessary transparency into the process and final report.

END OF PROTOCOL

References

1. Tourangeau, Rips & Rasinski, 2000. The Psychology of Survey Response.
2. Segal and Castellan, 1988. Nonparametric statistics for behavioral sciences.

Screenshots of Online Questionnaire



University of Hertfordshire UH

Investigating elements of Digital Capability

0% complete

Page 1: About the Survey

Dear Participant,

Digital capability is 'the ability of an institution to sustain *effective* and *efficient* use of *digital assets* to support *teaching, learning* and *working*, through *continuous evaluation, selection* and *adoption* of *new technologies* and acquiring necessary *skills*, for full *utilisation*'.

This study is testing elements of digital capability derived from a literature review. The study is looking to see how well the theory matches up to real-world perceptions. The primary objective of this research is to arrive at a conclusion as to which elements contribute to digital capability maturity.

I am interested to learn your perceptions of what elements/ factors contribute to **digital capability** as part of my postgraduate research work. The purpose of this study is to find out how people feel about the digital capabilities of their respective institutions. The responses you give will help assess the needs of tertiary institutions based on stakeholder perceptions and propose a capability maturity model.

I would appreciate you taking **about 10 minutes** to complete this survey with the assurance of full ethics adherence.

Thank you in advance for your time and assistance.

Best wishes,

Zarah Bello

University of Hertfordshire UH

Investigating elements of Digital Capability

14% complete

Page 2: Consent/ ethics

[The participant information sheet will be uploaded here!]

I have read the participant information and hereby freely agree to take part in the study entitled 'Investigating elements of digital capability' under UH Protocol number [******].

- ○ Yes
- ○ No

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Page 3: About you

Stakeholder type:

- Management
- Tutor
- Learner
- Administrator
- Other technical staff

Which age group do you best fit into?

- 18- 24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+
- Prefer not to say

What best describes your gender?

- Female
- Male
- Prefer not to say

Prefer to self-describe:

Which Tertiary Institution are you associated with?

Which Tertiary Institution are you associated with?

Which department do you belong to?

What is your current level of study?

What is your current course of study?

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University of Hertfordshire UH

Investigating elements of Digital Capability

42% complete

Page 4: Elements

Please rate how strongly you agree or disagree that the elements listed below, are elements of digital capability (on a 7 point scale, where 1 = strongly disagree and 7 = strongly agree)

This part of the survey uses a table of questions, view as separate questions instead?

	* Required						
	1	2	3	4	5	6	7
Stakeholders: include government agencies, ministries, all levels of students and staff roles within an institution	○	○	○	○	○	○	○
External Environment: the environment in which the institution is physically situated, ie. country or city	○	○	○	○	○	○	○
Tertiary Institution: the institution of learning in which tertiary level education is delivered	○	○	○	○	○	○	○
Infrastructure: the basic physical structures, network infrastructure, connectivity, hardware, software and usability that supports the institution	○	○	○	○	○	○	○
Individual skills: an individual's interpersonal and technical skills, and their readiness/ willingness to achieve their full potential	○	○	○	○	○	○	○
Digital Identity & well-being: health, safety and security. Availability of technical and family support to help individuals maintain a healthy work-life balance. Also	○	○	○	○	○	○	○

Tertiary Institution: the institution of learning in which tertiary level education is delivered	○	○	○	○	○	○	○
Infrastructure: the basic physical structures, network infrastructure, connectivity, hardware, software and usability that supports the institution	○	○	○	○	○	○	○
Individual skills: an individual's interpersonal and technical skills, and their readiness/ willingness to achieve their full potential	○	○	○	○	○	○	○
Digital Identity & well-being: health, safety and security. Availability of technical and family support to help individuals maintain a healthy work-life balance. Also consider relationship management, self-motivation and self-management	○	○	○	○	○	○	○
Resources, tools & content: the learning resources, tools, content and social networks used to support institutional goals - inclusive of Administrative systems, digital libraries, LMS and other digital educational resources.	○	○	○	○	○	○	○
Learning, training & development: the learning and teaching practices and methodologies aimed at delivering new knowledge or skills, including professional development	○	○	○	○	○	○	○
Collaboration: the collaboration culture within the institution. Including collaborative working, learning and teaching; facilitated through communication, connectivity and infrastructure	○	○	○	○	○	○	○
Creation & Innovation: the creation and innovation culture within the institution. Including design and innovation of new approaches to the use of digital technology for learning & teaching Creation of digital content and media production	○	○	○	○	○	○	○

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Investigating elements of Digital Capability

57% complete

Page 5: Elements positive contribution

Please Indicate your level of agreement that each of the elements listed below make a positive contribution to digital capability in tertiary institutions, on a 7 point scale (where 1 = strongly disagree and 7 = strongly agree)

This part of the survey uses a table of questions, view as separate questions instead?

	* Required						
	1	2	3	4	5	6	7
Stakeholders: include government agencies, ministries, all levels of students and staff roles within an institution	○	○	○	○	○	○	○
External Environment: the environment in which the institution is physically situated, ie. country or city	○	○	○	○	○	○	○
Tertiary Institution: the institution of learning in which tertiary level education is delivered	○	○	○	○	○	○	○
Infrastructure: the basic physical structures, network infrastructure, connectivity, hardware, software and usability that supports the institution	○	○	○	○	○	○	○
Individual skills: an individual's interpersonal and technical skills, and their readiness/ willingness to achieve their full potential	○	○	○	○	○	○	○

usability that supports the institution							
Individual skills: an individual's interpersonal and technical skills, and their readiness/ willingness to achieve their full potential	○	○	○	○	○	○	○
Digital Identity & well-being: health, safety and security. Availability of technical and family support to help individuals maintain a healthy work-life balance. Also consider relationship management, self-motivation and self-management	○	○	○	○	○	○	○
Resources, tools & content: the learning resources, tools, content and social networks used to support institutional goals - inclusive of Administrative systems, digital libraries, LMS and other digital educational resources.	○	○	○	○	○	○	○
Learning, training & development: the learning and teaching practices and methodologies aimed at delivering new knowledge or skills, including professional development	○	○	○	○	○	○	○
Collaboration: the collaboration culture within the institution. Including collaborative working, learning and teaching; facilitated through communication, connectivity and infrastructure	○	○	○	○	○	○	○
Creation & Innovation: the creation and innovation culture within the institution. Including design and innovation of new approaches to the use of digital technology for learning & teaching Creation of digital content and media production	○	○	○	○	○	○	○

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Page 6: Ranking Elements

Please rank the following elements in order of impact on digital capability in tertiary institutions on a 10 point scale (where 1 = least impactful and 10 = most impactful)

This part of the survey uses a table of questions, view as separate questions instead?

	1	2	3	4	5	6	7	8	9	10
Stakeholders	○	○	○	○	○	○	○	○	○	○
External environment	○	○	○	○	○	○	○	○	○	○
Tertiary institution	○	○	○	○	○	○	○	○	○	○
Infrastructure	○	○	○	○	○	○	○	○	○	○
Individual skills	○	○	○	○	○	○	○	○	○	○
Digital identity & well-being	○	○	○	○	○	○	○	○	○	○
Resources, tools & content	○	○	○	○	○	○	○	○	○	○
Learning, training & development	○	○	○	○	○	○	○	○	○	○
Collaboration	○	○	○	○	○	○	○	○	○	○
Creation & Innovation	○	○	○	○	○	○	○	○	○	○

Are there any other elements that may contribute to the digital capability maturity of a tertiary institution? If so, please indicate the element and why you consider it an element? *Optional*

University of Hertfordshire UH

Investigating elements of Digital Capability

85% complete

Page 7: Re-Contact

In the event that we may require further information as part of this study, would you be happy for us to contact you?

- ○ No
- ○ Yes

Email address:

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University of Hertfordshire UH

Investigating elements of Digital Capability

100% complete

Final page

Your responses to this survey have been submitted.

If you need a formal record of your submission, please use the following details:

Completion receipt

Receipt number: 1-1-1
Submission time: 2019-03-28 14:16:01 GMT

Print | Download PDF | Email

Thank you for completing this survey!

I would like to remind you that the information you have provided in this survey will be anonymised and cannot be traced back to you. Furthermore, all the data will be held in accordance with GDPR and guidelines from the University of Hertfordshire Ethics Committee.

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Interview Schedule

The following questions have been designed to gain an in-depth perception of tertiary education stakeholders on the elements that contribute to Digital Capability and how these elements impact Digital Capability Maturity in Tertiary Institutions.

In answering the following questions, kindly draw on your broad knowledge of the tertiary institition environment and your experiences as a member of management within the institution:

1. **What elements contribute to digital capability?** *(Probe)*

(Open-ended)

2. **In your opinion, how do these elements impact the digital capability maturity in Tertiary Institutions?** *(Probe)*

(Open-ended)

3. **In your opinion, which specific element have the most impact on learning and why?** *(Probe)*

(Open-ended)

4. **Are there any other opinions you wish to share in relation to DCMiTI?** *(Probe)*

(Open-ended)

Appendix S: Transcripts from Study 3

Interview Transcript 1

Date: Friday 10th May 2019

Time: 10am – 10.30am

Interview between 'Participant 1' and Interviewer.

Audio recording started

ZB: Good morning [HB].

HB: Good morning [ZB].

ZB: Thank you for joining me today. So, the idea of… the primary purpose of this interview is for me to gather in-depth information about your perception or your opinions about DC in HE, and just to understand how those element impact on one other. As you may already know I have been working on this research for coming to two years now, and I have done an extensive literature review and, in that Literature, review I was able to uncover 10 things that impact DC. So not necessarily factors as such, I kind of struggled with the term to use whether to use elements or factors but so 10 things that impact on digital capability. I am now trying to compare what real world perceptions are to what the literature says to see if there is practice gap there. I am suspecting there may be, but it will be really interesting to see what stakeholders within this institution – there perception on Dc to then analyse that data and see what come of it.

I have this sheet [lowers voice] that which again I should probably have sent you before

HB: [Laughs]

But it's basically explaining how I have defined DC for the purpose of my research and then listing out the ten elements that I have identified and a brief description of what each of those then elements are.

Now I'll just go straight into the questions.

HB: Yeah, I'd... I'll try not to be influenced by that because they might be different to what I think.

Question 1:

ZB: So, drawing from your broad knowledge of the TI environment and your experiences as a member of this university, what would you say are the elements that contribute to DC?

HB: I mean I'm partly influenced because I'm very aware of the Jisc framework, I won't be able to remember it off the top of my head but so I have an awareness of what a sector body thinking DC looks like. But from my perspective I think there's element of Digital skills, so as a staff member, your ability to be competent in using digital technology within your teaching but also within your discipline, so keeping up-to-date with the currency of digital technologies within your field of study and ensuring that we are teaching that within the currency of the curriculum for the students within the discipline. But also keeping up to date with digital skills associated with teaching, so assessment tools that you might use, classroom technologies, student engagement apps or facilities, so I think there's something about the skills of the teacher in that sense both disciplinarily and pedagogically.

There is also then I would say a digital analytics kind of side so how are you capable of using data and sources, and referring to materials and drawing out themes from the data were getting, which we didn't use to get, so a kind of DC in terms of data analysis and data visualisation to a certain degree. And that might be individual in terms of how you collect data or know where to get data, can see the data but also then from an institutional perspective about how we are making use of big data to support students and support infrastructure really, to make sure were efficient.

I think there is… the other element is digital creation, which I think that people are struggles with [giggles] that involves then the ability and skills to create materials, online materials, resources and I think some people have the perception that should be you've got to be able to code, you've got to be able to create websites, I don't think that should be the case. Some people will be able to do that, some people should have the opportunity to do that, I think within our university for all good reasons, we have good structures but sometimes it inhibits people who have huge digital creativity, there not allowed to make a website because it doesn't fit with the other structures, so I think there a bit about how an institution enable creativity but also doesn't then upset people who haven't got that level of creativity, it doesn't put them off from trying what could be quite a small creative innovation of video recording, a podcast of digital creation in that sense.

What else have I got on my list?

The biggest one I think in digital wellbeing, and I think that is so relevant for everybody, for student for staff, for our awareness of society as a whole. And we have a responsibility as staff to be ethical in our use of digital media, I'm a big user of twitter and I use it both from a work perspective and from an individual perspective but I'm very aware of what I'm posting and I think we need to be aware of that and we also need to help communicate to students the importance of understandings their digital footprint and their communication in digital media. And that, as well as kind of the digital footprint, I do think that digital well-being in broader than that in terms of I think a university should have some guidelines about say for example email etiquette and times when there's an expectation that you would respond to an email but a very clear message when there are times when you should not be responding, because that's setting up unrealistic expectations. So helping everybody to manage the work-life balance but more than that their digital usage and we've seen so much biological literature about the risks of looking at digital media very late at night, disrupting sleep patterns, we've looked at neck and eye injuries, so I think there a big big piece about digital well-being in its broader sense.

Is there any other aspect of DC… [thinking]?

I think the other element, I guess is as well as the skills but your own sense of development that you are committed to developing your own skills and practice and keeping up to date; and i think to get a culture within an institution where everybody understand it is their expectation and wants to learn, I meant that's where you want it to be really [laughs] you want people to be excited about learning something new or making good use of a digital tool that's hopefully going to be more efficient for you, that you understand what its purpose is, why its going to be good. So yeah, that would be a lovely kind of measure of a digitally capable institutions if everybody staff and students, staff from all different parts of the university were enjoying developing their digital skills and excited about learning something new and putting it into practise [laughs]

ZB: It would be perfect

HB: It would be nice wouldn't it?

ZB: yeah on that was really insightful actually because you gave to really in-depth description into each of them and that was quite interesting. So, should I move onto the next question?

HB: Yeah let's.

Question 2

ZB: So, in your opinion, you might have already touched on some of this but how do these elements, HOW do they impact the DCM of a university or tertiary institution?

HB: I think, talking about our university, I think we are quite strong in terms of DC because we've had a legacy of the VLE, so 2001 we had StudyNet, that when it was introduced and the way it was introduced then was quite clear, there were thresholds that every module had to do, it wasn't just you could have a module you could not have a module, everybody had a module, there were thresholds of what you had to put on it, so again it was a strategic implementation which I think was really important. And that then has always been the case that our institution from a Learning and Teaching perspective since 2001 has been committed to DC to a certain degree and within then the purchasing of a new VLE and a roll of this kind of wide sense of a guided learner journey, we took a long log time consulting with students and staff to make sure we were going to go out to tender for the right thing for our institution and that consultation process took four years. And so I think that commitment to getting it right because it's so important to us, where as I think other places will have gone oh yes we need a VLE or we need this technology for this or we need this, you know and just gone out and brought something will have hindered DC in some institutions. Now I'm not saying that ours is perfect, of course it isn't but I think because of that centralised approach and that commitment to technology enhanced learning I think we've got a reasonable benchmark of DC across the university in terms of the academic side. I think our staff are reasonability competent, I mean obviously within that there a huge range, some people are incredibly competent, some people are less confident and competent, but we have done a huge amount to provide staff development, to be clear about this is what we are doing, this our approach. It is a expectation, if your are coming to work at the university of Hertfordshire, these things are things you will have to engage in. So, I think that message has been reasonably clear.

I think what that sort of misses is perhaps some of those wider discussions about digital well-being, we haven't had that on a broad scale within the institution, I think we've been focused on some skills, [ermm] getting the right tools and technologies in places, you know resourcing, we've committed a lot of money to ensuring a digital focus within the university. What I'm not sure we've done to the same degree is have that wider discussion, digital well-being, digital creation to a certain extent.

ZB: Is well-being something that's considered in terms of decision-making when looking at which learning environments to choose.

HB: Well that's a good question. I think those of us that were involved in kind of the decision about what we were going to buy, I think yes, they were considered. Especially things like the usability, could, would there be the app, and how would it all join together so you've not got to looks of lots of different things, so there would be some kind of management and efficiency in terms of that. I'm [pause] not sure we had the wider conversation with all parts of the university. And I still think these kinds of, there are pockets of conversation about email etiquette, there are pockets of conversation about social media usage but I'm not sure we've had any strategic discussion or a strategic paper about those things and perhaps that something that is needed. And some institutions with a DCM would definitely be there, I think. The other thing I think were perhaps a bit behind the curve in is DC within the disciplines. So, you know we're an institution that applied in its nature we bring in lots of people from industry, we bring in people from the NHS, which is great and that does bring in currency of digital developments that are happening in their disciplines, but what we we've also got and I am one of them is a lot of staff who have been here a long time. And so they may miss out on knowing about some of the very recent digital developments happening within their disciplines and so we may be a bit behind the curve on some of the latest developments; and also the finance to keep up with that, you know the landscape is shifting so quickly, [ermmm] so I think that's probably in that wider sense of digital capability maturity.

ZB: Is staff professional development compulsory or is optional?

HB: Ah there's an interesting one, [errr] it's… for things like the guided journey role out it was pretty much compulsory. So, every module leader had to go on training and that was recorded… I'm not sure what would have happened if a line manager would have said you haven't been? And because we provided training in so many different ways, there's a workshop, there an online module to do, there one-to-one support, there student technology mentors. So actually, I think it would be fair to say it wasn't compulsory to come to a workshop, but it was compulsory to engage in training of

some nature and actually having the variety is really important in that. In terms of then other development, I mean that a very specific things, in some ways its not easy because its been a massive project to do but because it was a roll out, you've got the, your got the kind of [I don't the word] but you've got a bit of a stet to say look you've got to get up to speed, look this new, you've got to understand it. Whereas other things that are sort of gentler and more on-going are I'm not sure it's seen as a compulsory thing, things like you know just being really competent with Microsoft products. You know it's not compulsory for people to do excel training and things like that and that's where I think we could move to kind of a better baseline of staff.

ZB: So that in terms of staff development, but I've seen quite a lot of staff development programmes run within the university.

HB: Yeah there are a lot offered.

ZB: Ok a lot offered but it's just dependent on the person.

HB: and I think that the, you know… its monitored so if you go to a session that's put on the system that fine, but your line manager would never check up on that and so it doesn't become a compulsory, mandatory thing.

ZB: Is there reward, like a recognition scheme?

HB: There's not necessarily a recognition scheme but I think if you then. Lets say you went to something, you then implemented it within your teaching for example, you could then write that up as part something like applying for fellowship with HEA or associate fellowship and within that you'd have to say how you used technology to enhance your teaching and so in a very indirect way becomes recognised. I think what's good within this university is, we've often talked about professional development for academic staff, there's not always been a clear ring fence time for professional development of professional and technical staff; and the university is committed to professional and technical staff having I think 10 working days where they can do development of some nature so that might be going to a conference, it might be helping out during the university graduation ceremony, it might be doing a course, it might be doing online training. So there kind of recognising that staff development is sort of everybody's right and an expectation of everybody; is important and allowing them time for that is crucial.

ZB: Ok! So, some of these… some of what we've just discussed in this last question, how would you say having it of not having it impact the ability of the university to mature digitally.

HB: In terms of staff development?

ZB: Yeah.

HB: If we didn't have it, we'd be way behind. I think it's really important. I think as I've mentioned, I think it needs to be in a number of different modes and different ways for people to engage with it. Particularly with technology focused development, its sort of it has to be 'just-in-time', so you can do something, go to a training session, if they don't use it for 6 months its gone so you've got to think about when you need it, when its relevant for you but also because its in those different formats that you might go to a training session, you might not use it but coming up to that point 6 months later you might go oh I can just look at linda.com and I can just refresh what that is. So, I think it's got to be in multiple modes, and it's got to be accessible at the time when you need it. And I think what's really nice within the university is that we have got lots of people if you pick up the phone to them and say: oh I've forgotten how I do this, or I want to do this in my teaching, how do I do it?; then people will help.

ZB: So, a good support network.

HB: I would say.

ZB: You just mentioned Linda.com, so having resources like Linda.com, how do you think those impact on DCM.

HB: I think there… I mean I have to say I don't use it enough, as I should [giggles]. And it's on my little action plan to look specific things I want to do with it. But I think it's great that it's an option. I think it's really positive. I don't know... I mean I haven't seen any of the stats on how it's been used yet but I think it's a really positive move. Erm and I think, its is, for me it's a complimentary tool; because I think a lot of things you either do a s a course online and then like I say you might need to come back to it and tap into it again; or it's something quick you want to look at; oh I wonder how you do that? Oh I'll just have a look on linda.com.

ZB: Yeah, fantastic! So, onto the third question.

Question 3:

ZB: So, in your opinion, which specific elements have the most impact on learning and why?

HB: [Ouuugh] I mean I guess in terms of those high levels elements at the beginning we talked about, digital skills I think is probably the most important. [Eermmm] because I think you have to feel [pause] confident and some degree of competency, but the confidence is really important within that. Particularly in a teaching environment, because it can feel every pressured and if things don't work, if your not confident you can feel you've lost all, not creditability with but you can loose them for then the session and sort of feels like wasted. Where as actually if your confident, if it goes wrong it doesn't matter; and having that confidence to deal with it whether it doesn't go quite to plan or completely doesn't work I think is a really important and one of the things we talk about in terms of… with new staff not worrying about the technology. Technologies are there to help you, they are not a thing in its own right. If it doesn't work, it doesn't work, you've got other tools; and having those other abilities the confidence in the moment to do something different I think is really important.

In terms of… from a sort of student perspective [pause] the specific elements, I mean I think again, I'm hoping, I hope our joint-upness of what were thinking in terms of digital use for students and for staff is an important element; that there is a kind of digital infrastructure. That it's not something over here, it's not something completely separate over here, and it's not disjointed. I think that really important for students that they see how these things interlink, that the information pulls together in logical ways, the reading list is linked with the lecture, that sort of thing, you know. There more joined up we can make things, the better.

And I guess from a student perspective as well that were using the right tools that they want to use. It's all very well us having studynet but actually what the students like to use, in our particular case is that Canvas app which doesn't run through studynet, so you have to go straight to the Canvas app. We have to be aware of that. That's why we brought something that had a good app. So we have to continuously listen to what the students want but also were looking at the data to use what there using and how there using it; and so drawing on analytics to sort of guide further decision making.

ZB: Yup! So you mentioned, I mean if I was to sort of group them I would group into three, you've talked about skills and then infrastructure, of the various tools that are, I mean the flow of information being linked [laughs]… the 'together-ness'.

HB: yeah, together-ness. I like that, there you go.

ZB: and then you talked about the tools that were available to the students. So, if you had to rank them on their level of importance?

HB: [Oooooh] I think in some ways I guess [pause] I mean if the students aren't using them then it doesn't matter what else were doing. So, in some ways it's kind of the student usage in that sense is probably the most important. And if we get that wrong then [laughs]… then were in trouble.

So, I guess that the most important. I mean it' not necessarily 'tools', its perhaps not the right word but I meant student usage. Engagement

ZB: Usage of the tools you mean?

HB: Yeah

ZB: Ok. So that would be number one.

HB: Yeah. There no point doing it if there not using it [laughs].

ZB: [laughs] there isn't! And then you wouldn't be able to gage if there's no analytics from the usage then you're a bit lost.

HB: You're guessing in the dark.

I guess number two I think is probably skills. [Pause] cause that will have an impact on learning. If you're not bale to facilitate using tools well then, that going to impact on student learning.

ZB: And then the third…

HB: Three will be infrastructure, yeah!

Question 4:

ZB: Ok, and then finally… in your opinion [pause- restart]. Are there any other opinions that wish to share in relation to the Capability Maturity of a University?

HB: I think it's very easy for people in my position and in my role to really focus on staff development and staff capability, so we think about workshops, we think about teaching in the classroom. What I don't do as much is think about student capability coming in, so what capability do students have from different backgrounds, do we make an assumption that everyone has a certain degree of competence within digital usage. Do we have an assumption that all students have some of the hardware? And I think at university level in the wider context then I think we are having those conversation, I think were thinking about laptop hire and all sorts of different things. But from a kind of practitioner perspective, I probably make quite a lot of assumptions about my students and I think we need to be alert to that and that might be quite different in different disciplines. And it would be easy to make an assumption that students coming to study Computer Science for example would have very good digital capabilities, they may have very good digital skills in certain areas, they may be great at digital creativity, and they may not be great at digital well-being. And so actually again thinking about the elements of DC that might be quite different, for different students, different disciplines, and students at different periods of their life; and from different backgrounds.

ZB: [Ahhh] so in terms of backgrounds, how…, what… can you elaborate on that?

HB: Well just what their previous education experience has been. If there's been a lot of DC within their schooling, if there coming from countries where

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 2
Date: Wednesday 22nd June 2019
Time: 10.00am – 10.47am
Interview transcript between: 'Participant 2' and Interviewer

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Audio recording started

[Brief breakdown of the research for interviewee]

ZB: Drawing from your broad knowledge of the Tertiary Education environment and your experiences as a member of management. I have a list of about four questions that I would like to ask you.

KB: Ok, yeah!

ZB: I'll do this so that you can see them as well [turn's laptop to face participant]

Question 1:

ZB: So the first question is; what elements do you feel contribute to Digital Capability?

KB: It's in individuals or, so for a person? Personal digital capability?

ZB: Yeah, you can talk about in in the individual sense or in the organisational sense, so whatever applies and if there both, I'd like to hear

KB: Yeah, I think within the institution certainly we have been looking at digital capability quite specifically as defined by Jisc (joint information systems committee) and a couple of years ago we had put together a group within the institution to look at whether or not we would define what we though DC meant for the institution. We did a lot of talking around about that and you know different views were coming but we also then went out look at what Jisc had defined and essentially we came down to agreeing that what they had defined would broadly encompass what we thought those things were.

I think they had 7 in their framework rather than 10.

ZB: I should probably have given you the definition of Digital Capabilities in the context of my research, so just quickly I've defined DC, not different from what Jisc have said but just my own definition in the context of my research.

Definition: it's the ability of an organisation to sustain effective and efficient use of digital assets to support teaching, learning, and working through continuous evaluation, selection and adoption of new technologies and acquiring necessary skills for full utilisation.

KB: Yeah ok that quite broad in terms of that, and they there's 10, you said there were 10 elements to that.

ZB: Yeah, I won't show you them now because they will probably influence what you're going to say to me.

KB: No I don't want to be influenced.

ZB: Yeah but just the definition I thought would be quite useful to help you understand how I have defined DC in the context of this research.

KB: Yeah and obviously it think there's those two aspects, there DC of the organisation but that also is actually quite dependent on the people and what they are able to do, use make of digital technologies and the rest of it. So there two things do depend on one another.

And the Jisc framework certainly very much looks at the individual level and what an individual's digital capabilities might look like, and I won't be able to round them all off but ICT skills, general, you know how to use applications and pieces of software and all the rest of it that we have; day-to-day other things like information literacy, ability to find and use data. One of the aspects I like about it that other one of Digital Wellbeing; so being able to be safe online and understand what your digital footprint looks like. I like the idea that ranges from those soft things which are much more about the use of the tools in a safe and secure and I don't mean that just from the point of view of data, I mean safe and secure in a personal sense, a wellbeing sense. To the actual use of, appropriate use of the appropriate tools and being able to select the appropriate tool for the job and so on.

So I quite like that, the broad range they have. I think they've taken it down that road of looking at, depending on your role within an institution you will need, or you should possess or whatever you wanna call, how you wanna phrase that; slightly different levels of DC among these different dimensions. So if your job involves, if you're a research your job might involves a higher level of DC around research and finding information, data collect and manipulation than someone who is an administrators in a school looking after student programmes or someone who does a lot of teaching and has to go into a classroom and use the VLE and mark online and all the rest of it. So I think there recognising that there's a, and I agree with that there a range of lots pf different aspects to DC and you as an individual will fit slightly differently into a profile and have strengths and weaknesses.

I think at an institutional level I've used the phrase 'a digitally capable culture' which is a kind of cop out to some extent but its saying the institution to some extent be enabling and facilitating staff to access, give them access first of all to the right tools for the right job, digital tools. And then support them in development in the areas where they need to develop

to enable the institutions to be able to carry out its role but also move forward and adapt and be forward thinking and actually leverage the best it can from all the digital tools and so on.

ZB: Ok, is this; I suppose your experiences are somewhat influenced by the Jisc framework that out there. So are there any other elements' that you feel may contribute to digital capability outside of that framework?

KB: I mean im not sure, again because I think it covers pretty much most of what I think would make up DC and it's trying to be quite generic at the same time as also recognise the difference in roles. So it's not going to talk about well you have to be able to use word processing and spread sheets and it's not like that; its saying you have to be able to use the tools that are appropriate for the role that you have and the job that you need to do. Errrm, and I think that fine because we can recognise that even within the institution there will be staff and students in one schools who will be using one set of tools and approach to DC and another set of students having a much higher level of DC in some area for example they will be doing video editing and production and recording and others the most they do is for example take a photo or take a short video on their phone and upload it to the VLE. So I think, you know there is that variation and that's what we've got to recognise and when we talk about capabilities I still think it's something around; in general an ability to recognise when use a of digital technology is appropriate, know how to use that appropriately and then enhance what you're doing by use of that tool. Yeah I think part of the problem is we a lot of technologies with a lot of rich functionality within them and we don't use they at all to the extent of the benefit we could get. We tend to use them in a very limited way most of the time. I mean you know, without, I don't mean to disparage any of my colleagues, I'm including myself in this; it's everyone in the institution, we don't really know how to use outlook well. Well enough.

ZB: [Laughs] I have to agree. I can confess to calling helpdesk, but you know it's just one of those things.

KB: So it is a day-to-day tool, we all use it, we all use it extensively, every single day, it's our main method of communication if you asked staff students, and you know what do you use? Email! It's the things that open on everyone's desktop, it's on everyone phone but we don't use it at all to the limit that we could be using it.

We don't organise our work, you know some people will have folders and other people won't. Some people will flag things for reminders and some people will automatically be able to cypher things into folders and delete things or use the calendar in conjunction with others and see who's available for meetings and yet not everyone can. And we don't yet have even I think a kind of baseline expectation of what people should use certain tools for and think that's one of the 'ish' challenges we've got is well we say we've got these tools and we leave it up to the individuals to make the use of them they think or is appropriate.

ZB: and that expectation would come from? Well if there were to be one where would that come from?

KB: I mean that's a difficult one because I think we've looked at it in the DC group whether we should be saying within for example role descriptors being more explicit about what we mean, because there will be often some statement, some vague statements certainly in generic type role's around you know, good IT skills or proficiency and blah blah blah. And sometimes when people are applying or a job they are asked to carry out a task which might involve some use of a spreadsheet or a mail merge or something along those lines or using PowerPoint to do a presentation, so there will be a bit of testing of that when you do recruitment, but it's one aspect of things and it's a very small element of, and we haven't gotten to the level of saying actually to do this job you need to be really familiar with these things and you need to have that level of digital capability and maybe it's not a problem of you don't but if you don't then we need to have support and development training in place for you do that you can because when you've got all that you'll be the best; or better at your job as a results because we know that these are things that you need to be able to use.

ZB: Yeah

KB: So we do it to an extent, so as I said staff will come in and they won't know how to use our VLE so there's training for the VLE. There's master classes so you can use other parts of it, there are online courses that we direct to, there are workshops and there's one-to-one help but it tends to be again I think on the basis of; there's bare minimum of stuff covered and then beyond that it would be on the basis of a voluntary kind of recognition that you need some development and you choose to go on the training because it will help you personally; rather than being somewhat that we've said oh you have to do that and achieve it. Yeah.

ZB: Ok, yeah! I think we've covered quite a lot of elements there.

KB: a lot.

ZB: So if there's no other elements that you can think of then I'll go on to ask the second question which stems from the first question and ask you opinion of how the elements that we've just discussed impacts the DCM of a university?

Question 2:

ZB: like what effect would that have on the Digital Capability Maturity of the institution?

KB: Ummm, yeah I mean clearly the more confident or competent individuals are in each of the elements then the more digitally capably mature [giggles] [a lot of words] that the institution becomes, you know, the better, you know as individuals develop that capacity the institution grows that capacity. So ermmm, I think we tend to concentrate more of the ICT skills, you know being able to use packages or bits of equipment that we have within the institution and probably getting individuals more to a position where they are continually self-evaluating what they need to do in terms of their jobs and they currently can do with the tools that they have at their disposal; and trying to evaluate how far off they are

is really a sign of the maturity; is that it's a self-directed erm learning organisation. So its learning organisation in the area of digital capability and individuals have the responsibility of ensuring that they are keeping themselves at the point they need to be in order to do the job, in order to move the institution forward,. There might even be a step beyond that which is a sort of horizon scanning of seeing well I know how to use all the stuff that I've got but actually there's this thing over here that I've recognised and im aware of and I know that if I or we as an organisation moved in this direction we would improve things and we would be able to do things better or more effectively and that probably another level of maturity I which is that kind of additional bit of being a learning culture that says well DC is not fixed, it's always going to be changing and just being on the curve is one level of maturity but being ahead of it is an even greater aspiration.

ZB: You mentioned among the elements you mentioned was wellbeing, so how would say that affects the digital capability maturity?

KB: Yeah I mean I think that one is an interesting one because ergh, it's probably one that has become, which I don't think was anything that people thought of as an element of DC a few years ago even but I think has become more of an issue and people have become much more aware of the dangers of constant access to online, being on your phone all the time, the amount of information coming to you. The ability to turn off from that and rest from it and not be affected by it one way or another. You know having alerts on all the time so that you don't switch off your phone and you don't turn off your email, your always on. And I know we've been taking steps institutionally, locally, there isn't a dictate about it but I know there are area in the university for example staff say we won't be sending emails or we recommend we don't send emails between these hours or answer emails between these hours or something like that. But again you goof use of outlook, because individuals will say well I need to work in the evening or I need to do this in the evening…

ZB: Or if I do this now, I won't have to do it in the morning.

KB: Yeah won't have to do it in the morning, so yeah there that bit of yeah we have to understand that people may want to work a bit more flexibly and do that at a time that suits them but the impact that might have on others need to be thought of. And if you were more digitally capable in using outlook, actually saying we forbid emails, another way of saying it is put delays on your emails so they don't arrive in people's inboxes until the morning. So there are bits of one part of digital capability which impact on another bit as well and recognising what you can do might influences another part of you DC is important as well because there are all interconnected in some way. I think the digital wellbeing is an interesting one because I think a lot of people, there is some evidence for young people as well that it is affecting metal health and wellbeing in quite adverse way so we have to be careful about it.

ZB: So this an extension to the question really but because I am trying to draw distinction between real world perceptions from stakeholders and what literature says, there is quite, I mean in the literature that I have read I struggled to determine whether digital identity can be seen as an individual skill that individuals, just as much as you possess the skills to be able to use a computer and use technology you need to be able to have that skill of knowing and being aware of when your over extending yourself and when it does have adverse effects on your health, both physical and mental. So just knowing that the possibilities are there kind of helps you realise when you may need help, so it can either be seen as an individual skill or it could be seen as an organisational responsibility for management in terms of decision making, to make sure that they put the right chairs for staff since they know they are giving staff jobs to do in front of a computer for long hours and so these decisions should be a part of institutions so wellbeing kind of sits are the core of the whole decision making process in terms of what colours to paint the walls, in terms of what colour carpet to have in the rooms

KB: Exactly, uh huh all that [nods in agreement] all of that

ZB: there have been different perspectives so some look at it in terms of the structure, the workspace and how user friendly it is, how the environment around you encourages and supports and that like wellbeing in terms of what the organisation could do but then again also offering training or staff and students within the institution to give them that awareness of their own individual wellbeing.

So I was thinking if I were to position wellbeing, would I position it as an individual skills or as an organisation responsibility.

KB: I so think there are two aspects to it and I do agree with you and think, I mean clearly we do have online training courses of course but around use of VDU, when you start work here you have to fill in an occupational health form for each new employee and it does as will they be using computers and visual displays for long period of the day and so on, so there is an awareness that your workspace has to be setup appropriately if you have that as part of the requirement for job that you'll be sitting at a screen. So there's things in place to make sure that you are aware of how to position your keyboard and get the right chairs and there is support and help both from occupational therapy and through your own departments to get the equipment's. So for example we have a number of the standing desks because people want to stand for a bit of the day and not be sitting at their desk all day using a computer find it easier more comfortable in terms of their actual muscular skeletal wellbeing. You know the use of laptops as opposed to fixed seats and so on. Your right and there might, I've been in other institutions specifically in one other institution who made a decision that the work place would not be as we have here everyone has their own desk within a space on a floor, either within an office or an open plan office but they have their own workspace; but they have gone completely to errr hot-desking with everyone has a laptop and you just come and plug-in where ever you want to plug-in and work from that location. So you don't have a space that's yours,

you've got a locker somewhere where you can keep stuff but your physical workspace might be in the library one day or it might be in the open plan office in this particular building or it might be in the café but you can work anywhere because you take your work on your laptop and you've got wifi connection, so yeah there's an infrastructure thing, there a decision at an institutional level.

ZB: Was there a particular reason behind that decision?

KB: That was the way they decided they would, they has basically a blank canvas and were able to build a whole new campus so they chose instead of using clearly the footprint for hot-desking is smaller so you've got, you don't need as many spaces because you tend to use something like 8 spaces for 10 people because not everyone is going to be in at the same time. So you don't need 10 desks you only need 8 because its likely 2 people are somewhere else so there are some ratios that are different from that but depending on types of jobs people will work out a space footprint and that becomes less. And think this is what's interesting as well maybe just as were exploring it about the culture of the institution which might encourage a certain way of working through digital means your DC are different and the institutions responsibilities are different to ensure that everyone is safe and well trained and comfortable in that environment. So if it is we expect you all to hot desk be all mobile then there's a different set of responsibilities for the institution and a different set of responsibilities for the individual; thank if we say you all got your own space and here's your workspace, you mainly work here; or here's your classroom and it's got this equipment in it and you need to learn how to use it or there's the lab and [la da dah]; so it will… there's a… once you make that decision of how you think your estates gonna be and your workflow should be working, you then need to support the Digital Capabilities for everyone in there, differently.

That's an interesting one to think about, because… because we've probably got a mix of that at the minute, you know you will have people who have got, like me… a desk and you will have other people who… like in my team we've got people who hot desk because there not full-time they work part-time; and so people share a work station. They just come in, use their laptop in the same space. And they you also would expect, you know a lot of our staff of the staff who go out and teach will take their laptop into the classroom with them. But at the same time we've got a fully functioning all singing, all dancing classroom with a PC in there; and to some extent we are signalling to people you: you don't need to bring a laptop in, all you need to do is logon because you'll be connected to your workstation through this this…

ZB: Yeaaah!

KB: This desk has got a PC on it and as long as you logon, it's just logging on from your office; and you've got your OneDrive, you've got all your files and you've got your VLE and access everything you need here! You don't need to bring it in on a laptop or a memory stick, it's all here. So there's a bit of a signalling how we want people to work and yet people will still work differently and they still…

ZB: Well I guess some of those options are like backups because with technology you always have to have a plan B.

KB: [Laughs] there is that!

ZB: Im just trying to think about what would happen if you had a digital classroom without a computer and then you turn up to the class and your laptop decides to have a fever on you and then you would be in complete distress.

KB: Absolutely! The backup of the backup is you've got a whiteboard as well.

ZB: [Laughs] yeah.

KB: So you know if anything fails you've still got a fall-back position.

ZB: Were probably still in that transformation stage where we haven't quite reached the stage where whiteboards can disappear yet, but were getting there slowly; and I think personally, from going into the classroom myself, if I didn't have a white board in the classroom I might have a meltdown, because I just… there are certain things that you want to explain and then you find that you can't quite explain it until you kind of draw it out; and having it there just gives you that comfort of knowing that if your actions [hand gestures] and your words fail you have got the option of being able to do that as well. So yeah!

KB: Yeah! Yeah!

But the technology in classrooms now is quite complex; and its interesting just yesterday at student education experience committee we had a team from library computing services come in to talk to say… to talk to the committee about what should be in the classroom, a standard classroom not a specialist lab or you know, something where you need specialist equipment or technology but a standard classroom or lecture theatre or seminar room and they showed a little video of what is currently in a standard room. And it is quite complex, interestingly, the video was only I don't know a minute and a half, two minutes long but it's interesting the number of people in the room who said: oh I didn't know we could do that! Or I didn't know that was in the room, you know! So there a thing around we're providing… you know the institution can provide a lot of stuff that would… [pause] you know, on one looking at it would tend to suggest everyone is very digitally capable because look at all this equipment that's in the room that you can use but actually the staff coming in you know, have never even known that it's there and they'd use a white board. Nothing else! So that's where we are, but it doesn't mean to say because you use a white board you're not digitally capable or you don't… it's you have chosen that what you w3ant to do in terms the teaching approach that your taking and that's the most appropriate tool that you've selected at the time; you don't need that technology to do the teaching. For other people you know, it's different and the technology makes a difference.

ZB: So what impact would you say it has on the institution, the ability to use the technology that is available? Would you say… in terms of our definition of digital capability that talks specifically about learning and teaching pr9ocesses and then what impact would you say the use of available technology would have on the organisations capability?

KB: Oh I think that if staff are comfortable and able to use that technology then it clearly has an impact on the student experience and it can move the institution forward in ways that you know, would potentially be beneficial, just saying this is the most appropriate way for me to do it and not trying a different ay to do it is the problem, I think! You know, just saying well this is the way I do it and I don't need to change it, says more about… you know it's not about your digital capabilities but it's your actually ability to kind of reflect and thing and wonder you know, is there a more effective way I can do this and help students learn . So, the two things go together; but there are… knowing what's in the classroom in terms of digital tools and when it's appropriate to use them and how they can then enhance the student experience. One of things why the classroom are as complicated as they are is that we… the decision has been made that classrooms need to have all the bits in it so that if someone comes in and wants to use one of those things it's available to them, they don't have to go to a specific room to use a visualizer; there is a visualizer in every room. So you could be timetabled into any room, the visualizer is there and you that it's gonna be there and you will be able to use it. So there's that thing about, we we'll provide all these tools, we don't expect everyone to use them all the time but we need to provide them for the occasions that the people want to use them are in those rooms and that makes its quite expensive, taking that approach; to making every room as sophisticated as it is and it also makes it quite daunting for staff who come in who don't wanna use it all and don't know what it's all for; and it gets more and more complex to do the thing that you wanna do which Is just turn on the projector and do your PowerPoint slides because you've all these different options and things that you could add in and you know, so… the very fact we provide it means we've also got to keep staff awareness of it up. A so they just know how to use the stuff they would always rely on because it will be different but also, B so they can think 'oh actually I might wanna try that and that might be quite useful in my class If I use that technology just now' and support me to then support them to then change their practices.

ZB: Ok.

Not sure im answering the question but it's just what's coming out my head.

ZB: No it's great!

Question 3:

ZB: Ok, so I think we've covered the impact of the elements which brings us to the third question which is asking in your opinion, which specific elements would you say have the most impact on learning and why?

KB: The elements of digital capabilities?

ZB: I mean just in your opinion, whatever comes to mind off the top of your head. Because obviously I know you don't have all the elements off head.

KB: Yeah, im not, if I had, if you said to me there are the elements, which one? I think I would find that a lot easier.

I think … I meant it's an odd one. I think [pauses]

ZB: I should have probably written down the elements that you mentioned in question 1. And then we'd have a list now. I mean I know I remember you talked about individual skills, and then you talked about the concept of wellbeing, and then we talked a lot about resources which is the technology, erm.

KB: Yeah, yeah, using digital tools, find and … I mean it's an interesting one because for a lot of people in higher education the ability to research, to look for and find relevant reliable data of different sorts; of all sorts of different sorts and resources and whether that, and you know that might… so you know it's not just data but resources of any kind. I think that probably the most generally important in terms of learning because that's how we learn. We find out things, we take new things are assimilate it into what we already knew, ermmm and if you, it's one of the things we try to do universally across all the programmes and modules is give students that independence of eventually being able to seek out the thing that they want to know more about in ways that they know they can rely on, they can trust and that they can easily adapt into the reading work.

So I think that one researching finding information and using that information appropriately is probably one of the key ones for learning in higher education. There is so much out there in terms of information and how getting to the real source of something in the right, using the right methodologies to search that stuff out because you can use the wrong one and a) never find it but also you can find the wrong thing and not have the skills to actually evaluate whether or not it's something that useful.

So I think those one in general, that sort of information literacy and also the use of data and being able to bring those things together for everybody, for staff and students in learning. Cause even when you're a member of staff, a lot of your work is keeping your own knowledge and research up-to-date so that you can help students on that journey of improving their learning and understanding; so I think for me that probably the most important.

ZB: Ok. So are there any others that you would say are important?

KB: I mean there all important to some extent, I think the rest flow from that. So when I say finding, researching information and finding data and using data well and manipulating data require you perhaps, you know obviously to have good internet searching skills and also good writing skills because you then to, or good word processing skills; you need to

organise that and sort it and use it appropriately and your writing and also there would be a bit around, on the data side, you know use of tools that can manipulate and visualise data. So they are important skills using software packages whether that's excel or whether that Nvivo or whether that SPSS, there are other important skills. But there that kind of deeper, underpinning issue which is knowing the reason why we use data and what it tells you, how you manipulate it? And that can be Meta level regardless of the tools that you're using but the two things go together.

Question 4:

ZB: Yeah ok. Ermmm and then the last question is just to really ask if there are any other opinions you wish to share in relation to digital capability maturity in tertiary institutions?

KB: I think, I think errmmm personally I actually many years ago when I first started teach in HE in another institution we introduced at that time, we were the first… one of a small number of institutions at that time that introduced ICT skills literacy for all the students. So we said it is a requirements for all the student in this institutions to have this baseline level of literacy, it was called at that time, in information communication technology (ICT). So it was things like, you need to be able to do all of these things in word, you need to be able to do all of these things in excel, you need to be able to search the library catalogue this way, you need to be able to search the internet in that way. So it was like a you know one of those baseline driving license type of qualifications and all the students had to demonstrate they could do that and they had several tests to do it.

I still think were always behind the curve a little bit, were always catching up with what's available and what might be coming next, so were always just struggling to get to a point where we need to be, just to get by and actually we could be doing more. And doing more would be more beneficial if we could get there but it does take a big big effort to actually focus on that and say to the institution; and actually when we did it we focused on the students we didn't even focus on the staff and now you're getting feedback from students saying well it helps us learn if our staff are digitally capable, if they use the VLE well, if they use the class room technology well, you know if the staff do that for us, it helps us learn better, if they use you know lecture capture blah blah blah. So I think there's a bit around saying well we need to have both, students need to understand digital capabilities and they need to be digitally capable because they're going to have to do that to get their degree but also to find a job because that will be something that's important when they go out to work. But our staff need to be even more digitally capable than our students because they need to see what's coming ahead, what will be needed and opening new horizons for the students on these areas; which I think we don't do. It probably is the other way around where students in a lot of cases are more advanced in their digital capabilities than the staff are. Some are, not all; and we need to at least get the parity with student, the body of students but preferably ahead of that and be leading and pushing and opening new doors for them. And that what were not really good at.

I think the big challenge for us as institutions because were big institutions and it takes a lot of effort is, we tend to introduce technology into the institutions even when we try really hard not to, we tend to introduce it and then we put a big push on training initially and then it all dies down. Because it was part of the get the new system in, put the new thing in so there's a big push on let's get everyone trained, comfortable with this, lets really put a lot of effort, a lot of resource into it but then it stops or it fades off. And it's how do we keep that going, how do we change that's what I mean by 'a digitally capable culture' how e we change the culture that says: it doesn't stop when the new systems been in for six months because actually as I've said we only learned how to use a fraction of that new systems and we are gonna have to keep ourselves, were gonna have to learn more and were gonna have to keep going.

ZB: Would you say that knowing that new systems are coming in one of the things that, maybe that limits people willingness

KB: Yeah! They get tired! Everyone gets tired and it's about that you know, how do we make sure it's just part of your daily life that this is it, it's like hygiene factor of how do you keep that going and do you make sure you keep yourself up-to-date and know what you need to do next.

You know we were talking about trying to get digital capability or some aspect of that into you appraisal so that there was a discussion with your manager at least twice a year around are you capable of, do you know how to use all the tools you need to know to do your job? Are you happy with that? Is there something that's missing? And that should be a focus for your development for the next 6 months. Or you know if you come and say you know, I know how to do everything, that manager can ah say well actually well in that case you may be able to help others so that might be an aspect of something about sharing with other colleagues what you know to try and bring them up to the same level where you're at. Or, well you already are here and that brilliant, can you go out and see if there's something else we can be doing in this area and help us as an organisation move forward.

So there's a lot of things to discuss in appraisals and review but I think digital capability is missing and I think it should be in there because it's so important for us as an organisation, I think it's important for all organisations to use the tools we have most effectively to leverage then the best possible way to get the benefit of all the investment you make in them.

ZB: Yup!

KB: And just putting the system in doesn't work if you haven't got people comfortable using them and adapting and you know. And even when the system is in, it's never in cuz the next release comes out and something changes and you know another bits added on that does something that you didn't know it could do and this is great. I think it's just an on-going…

ZB: Continuous…

KB: Continuous learning experience and we've got to keep up with it. We've got to keep-up with it.
But I keep reflecting back on how much things have changing and yet they haven't changed at all [laughs]. You know there's more of its and we all just feel as overwhelmed as when all we had to do was worry about internet explorer and word and not much more.
But if you actually think of what people can do now, it is quite a huge bit different from where they were but it's still always I think not enough, not as much as we could do. Yeah, and I include myself in that.

ZB: Im guilt too.

KB: Guilty guilty.

ZB: Yeah ok.

KB: I think that enough from me. But I think im happy if there's anything you want to follow up with me that you think I wasn't clear or would like to ask more.

ZB: Ok great. I will go through and if there's anything I will bear in mind that your happy for me to re-contact you but yeah it was really just to understand your perceptions and that's exactly what you've shared. So it was fantastic. Thank you!

KB: Thank you!

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 3

Date: 22nd May 2019

Time: 3.00pm – 3.25pm

Interview transcript between 'Participant 5' and interviewer

Started audio recording

[Brief breakdown of research from interviewee]

ZB: So I won't show you all the 10 elements' that I have found but I will show you my definition of Digital Capabilities in the context of my research. And then you can have a look at the elements that I've found after we've finished.
[Hands over a sheet with the definition].

P5: [Reads definition from sheet]
Yeah ok. Is that… that's the definition you've come up with? Or is that?

ZB: Yes that's the definition I've come up with. There are quite a few definitions out there but I just wanted to be really clear and it still is quite broad… it may be that I select certain aspects of it to focus on for my actual thesis but for now that is the definition of Digital Capabilities that im working with.
[Pause]

ZB: Sorry I thought I was better prepared than this. Im just going to pull up the interview questions so that we can both look at them.
[Open up document on laptop]
Ok so, now im going to ask you a set of four questions. In answering these questions I would like you to draw on your broad knowledge of the tertiary institution environment and you experiences as a member of management within this institutions so answer these questions.

Question 1:

ZB: So the first one is, what elements would you say contribute to Digital Capability?

IP: My instinct is to start talking about resources but I'd rather not! In the sense that it's not the most interesting side of things, I suppose where I'd be most interested is cultural knowledge. Ermmm really it's to do with, naturally doing what I do because I'm Associate Dean Learning and Teaching I'm kind of concerned with the students initially, and what they're coming in with as a set of ideas and because they come in using digital devices of all kinds, and they kind of… most of our students within a certain ages group… they are digital natives and they instinctively is probably not the right word… but they know there way around a smart phone, a tablets… and actually the challenge then comes with the institution where you may have member of staff who may have been around a long time, who may be of a different generation who may not be quite as confident with some of the uses of digital technology. So it's a case of … the biggest challenge that I've found is that assumptions are made about capabilities. I find that staff and I've done this myself… will assume certain things about the way that students understand digital technology, which are not necessarily correct and I think that's caused some issues in the past; where [pause]… and I think as well because students live their lives digitally very much, what they're doing is they bring a whole set of.. It's like when you learn to drive a car and initially you're very mindful of all the rules and the regs and you know what you do but after 30 years of driving a car you just kind of doing it on auto pilot a little bit. And I think in some ways the more you use digital technologies the more you kind of become… almost blind to them. There a thing that you do but you're not necessarily reflective on the processes or what it means, or yeah does that make sense?

ZB: Yeah definitely!

IP: So I think partly my sense on a day to day basis teaching but then also and when im on my management role often working with LTIC here or with the Learning and Teaching development unit with things like the new Canvas rolling out on as the VLE, I suppose what im trying to do is make sure that the communication of what the technology is, what is does, what its available for is clear and its clear at all end of users so staff, students, professional staff and so on, does that make sense?

ZB: yeah!

IP: You asked about the elements that contribute to it…
I suppose if I tried to split it down a little bit, make it a little bit clearer rather than rambling…

ZB: No but im… sorry go on…

IP: There's knowledge, basic knowledge of the technologies and the assets and what's available. Then there are different levels of use; so can you communicate effectively using the technologies, are you able to be creative with those technologies? And then in the pedagogical setting are you able to utilise those technologies for effective teaching and learning; which is kind of where I become most interested. And all of that sits in a wider context of we live in a culture

which is digital. You know if I talk to my mum she'll claim she can't use it but you know, she uses it all the time. She's never actually off her phone or her laptop but she's using it for different reasons and with less confidence.

ZB: Yup!

IP: I suppose, actually like most technologies from picking up a biro to riding a bike you have to feel confident with it, and so I suppose the biggest elements is staff need to feel confident with it. So if there using speed grader to mark and they've spent their teaching lives using pen and paper they have to have a level of confidence in themselves using the technology; and in the technology being trust worthy, reliable. And the biggest thing I've found with students the confidence as well. And because I teach the side of things which is much more written, so I tend to teach essay work and reports, I found that I've assumed and certain colleagues have assumed that the students know how to do certain things; that they know how to do a spell check in word but actually they don't necessarily know how to do a spell check in word or they necessarily know how to insert a footnote or... and little things like that which if you've done them for quite a while you kind of take it as red but actually unless someone sat down and taught a student there not necessarily gonna know it. The biggest element for me because I'm not… I've picked stuff up as I go along, I need to have time to play with digital technology. The best way I learn is to actually just muck around with it. Having gained the confidence that I won't break it, because I used to work in a public library because we did a scheme which was intended to help people who have never used computers before to use computers in this local library, most of ours users were actually elderly retired and often they've never used a computer in their lives. And they were very very nervous and I remember it was almost like they were scared that if they touched the computer it would crumble under their fingers; because I've never used one before. But actually the most important thing for them was to feel that they weren't actually gonna break it just by typing something in incorrectly or using the mouse wrongly, so yeah time to play with the things. And time is the thing most people are pushed for it seems but you've got to the time to get things wrong.

ZB: Yup!

IP: And not think that getting things wrong is a problem.

ZB: Ok brilliant! So any other factors or elements that you would say contribute to digital capability?

IP: Well I suppose im gonna have to mention, I started by saying I wasn't going to talk about resources but actually the most obvious about any digital technology is the speed of change; and I think institutionally any institutions that wants to be able to claim that it's has maturity and confidence with providing digital, or a digital framework, it need to constantly invest because if I think about our won skills you know, animators doing digital animations you know that software changes pretty much on a daily basis so what was cutting edge this year is going to be prehistoric in 5 years' time, so every year that software needs updating and that a major job, and it's a major investment. So from a university point of view they have to keep putting the money in and also the resources to actually make sure that once the software is actually brought it's also installed. Because there are cases where software is brought, the licenses are brought but actually the software is never actually put onto the machines, because that takes time as well.

ZB: Ummm, and man… human resources as well.

IP: yeah of course

ZB: yeah ok.

IP: It's interesting I mean in our schools there is a division between those that use PCs and those that use Macs. I mean 3D animator will never use a mac, it's of no use to them and their software doesn't run on it. Whereas a graphic designer will never use anything but a mac. But the university (am I allowed to say this) [thinking], the university only has one mac specialist amongst its technical team and that's a real issue for our school because we have a lot of courses that use mac extensively and if most of your technical support are PC confident but there not confident with mac so I think that a challenge. It's not as much of a challenge as it used to be because the platforms are much more compatible but when I first arrived here nearly 20 years ago, it you put mac and PC together it was like matter and anti-matter and everything just collapsed. But I think you know, its things like that whereby it's quite a vulnerability if you only have one specialist in the university to look at a particular platform which lots of people use.

ZB: Yeah ok.

IP: Don't tell anyone I said that!

ZB: [Giggles] Apart from the fact that it's on the recording but it will be anonymised

IP: Although I have said it in other meetings! I think it's known.

ZB: Errrm ok, so I've got a couple of things here from you know physical and technical resources to financial resources, cultural knowledge which is one of the big one that you said and you kind of broke that down into you know the difference between digital natives and self-expectations, levels of usage, being confident, you need confidence to be creative and you talked about utilisation, not just having it being able to utilise it for learning and then you talked about it all sitting

within the wider context of the digital world that we live in now. So any other elements? Sorry we talked about trusting, well playing enough with it to trust it won't break it.

IP: Well I think in product design they call it stress testing don't they. Where you chuck your phone off a wall and stuff. I think you know people have to… I keep coming back to the analogy of riding a bike but actually you have to fall off the bike quite a few times before you keep going and I think… I know actually a lot of the time in our subject area and I suspect it's true in engineering for instance it's often a case of problem solving and sometimes you have to kind of push the technology to its limits and work out what it can't do. So a lot of our games art students and certainly a lot our digital media students they might be using open source coding and stuff so they might be having to kind of build the things as they go; I mean that obviously at a particular end of practise but I think it's quite important to have the confidence to know that the thing given to you is not a fixed thing and it can be changed and it can be adapted and it will change; because it's just part of what we said you know, the speed of change is terrifying sometimes.

Ermmm so I think yeah, but it's a little bit like that thing in education where our you know, our students are increasingly afraid of failing, whatever that means; and yet the teachers recognise that often its where you fail that you actually learn stuff because you have to work out where the fail came in and how it happened.

ZB: Ohhhhhh

IP: You look slightly concerned by that!

ZB: [Laughs]

IP: If I say that to a room full of students they do look at me like I've lost the plot but I think it's quite important. If I think about moments in my education where I've worked stuff out it's usually where I've made a complete mess of things and I have to sit down and think ok, why did that not actually go the way I thought it would? And I think when we're working with technologies it's those moments.

ZB: Yeah!

IP: It's those moments where your device tells you, you need an upgrade and you think oh do I dare this but because the last time I did this it ruined my complete interface and everything got lost but actually because I've had to sort of muddle through digitally as I go along and because you know, im a bit old to be digital native I've kind of… almost… you free form through it and you have to feel a little bit confident and so when I first sat down in front of the computer I was quite scared and now I'm not scared because it's just like a pencil or as you know, a paint brush I have to muck about a bit you know, I might have to get things wrong.

Maybe institution are quite scared of that, quite risk averse for obvious reasons.

ZB: I mean off the record if I could say; if only deadline accounted for all of those things then it would be great we would have this smooth learning curve. But because the deadlines don't move and then you've got to do more in terms of not only learn your field but learn technology as well; I mean it doesn't really apply in our field because I guess we use computers all the time. But then it applies in a way because if it's a task you haven't done before then naturally it's going to be a learning curve. I think the way institutions work is that, or the way courses are delivered doesn't account for that fact that you have to learn other things outside of what that course is teaching you.

IP: So were talking about assessment of student.

ZB: Yeah im taking about assessments because typically you know, because you said the best way to learn is to fail. Then I thought well deadline don't account for the fact that you need to kind of go down before you come up.

IP: You did look horrified by that.

I mean when a programme goes through periodic review and it's validated in the first place because all those module guides and DMDs should take account of that notion that students will need to learn certain things, so if you od the break down on the module, this is the number of hours for lectures, this is the number of hours workshop, this is the number hours of individual study; all of that should factor in that you, that Zarah need to spend x number of hours or days getting her head around this new thing that she's hasn't had to do before. It should do that!

ZB: It should do… assuming everyone has the same cultural knowledge.

IP: Exactly! And of course they don't you know, and if I've got a room full of students I know that some of them will have written a lot of essays and some of them may have never written a say in their life. You know, if I've got international students in whose education the simply do not do that kind of academic writing; I have to be conscious of that you know, there all heading for the same deadline and yet these students may not like doing the work their given but they may know what it is and yet this student may never have encountered this notion and may never have done referencing before. In a way that's an infrastructural problem with the way that we have to write modules and programmes is that have to give them a framework; and frameworks by their nature are quite rigid. If there not rigid they fall over.

ZB: were striving for academic excellence and also striving to keep up with technology and… so it kind of like…

IP Yeah, and what gets mangled in the process if you're not careful is people! Because people are different and no two people are identical in what they have done and what they are expected to do and therefore this framework has to have enough given in that so that it won't collapse but yet it will allows student x, whose never done this thing before to have the same change to get.. Success as student y who has done it before.

I think that's… it's probably an even bigger challenge at postgraduate because people are coming from a much more diverse set of background in a sense. Some maybe have a very… some may have their own companies, they may have been in the industry for years but they've come back to sort of build on that whereas someone may have come straight from a BSc or BA; and that's gonna be a challenge.

ZB: Yeah!

IP: We did have, until grade point averages came along at undergraduate level, so at that point at least all undergraduate study count. So your first year might not count towards your final degree classification but it will count towards your grade point average. Prior to that, and I, you know in many ways see the grade point average as quite a good thing but one of its disadvantages is that we can no longer say to our digital animators right, first year we want you to do really well, you'll wanna get really good grades and rest assured your final degree classification won't include your first year grades. So you could afford to sort of come a cropper and take a risk and do stuff you know, you could afford to experiment a little bit.

ZB: Yeah!

IP: We can't really say that I quite the same way because it will dent your grade point average if you do that and it doesn't work! So actually you… that thing about failure being an important part of learning; it less convincing now at least at level 4 where they go: well actually but my GPA will drop. Your right actually, it will!

ZB: It will.

Question 2:

ZB: Ok so, we'll push on the second question which is: In your opinion, how do you feel that these elements that we have just discussed impact the digital capability maturity of a university?

IP: I think they probably make people nervous! If I'm honest. There is a… digital technology by its nature is fast you know, the whole point of Turing and the people at Bletchley Park you know, they developed their technologies because the colossus could calculate much quicker than a human. So technologies which became digital are ever fast, ever more capacious in terms of their storage capabilities and so on; and I think that in itself unsettles people because it almost means the human [pause]… the human element has to try and keep up. And I think even if that's not the reality, I think that how people feel. It makes them quite nervous so… staff often say to me why do they have to change everything every few years. You know why have we got speed grader? What was wrong with what we did on studynet? And I remember studynet coming in initially and people going: oh why we using this thing? And why can't we just do it the way we've always done it?

So I think there's a… If the cultural changes aren't managed, really carefully; and it's almost impossible for them to be handles carefully enough because an institution is big and it has lots of people in it you know, and they all have to absorb the communication at the same rate and as confidently and as accurately; I think it can cause quite a lot of anxiety. That can kind of bleed out into general activities in an institution where people start to get paranoid. You know, a big part of digital capability now is that a lot of things are data driven. So over the last 10 years, more and more of what we do is being measured by numbers, so from student feedback on modules to NSS results to module grade profile failure rates and withdrawal rates, you've got these sort of stacker numbers which are all seemed by people to be judging them; it could take a positive spin so actually what the digital technology does is it give you a set of materials that you can use to understand what going well and also things that you can improve. You can take a positive spin to actually say I can see that programme has got a number of modules who are actually not doing so well, so let's see what we can do the bolster them a little bit. But I think it does tend to promote a kind of, an atmosphere of nervousness among people that's something is being measured; you know, that their being found not to hit the mark somehow. Ermmm is that the kind of thing the questions looking for?

ZB: There's no specific answers to any of these questions, it's really just to get a feel and understanding of how you perceive these things and the relationship that you feel there are.

So that was… I mean you've talked about a kind of, I guess it could be perceived as a negative effect because nervousness and anxiety are obviously not positive things.

IP: But the maturity thing is interesting isn't it because that's an interesting word!

ZB: Yup!

IP: And almost with the rapid change in the technologies, there almost isn't time for anything to mature because it's just getting to the point where you feel like you've got the grasp of it and then its shifts and it changes again; and I think that's

a challenge because you never feel you reach a point of maturation because the new things always coming along. So you're constantly on that cycle; and I see it in... Certainly my own kids, my children, I've got 13, 16 and 19. So ones just finished first year of university and I don't know whether it's me projecting something onto an age group. But I actually think if I look at my kids and if I look at the younger undergraduates coming in now, I've never known a more nervous generation of students and a more anxious one. You know, the number of applications for serious and adverse circumstances and the number of applications for extensions, the number of students with study needs agreements which are related to mental health issues… I can't help but think there the first generation that's really grown up with that culture of being measured constantly and in a way that it quite a negative view point but then again there is an argument that this sort of constant having numbers attached to you; now it's not just the technology, its actually the approach that certain governments have taken to education you know, so you test a child at 6, you test them again at 7. You test them… and actually that area of childhood which was about playing and learning through play has become quite rigidly evaluated.

ZB: Ummm…

IP: Now I don't necessarily think that the technology causes that but it allows it to happen because it's much easier to gather data. It's much easier to process it and pass it around an sift it.
I'm sounding quite pessimistic, aren't I?

ZB: No! It's actually a really insightful perspective that I haven't heard before; and its interesting because it sits quite well with what I have found in the literature but without a good explanation but you've kind of just, yeah… it's really interesting.

Question 3:

ZB: So, any other impacts that you feels any of these elements, because you mentioned quite a few elements on the first question on the elements that impact digital capability; so any other thoughts on how these things would then consequently impact the institutions in terms of capability maturity?

IP: Ermmmmm, bluhhhhhhhhhh *(As participant glances at the handwritten notes I made on his answers to the first question).*

ZB: Sorry my handwriting isn't great!

IP: No its ok, I can read you handwriting.
Levels of usage… Yeah I mean that things there about it sits in the wider context of digital usage or digital culture, I think that the thing that's hardest because there isn't appoint where you as a tutor get to work and you switch from being non-digital to digital and similarly for a student there not coming in and the working environment is somehow distinct from the environment they have got at home. The notion that if you've got Wifi you can work or train, you can work at home, you know you can be on the phone in the car if you've got handsfree and so on. I think that notion of the wider digital culture is slightly problematic because I think in some ways the institution [pause]… an institution by its nature has to have a shape and a character and a kind of visions and all institutions have their mission statements and so on; but actually one of things that happens is that whether you work here as a student, as a member of academic staff, as a technical member of staff but I think probably especially as a student or an academic actually, the walls of the institution are porous because actually the stuff you do, the institution is taken home with you. And that's a great thing in many ways, so if I'm doing a research, I can access the online library at home and that fantastic, I don't have to sit in the library till 3am in the morning. But at the same time, it means I can also pick up emails from students at 3am in the morning if I'm stupid enough to be awake; and I have done; and I think that may be… like anything you have to accept the negatives along with the positives and vice versa so its really great that you have 24hr access to this really great library. I say to students look this is great the amount of stuff you can access through this really great library through your phone or through your laptop is just incredible and then I get very boring and dinosaur link and say you know back in my day if you wanted to access something you'd have to order it and wait for it to come through snail mail and a few weeks down the line you'd get a parcel and you know that kind of instantaneity and that great but its also bring with it a kind of pressure to do stuff and pressure to take the work home; and oh I've got that thing I need to finish off. Half an hour before bed time and you're like yeah ok, do it now. So, I think maybe one of the things is the institution becomes spreadable. Because media is spreadable, you know it doesn't respect the boundaries of the campus or you know, and that has blessings and curses. And that's the bigger culture! And maybe that the things, its very hard for an institution to keep track of what's it and what's the rest of the world?

ZB: Yeah! Ok.
So, any other impacts?

IP: Don't think so.

Question 4:

ZB: Ok, so we'll go onto the next question which is; so, in your opinion which specific elements would you say has the most impact on learning and why?

IP: Ok, On learning?

ZB: Yeah!

IP: As distinct from teaching?

ZB: Ermmm [*thinking*]…. I guess learning and teaching.

IP: Ok well potentially, I think the thing I've just mentioned is tremendously impactful which is that, the digital has the… well boil it down to basics… something like the internet is an amazing resource but it's a nightmare because its too big and its full of stuff that you wouldn't want your students to be reading because it's not peer reviewed or evaluated. The biggest mistake is that students will pull anything they can off Wikipedia and drop it in a essay and you know that not gonna work you know, I'd say it's a very good place to start and a very bad place to finish but the positive things about that is that you know, the online environment is an astonishingly flexible thing with a whole load of potential so the notion that you can have a library which Is almost limitless you know; its pushing it a little bit but you know give what is on the online library its massive. Much more resource that could ever have been in a single physical library and even if the stuff isn't there straight away the access through inter-library loans is rapid so in terms of; if you take the notion of the university is a kind of engine for knowledge then that engine is well resourced in terms of what's available and the fact that the includes access to software, so in terms of the students actually making stuff, storing stuff; so storage capabilities are hugely more powerful than they used to be, that's all good, that's going to impact on learning.

I suppose the big thing which I'm still getting my head around is the fact that the technology enables us to not do what we've always done. There is a tendency in most things I think but I've noticed it in teaching which is if it's worked before it can work again. So, there will be and colleagues who have taught in the same way for 20 years and don't see a reason to change that. And I'm a little bit like that, were all a little bit like that you know. Well that lecture work, its ok, don't need to do too much with it and there isn't time to do too much with it but actually I'm interest and I think it's important that I look at how technology can enable me to do stuff, especially things I couldn't do before. So, very small example: but I like it, it works. Say I have a 3-hour lecture block, now nobody wants to sit and listen to me for 3 hours, so obviously the whole 3 hours is not the lecture and what increasingly Is useful for me is when the students are actually working and its usually quite a big group of students, larger than I would want for a seminar group but if you break them into groups, what I use a lot now is the paddlet facility. So, you know what I really like about that is it enables students to actually think aloud but they are posting stuff onto a screen they are producing the stuff for that seminar session but they are pulling stuff from the internet, there pulling stuff from each other because they are working in conversational groups; so you get this kind of really nice live sense of idea being developed. Now that is something you can do on a flip chart but its not anywhere as dynamic, as flexible, doesn't look as good frankly! But even the thing I've always liked using, we used to use acetate on an overhead projector, and I have some nostalgia for that but actually what I'd really like is to use a visualizer cuz actually if I'm using PowerPoint I get frustrated with my own slides. I generally will talk around them or against them or actually ignore them altogether sometimes because it fixes you in a linear pattern of talk about this, then about this and this; but actually what I like to do is… well I used to do it on the acetate but much more flexibly if I've got a pile of paper and a visualizer; I can think in action just as I'd like the students to do. So, its not just me giving them a set of pre-packaged information, this is me talking to them, them talking to me and me scribbling on the visualizer. Students are quite reluctant to use the visualizer but actually once they've done it once they quite like it cuz there often arts students so they quite like to scribble and doodle and write stuff and that sort of stuff because what it does is it stops the classroom being all about this person just talking at students, it makes it a more dynamic learning environment when I was… [*pause*]. It sounds grim but I learn from the students as well, but I can't do that if its just me downloading stuff, its gotta be a dialogue and loads of technology, well is suppose visualizer is not really digital technology; but it is cuz its projected through a … [*pause*].

ZB: Yeah, it's still technology.

IP: I haven't fully got my head round lecture capture yet, but I've started to nibble round the edges and that's got quite a lot of potential and I suppose in our school it's worrying a lot of people. Some of them worrying that it's a way of them being spied on, so I have people coming out of the classroom saying: "oh has my conversation been recorded?" cuz there in a room that got penOpt in it, so there's that kind of paranoia that I mentioned earlier which worries me. Its also made some colleagues get very proprietorial about their teaching materials, "I'm not having my material recorded because it's mine!". Which forces you to go and look at their contracts of employment actually because it's shared ownership but its in a very odd thing because I don't… the stuff I prepare for teaching is stuff I prepare for teaching and I share it, that's what its for! And digital technology enables me to do that much more easily but if you are quite protective of your materials then I assume you can see it as a threat as well.

Forgotten the question though.

ZB: Well still giving me good insight; but yeah, the question was the most impactful elements so with this question what I mean Is that if you were to rank them so if you were to say this is the most important, this the second most important or impactful. How would you rank them based on the elements that you've previously discussed?

IP: Well annoyingly its probably the thing that I haven't mentioned by word, but I mean what underpins all of those is the interactivity. It's the most powerful element within teaching that is enabled by digital technology which probably wasn't there beforehand. It kind of enables and also forces the teacher to recognise that learning is dialogue that kind of has to be… so yeah it didn't come up in my answer to the first two questions but I think its kind of underlying everything. Its that notion that yeah whatever the technology is, it's a kind of interactive.

ZB: So technology would be the first; and then in terms of the other ones that you have mentioned how would you then say what's the next most important element.

IP: Most important element! Can I just turn the paper around? [*referring to my interviews notes*]

ZB: Yes of course.

IP: [*Errrrrmmm]* Yeah, I… Confidence. It's the time to develop confidence and I think the next one would be playfulness, I think its that nature, you have to have the element of… playfulness might not be the right word but in a different context its appropriate but I think it's the room to experiment and to push the technology a little bit. I think the really important thing is to recognise that technology is a tool and your using it, it shouldn't feel like its restricting you… in a way. I think that element of being able to experiment, try things out.

ZB: I mean when you've, when your ready to stop your gonna have to like….

IP: I realise how random the numbering is getting…

ZB: You don't have to like rank all of them but it was just to get an idea of which aspects you feel are the most important but because we talked about quite a few, that's why I keep probing.

IP: Well we could add knowledge as another one and then communication as another. I think that's probably it.

ZB: So knowledge first and then communication, or in which order?

IP: Yeah because you have to have the knowledge to communicate, I guess. I mean the rank ordering is slightly…[*pause*] yeah… catch me in a different mood and I'd rank them differently but yeah I think… because there not discrete, they are

ZB: Cause they're quite interrelated…

IP: Yeah, there's a continuum

ZB: Yup, there a continuum and one thing may depend on the other. But feel free to build on that if you like to. If you have anything to say about that relationship. Ermmmm… and I think was the second to the last question.

Question 5:

ZB: So finally, just ask of there are any other opinions that you wish to share in relation to the development of Capability Maturity in Tertiary Institutions.

IP: Ohhh ok, im trying to think of something I haven't already Said. This is the thing with me, you have nice discrete questions and I've rambled off all over the place. Anything I would add? [*glances at my notes*]. Doesn't sound like it.

ZB: And I had turned my page ready to go on [*giggles*].

IP: I know there, you got a nice blank sheet to write on.

I quite… there a lot of talk in education about sort of kindness and compassion at the moment and I think its kind of interesting because, maybe because I grew up in a certain generation where technology was often presented in science fiction films as the thing that turns on you, you know it's the Frankenstein syndrome. I think maybe more so for my generation I think there's still a tendency to looks at technology as something which is really useful to you until the point when it turns on you and I think when we think about the digital within an institutional setting especially within education. It's there to enable, whether it's there to enable you to access knowledge or to enable you to create or to test out problems or to find solutions. Its meant to be there to enable and I think if I come back to that thing about how it can cause anxiety but actually if we get it right, maybe the true maturity is to be able to live with this thing on equal terms and feel like were using it effectively and we have a certain degree of kind of kindness and compassion. Errm and I think if one of the things is if the data is showing us that our students are increasingly anxious and our students are increasingly disclosing that they have mental health concerns or one of the big things we look at is looking at the bad attainment gaps, so if our black, minority and ethnic students are not succeeding in the same way that our white students are succeeding teres got to be reasons for that and I think maybe that's where the technology; rather than been seen as something that we batter ourselves with it can actually enable us to do things better.

ZB: Yeah!

IP: But yeah I'd just reiterate some of the stuff I've already said, you know the speed of change is quite difficult to cope with so I think we have to manage our own expectations and those of students and we have to be kind to ourselves... abit. I

think we have to… institutionally as teacher what we have to do is against the pressures of time that were all up against you have to kind of be willing to play around a little bit. Errmm and I maybe so that because I kind of ended up… I teach the wrong subject.

I shouldn't be in a creative arts school at all. I suppose I had to in order to justify my existence in any institution, kind of I had to adapt what I was interested in and what I was looking at and that's been quiet a beneficial thing for me, I hope for my students and I hope for my colleagues. So I suppose its that thing not to feel restricted by the technology but the true maturity is to know that you can work with it.

ZB: Yeah!

IP: And you can get things wrong.

ZB: Yup!

IP: Is that alright!

ZB: That's perfect! Ermmm and guess that's all the questions. Thank you very much for your time and for willing to participate in the study. Just to reiterate like it says in the participant information sheet: the recordings will be kept safe and secure on my laptop, locked and when I do transcribe them it will be anonymised and none of the resposnes wil be traceble back to yourself.

I will send you copies of the transcription once I've done them just for your review and if you have any comments. Otherwise I'll go ahead and Do a content analysis on them and that's it.

Ended audio recording

[Note: Restarted audio recording because the conversation continued…]

Audio recording started

IP: … teaching the communication theory transmitter – receiver and how the transmitter becomes a receiver and the receiver becomes transmitter, it's that kind of notion but actually that circular process of it isn't just about stuff being pushed out there, which is the old model of teaching; here's the information you observe it and you re-iterate it. But actually, that notion that things are constantly moving in a cycle.

ZB: Yeah!

IP: I'll often think about you know, the feedback loop becomes that kind of central method for modern life whereby, back to the riding bike, you are in feedback loop of information with that frame and the wheels and if you don't keep the information constant you will fall off. And in a strange sort of way everything from writing an essay which is marked by a tutor and the tutor will feedback to you to… you know, creating games within a games engine which will be played by people that kind of constant notion the technology enforces your awareness that there is constant interaction, constant feedback and that can be an exhausting thing and quite threatening but it's also very enabling as long as you can keep your energy levels up the deal with it.

And I think what you've just described as constant cycle of change, that's the thing that's really hard to keep on top of in the end.

ZB: Yes definitely!

IP: It drains the energy out of you some days [laughs].

ZB: [Laughs] we all have good and bad days.

Oh I'm sorry I didn't ask you if I could switch back on the recording because you just said: oh what I would have said for the last question…

IP: Yeah, yeah it just occurred to me, because I had said… I did that big ramble at the beginning and then I though well actually underlying every single things I have just said there is this notion of interactivity, I think the interactive feedback loop Is the kind of… if I tried to understand in a single model what happens in an institutions it's got to be that thing and where the feedback loop is broken the institution wont mature because it won't… but then again back to that thing how can it ever mature when things change so much; Maturity requires the belief that you'll reach a certain point where things won't keep changing but actually if things are constantly changing then there is no maturation because its, because your always as young as you were 20 years ago if time is infinite.

ZB: Yeah! Well actually the CMMI framework that im looking at considers that… the idea of being a capability maturity framework is that it's a continuous re-assessment and re-evaluation so it's only maturity from that… its only maturity from that moment in time.

IP: and then it becomes an infinite again.

ZB: exactly, and then you assess and re-evaluate and there a maturity for that moment in time, I mean you just keep climbing up the ladder.

IP: Well to quite the lion king, it's the circle of life I then isn't it?

ZB: Yes, [laughs] definitely. The circle of technology…

IP: Yeah!
ZB: … and life!
So yeah, thank you very much!
IP: OK.
ZB: It was a pleasure.
Audio recording ended

END OF TRANSCRIPT

Appendix T: Content Analysis Codebook

Name	Description	Files	References
Collaboration		0	0
Creation & Innovation		1	2
Enabling creativity		1	1
Skills to create		1	1
Wellbeing		1	1
DI&W		2	9
Awareness of society as a whole		1	1
Biological health risks		1	1
Ethical use of media platforms		1	1
Managing work-life balance		1	1

Name	Description	Files	References
modelling best practice - digital footprints		1	1
Digital analytics		1	2
Data analysis		1	2
Data visualisation		1	1
Digital Capability		1	7
External Environment		1	1
Individual skills		2	26
Digital engagement		1	3
Digital footprint		1	1
Digital skills		2	6
Disciplinary knowledge		1	1

Name	Description	Files	References
ICT Literacy		1	1
Information literacy		1	1
Keeping up-to-date		1	2
Own sense of development		1	2
Pedagogical skills		1	1
Staff capability		1	1
Student capability		1	1
Wellbeing		2	4
Infrastructure		2	19
Accessibility		1	2
Connectivity		1	1

Name	Description	Files	References
Hardware		1	1
Technology		1	1
Workspace and equipment		1	1
Institution		2	22
Commitment to TEL		1	3
Financial commitment		1	2
Institutional culture		1	1
Institutional guidelines	E.g., email etiquette	1	2
Email etiquette		1	2
Social media usage		1	1
Staff training		1	1

Name	Description	Files	References
Learning culture		1	4
Occupational health	awareness that your workspace has ro be setup appropriately for you do do your job without causing harm to yourself	1	1
Policies		1	1
Strategic planning		1	3
Structure		1	1
Jisc framework		2	2
LTD		2	15
Modes of learning		1	3
Classroom		1	1
Linda.com		1	2

Name	Description	Files	References
Mentors		1	1
Workshops		1	1
Pedagogy		0	0
Professional development		1	3
Technology focused		1	1
Maturity		2	2
Q1 - What elements contribute to DC		2	11
Q2 - How do these elements impact the DCM of a TI in respect to T&L		2	15
Q3 - Which specific elements have the most impact on learning and why		2	9
Q4 - Any other opinions		2	8

Name	Description	Files	References
RTC		1	7
Assessment tools		1	1
Clarity		1	3
Classroom technologies		1	1
Consulting stakeholders		1	3
Guided learner journey		1	2
Procurement consideration		1	1
Accessibility		1	1
Usability		1	1
Strategic implementation		1	1
Student engagement apps and facilities		1	1

Name	Description	Files	References
VLE		1	2
Wellbeing		1	1
Stakeholders		2	5
Learner		1	5
Other staff		1	2
Tutor		1	5
Responsibilities		1	1
Ethical		1	1
Modelling best practice		1	1

Changes from Model v1.1 to v1.2:

Changes	V1.1	V1.2	Reason
1	Collaboration (Co) represented as a theme	Co represented as a function/ responsibility of the Tertiary Institution (TI)	
2	Creation & Innovation (C&I) represented as a theme	C&I represented as a function/ responsibility of the Tertiary Institution (TI)	
3	Digital Identity & wellbeing represented as 1 theme	- Digital identity moves to an individual skill - Wellbeing represented a standalone	
4	-	Wellbeing moved into a subtheme of the institution	
Summary	9 elements	**6 elements:** 7. EE 8. TI - Wellbeing - Collaboration - Creation & Innovation 9. Infrastructure 10. LTD 11. RC 12. Individual skills	Wellbeing, Co, and C&I are all split between the institution supporting and enabling this culture which will ultimately help individuals cultivate certain collaborative and innovative skills. They are all represented by some individual skill. There they have been grouped under the theme of institution because the TI must offer services to support the practices.

Initially digital identity were placed together as one element. However after much consideration and following the interviews with management it became apparent that actually digital identity is an individual skill that includes knowledge of wellbeing, however, wellbeing itself is an elements alone that is mainly a responsibility of the TI to ensure that they safeguard the wellbeing of individuals and ensure that all aspects of wellbeing as considered in managerial decision making.

Appendix U: Ethics Approval Notification for Study 4

University of Hertfordshire UH

HEALTH, SCIENCE, ENGINEERING AND TECHNOLOGY ECDA

ETHICS APPROVAL NOTIFICATION

TO Fatima Zarah Bello

CC Nathan Baddoo

FROM Dr Rosemary Godbold, Health, Science Engineering & Technology

DATE 07/10/19

Protocol number: ECS/PGR/UH/03871

Title of study: Investigating elements contributing to Digital Capability Maturity in Tertiary Institutions (DCMiTI) in North West Nigeria

Your application for ethics approval has been accepted and approved with the following conditions by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

no additional workers named

General conditions of approval:

Ethics approval has been granted subject to the standard conditions below:

Permissions: Any necessary permissions for the use of premises/location and accessing participants for your study must be obtained in writing prior to any data collection commencing. Failure to obtain adequate permissions may be considered a breach of this protocol.

External communications: Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Invasive procedures: If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and copies of your completed consent paperwork to this ECDA once your study is complete.

Submission: Students must include this Approval Notification with their submission.

Validity:

This approval is valid:

From: 07/10/19

To: 30/09/20

Please note:

Failure to comply with the conditions of approval will be considered a breach of protocol and may result in disciplinary action which could include academic penalties.
Additional documentation requested as a condition of this approval protocol may be submitted via your supervisor to the Ethics Clerks as it becomes available. All documentation relating to this study, including the information/documents noted in the conditions above, must be available for your supervisor at the time of submitting your work so that they are able to confirm that you have complied with this protocol.

Should you amend any aspect of your research or wish to apply for an extension to your study you will need your supervisor's approval (if you are a student) and must complete and submit form EC2.
Approval applies specifically to the research study/methodology and timings as detailed in your Form EC1A. In cases where the amendments to the original study are deemed to be substantial, a new Form EC1A may need to be completed prior to the study being undertaken.

Failure to report adverse circumstance/s may be considered misconduct.
Should adverse circumstances arise during this study such as physical reaction/harm, mental/emotional harm, intrusion of privacy or breach of confidentiality this must be reported to the approving Committee immediately.

Appendix V: Protocol for Study 4

A Draft Protocol for Investigating the Elements of Digital Capability in Tertiary Institutions in Nigeria

August 2019. Zarah Bello. ORCID ID: https://orcid.org/0000-0001-8477-8087

Protocol for a Qualitative Study on the elements impacting Digital Capability Maturity in Tertiary Institutions in Nigeria

11. Introduction

Digital capability maturity in the context of this study is defined as 'the ability of an institution to sustain effective and efficient use of digital assets to support teaching, learning and working, through continuous evaluation, selection and adoption of new technologies and acquiring necessary skills, for full utilisation'.

A systematic review was conducted to uncover the elements of digital capability, and how these elements affect the capability maturity in tertiary institutions of learning as precursor to developing a capability maturity framework. The results of the review found 498 elements of digital capability, aggregated to 10 themes. The main objective of this study is to substantiate the findings from the literature review using empirical research methods. The outcome of the study will provide a fair contrast between the real world and theory, providing a sound empirical basis on which the conduct the remainder of the research upon.

A combination of quantitative and qualitative research methods will be used to investigate the hypothesis, to determine whether there is sufficient empirical evidence to support the claim that the elements of digital capability (table 1), are truly the elements that contribute to digital capability maturity in tertiary institutions. Furthermore, evidence will be sought to support the assertion that maturing the elements of digital capability within a tertiary institution setting, will lead to continuous improvement of such an institution, and consequently improve the quality and education outcomes from such institutions.

12. Background

A systematic review was conducted, guided by the following four (4) research questions:

RQ1: What elements contribute to digital capability?

RQ2: How do these elements affect the digital capability of tertiary institutions?

RQ3: What is the current status of research on digital capability maturity?

RQ4: What is the current status of research on digital capability maturity in Nigeria?

The review involved 283 studies that reported 498 elements contributing to digital capabilities. These elements were aggregated to 10 general themes (table 1).

	Theme	Description	Theme in practice/ the ability to…
1	**Stakeholders**	The stakeholders include the government agencies, ministries, all levels of students and staff roles within an institution	All stakeholders are learners – often as part of wider responsibilities within the institution (*For other key responsibilities refer to stakeholder responsibilities*)
2	**External environment**	The environment in which the institution is physically situated: country or city (T*his may differ for virtual institutions*)	Socio-economic and socio-cultural factors. Public policies on education and the role of the government agencies and ministries.
3	**Tertiary Institution**	The institution of learning in which tertiary level education is delivered (Level 4 and above)	Organisational structure, size, and facilities. Framework, corporate strategies, leadership, organisational goals, and practice guidelines. Internal cultural and social values, ethical guidelines, and accountability measures. This also includes division of labour, recognition reward schemes, adoption of best practices and teaching culture. Manageability, sustainability, and financial capacity
4	**Infrastructure**	The Infrastructure that supports the tertiary institution	Basic physical structures, network infrastructure, connectivity, hardware, software, and usability
5	**Learning, training & Development**	The Learning and teaching practices and methodologies aimed at acquiring new knowledge or skills	Teaching methods, practices and strategies and delivery techniques, pedagogical practices, and acquisition of new skills that a variety of learning options: self-directed, traditional learning, distance learning, eLearning, and staff training. Assessment of learning outcomes, evaluation, and reflection, reporting and learner feedback.
6	**Individual skills**	An Individual's interpersonal and technical skills, and their readiness/ willingness to achieve their full potential	An individual's demographics, cultural capital, level of education, interpersonal skills, self-efficacy, problem solving abilities and attitude towards learning. Including a full range of ICT skills and competencies, level of technology usage. Socialisation and readiness of individual to improve their ability
7	**Digital Identity and Well-being**	Sense of belonging to a safe and secure institution. Individual's ability to achieve personal goals and benefits while maintaining a healthy work-life balance. Consider health, safety, and security as well as relationship management, self-motivation, and self-management.	Identity incudes social media presence and active participation in the institution online communities. Consider the institutions ability to safeguard the well-being of the community, through management support, technical support, and family support to help individuals with healthy techniques to achieve a healthy balance.
8	**Collaboration**	The collaboration culture	Collaborative working, learning, and teaching; driven by cooperation, participation and facilitated through communication, connectivity, and infrastructure.
9	**Creation & Innovation**	The creation and innovation culture	Creation of digital content and media production. The ability to create new ideas, projects, and content. Design innovation and innovation of new approaches to the use of technology for learning & teaching.
10	**Resources, tools & content**	The learning resources, tools, content, and social networks used to support institutional goals	Inclusive of digital libraries, LMS and other digital educational resources. Administrative systems used within the institution for monitoring and management of the resources used.

Table 0-1: Description of elements aggregated into themes

The distribution of weightings in terms of frequency of appearance in literature indicated that 18.7% of the literature is on learning, training & development, closely followed by resources, tools & content (13.7%), and then collaboration (11.1%). The least attention in literature given to digital creation and innovation with (3.9%), external factors with (4.7%) and then digital identity and wellbeing with (5.7%).

The review reported that if developed, all the elements identified have a positive effect on digital capability, consequently resulting in improved capability maturity of the institution as a whole. The relationship between elements are interrelated and described as a 'web' of elements (Figure 1). The elements/themes do not appear as mutually exclusive, indicating that only by considering a combination of the elements, can an optimal level of digital capability be achieved. This corroborates findings from Shengquan and Li's (2006) ecological systemic change theory and suggests that division of elements into separate parts without relationships will not necessarily lead to improvement. Therefore, if the role of capability maturity is to be used as a lever towards continuous improvement of institutional capabilities, the elements and themes must be matured in parallel to result in overall process maturity.

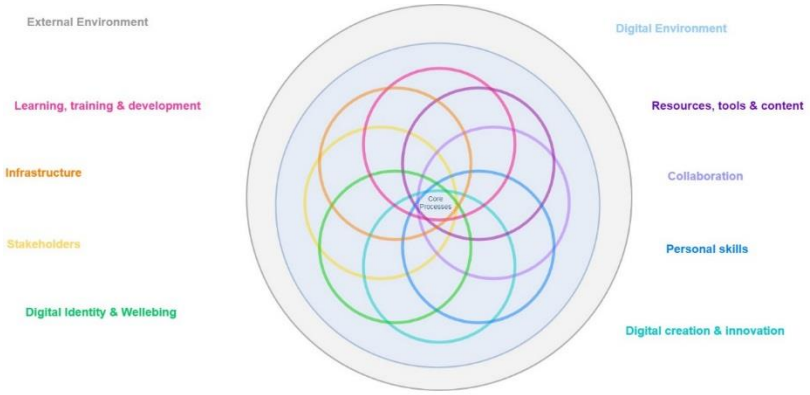

Figure 0-1: Relationship between themes of DC

The review further reported that stakeholders identified are the members of the institution and their full commitment is required to motivate learners to actively and frequently participate in the teaching and learning process. Furthermore, the results of the study highlight the significance of the contributions of stakeholders to the success of institutions maturity initiatives.

Many solutions have been offered towards change management, process improvement and overall development of higher education quality and efficiency. This study is part of a larger PhD

research work that aims to use the affordances of capability maturity frameworks to improve the quality and efficiency of tertiary institutions by developing a Digital Capability Maturity Model.

The last section of the review reported on the current status of research on DCMiTI in Nigeria. A limited number of studies were available in this context giving some indication as to the level of maturity of this area of research. All the literature reported stemmed from the southern axis of the country, indicating a gap in available academic literature from other areas of Nigeria.

The larger research work aims to develop a DCM model for tertiary institutions in North West Nigeria as a means to developing digital education processes and consequently improving the quality of educational outcomes. Towards the development of DCMiTI in Northern Nigeria, this study aims to assess the current status of DCMiTI and report on these results. Then a comparative analysis of the two results will be used to calibrate a conceptual model of DCMiTI. Prospective future work will involve validation and operationalisation of the model.

The outcomes of the study will further substantiate the literature review that has been undertaken. However, the cause and effect between variables cannot be determined by the outcomes of a correlation study alone, therefore a series of additional studies will be undertaken. Details of the data collection and analysis techniques that will be used are detailed in the next section of this protocol.

13. Methodology

Mixed methods of both qualitative and quantitative techniques will be used to test the outcomes of the first two research questions.

RQ1: What elements contribute to Digital Capability Maturity?

RQ2: How do these affect the DCM of Tertiary Institutions?

RQ3: What is the current status of DCM in TI? (Addressed by the results of Study 2)

The study will further provide the basis for answering the fourth research question, which is:

RQ4: What is the current status of DCM in Tertiary Institution in Nigeria?

The study is divided into three separate phases as shown in figure 2.

Study 3: (TI's in NW Nigeria)

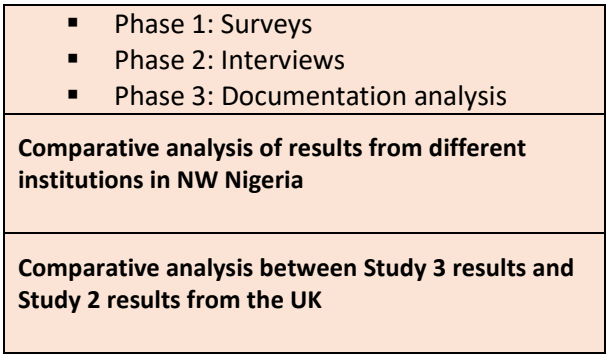

Figure 2: Breakdown of the series of studies

Phase 1:

The first part will involve the use of a semi-structured questionnaire to collect perception data from participants among participating Tertiary Institutions in Northwest Nigeria, the full questionnaire is available in (Appendix: Questionnaire).

Phase 2:

The second phase will involve interviews with management staff to discuss and further understand what the perceived contributions of the elements are from their perspective (Appendix: Interview Schedule).

Phase 3:

A documentation analysis will be conducted through active examination of the institution's performance on various elements of digital capability to determine how the elements impact the digital capability maturity of tertiary institutions/ how elements impact planning and execution of digital education programmes.

13.1 Data Collection

Data for the various phases of the study will be collected in several different ways:

Phase 1: A semi-structured questionnaire, aimed at producing responses that are related the study and would allow us to substantiate the literature findings from the first two research questions. This data will be collected using paper copies of the questionnaire. The target participants for this mode of data collection will be tutors, learners, administrators, and other technical staff.

A stand will be setup at strategic location of the Campus on various data, with some posters and a timetabling sheet to recruit participants willing to take part in the study.

For management, tutors and administrative staff, invitations to participate will be sent out via email.

Phase 2: An interview with various members of the management team will be conducted and audio recorded with the aim of collection their opinions on what elements impact digital capability and the effects that such elements have on the digital capability of the institution.

For management members, an invitation to participate will be sent via email and for interested participants, an interview date and time will be arranged.

Phase 3: An observation analysis will be conducted by actively examining various elements within the themes of digital capability to ascertain what impact they have on the digital capability of the institution. This examination will include data on network facilities, software, hardware, policies and procedures, well-being facilities, privacy, security, examination procedures, assessment methods, student grades, LMSs, collaborative facilities among others.

13.2 Sampling

The sample population in this study will consist of all the Tertiary Level Institutions in the North West Zones of Nigeria; inclusive of Universities, Polytechnics, Monotechnics and colleges of education. The North West Zones of Nigeria consist of 7 states: Kaduna, Katsina, Kano, Jigawa, Zamfara, Kebbi and Sokoto. However, the sampling frame will be limited to Kaduna, Katsina, Kano and Jigawa due to the risks involved in travelling to the other states (See Appendix: EC5).

Since the population census is quite large, the study will employ only a selection of participants for data collection.

Table 0-2: list of population members

Members	**Inclusive of**	**Involvement**
Stakeholders	Management, government, Ministry of Education	Part A and Part B
Tutors	Tutors	Part A only
Learners	Learners	Part A only

Administrators	Administrators	Part A only
Others	Others	Part A only

13.3 Sample selection

Due to time and budget constraints, it will be impractical to try and collect perception data from the whole sample, since a reasonably large sample selected at random will typically be representative of the characteristics of the whole population.

Participants from the sampling frame will be selected using random sampling, whereby all members of the population have an equal calculable chance of being selected. The sampling will be performed in response to the groups of strata identified in analysis of the literature search (See Table 4: population members). Participants will then be selected at random within each stratum. This helps to ensure a valid and unbiased sample that adequately represents the whole institution.

13.4 Sample size

A random selection of participants from each stratum will be recruited for this study. The study will start by targeting the following sample sizes as shown in (table 5) below.

Table 0-3: Sample size selection for per institution

Strata	Sample size
Management	5
Tutors	100
Learners	100
Administrators	100
Total sample size for Phase 1	Minimum 300
Total sample size for Phase 2	5

13.5 Dates

The data collection exercise will take place from August (upon receipt of ethics approval) and is estimated to take about 8 weeks, although the data collection process will be classified as on-going throughout the analysis stage in case additional samples may be required. The complete study should take no longer than four calendar months.

13.6 Data quality and management

Some of the issues that will be considered in terms of the quality and management of the data collected are Data management, measurement error, missing data, non-response, quality criteria, reliability, and validity.

13.7 Piloting the study

The questionnaire will be tested in a pilot study as soon as ethics application is approved and before the main study is conducted. This pilot will allow us to obtain feedback from a selection of the participant group using the intended administration method. The results of the pilot study will be reviewed, and the data collection tool refined in an iterative process until we arrive at a final set of clear and concise questions that would allow us to achieve the aims of the study. It is also a good chance to test the understandability of the pre-questionnaire information sheet and the definition of the elements/ themes.

14. Ethics Approval

The nature of the data that will be collected requires ethical approval to be sought from the ethics committee of the University of Hertfordshire. The study will adhere to all the guidelines set out by the ethics committee.

Participants will be informed both verbally and in writing about the details of the study, and that participation is solely on a voluntary basis, and participants are free to withdraw from the study at any time. In addition, written consent to participate will be obtained from volunteers.

Raw data will be stored securely in accordance with requirements of the ethics committee and in line with the GDPR (2018).

15. Proposed Data Analysis Techniques

Since there are series of studies each involving different data collection techniques, the analysis techniques will involve a combination of qualitative and quantitative techniques.

15.1 Phase 1: Mixed methods

The data collection tool uses ordinal scales and thus the data collected will be ordinal and non-parametric. This data will be exported to SPSS for non-parametric statistical analysis.

Question type 1: *Indicate your level of agreement that 'elements found in literature' are elements of digital capability (Using a 7-point Likert scale).*

Multi-variant factual analysis will be conducted to ascertain the contributions of each element to digital capabilities.

Question type 2: *Indicate your level of agreement that the 'elements found in literature' make a positive contribution to digital capability in tertiary institutions (Using a 7-point Likert scale).*

Multiple regression analysis (non-linear regression) will be used ascertain the contributions of each element to digital capabilities, allowing us to report on the distinction between theoretical perceptions and real-world perceptions.

In addition, the variability in opinion of the different stakeholders may be tested using (Kruskal-Wallis test).

Question type 3: *Rank the elements of digital capability in order of significance of their impact on digital capability in tertiary institutions on a scale of 1-10 (where 1 = least impactful and 10 = most impactful).*

The data from this question will be analysed using a Relative Importance Index (RII) to find group means and determine which elements statistically contribute the most.

Question type 4: A*re there any other elements that may contribute to digital capability of tertiary institutions? If so, please indicate the elements and effect (Open-ended).*

The last question of the study involves an open-ended question asking participants to indicate if there are any other elements that may contribute to digital capability which have not been identified in the study. The results to this question will require content analysis.

15.2 Phase 2: Qualitative analysis

Interview with management will be audio recorded and transcribed verbatim. Content analysis will be used to analyse the transcription data using Nvivo.

15.3 Phase 3: Mixed methods

Documentation analysis will be analysed using mixed methods.

15.4 Comparative analysis: Quantitative analysis

To perform a comparative analysis of DCMiTI in UK and Nigeria, a group comparison will be conducted using t-test for independent sample equivalent in non-parametric statistics. The data from both studies will be used to find out if there is a statistically significant difference between the group means (Man Whitney u-test). Using 5% level of significance as the rejection region, the results of this analysis will be used to provide a distinction between the current status and perception of digital capability between the UK and Nigerian tertiary institutions.

Furthermore, the following assumptions have been made in anticipation of the hypothesis tests that will be run.

Assumptions:

3. We assume that DCM does not have a Normal Distribution.
4. We assume that stakeholders are chosen at random, and they are independent of each other (that is, the perception of one respondent does not affect the perception of another).

16. Disadvantages

Parametric tests have greater statistical power, meaning they are more likely to find a true significant effect and are thus the preferred option for analysis. However, non-parametric test are also known to perform well with non-normal data (data that does not assume a normal distribution), especially when there is a sufficiently large sample size. For this reason, non-parametric analysis is considered appropriate for the purpose of the study.

17. Reporting

On completion of this study, the results will be reported to either accept or reject the hypothesis and ratify the claim that the elements of digital capability listed in (table 1), are those that contribute to DCMiTI. The results of the statistical analysis will be presented in the form of tables and/ or graphs that convey the information necessary for the intended audience to understand the data. Being mindful of the ease of misinterpreting graphs, descriptive data analysis techniques will also be used to provide a supporting narrative of the results, emphasising the key points. Furthermore, a reflection of the study will be documented, highlighting any threats to validity of the data, and concluding with suggestions for future work.

The results of this study will further inform the overall doctoral research on proposing a framework for development of digital capability maturity in tertiary institutions of learning.

18. Making changes to the protocol

There may be a need to apply changes to this document as the study progresses and in the event of applying these procedures in a different situation. While some of these changes will be useful to improve the current process as documented, other changes will be necessary to suite to context of the situation in which the protocol is being applied. All changes will be recorded, and the protocol will be updated accordingly using version control.

19. Communication and dissemination plan

The results of this study will be published as a conference paper. The conference that has been targeted for this publication will be ASCILITE 2020. Key dates related to submissions, registrations and other important activities for this conference are not yet available.

In the event that the results of this study are not available to meet the requirements/ deadlines for this conference, a conference plan has been drawn up. In light of positive impact that contributions of peer review and conference feedback have on academic research, various options for disseminating the on-ongoing outcomes of this overall PhD research work can be identified (See Appendix: Conference plan in Appendix).

Finally, an edited version of this protocol will be included as part of the online appendix for this publication to provide the necessary transparency into the process and final report.

END OF PROTOCOL

References

1. Tourangeau, Rips & Rasinski, 2000. The Psychology of Survey Response.
2. Segal and Castellan, 1988. Nonparametric statistics for behavioral sciences.

Invitation to Participate

Invitation to Participate in a Digital Capability Maturity Study

I am currently preparing to undertake a study titled 'Investigating the elements that contribute to Digital Capability Maturity in Tertiary Institutions (DCMiTI) as part of my PhD research programme at the University of Hertfordshire, United Kingdom.

Digital Capability Maturity (DCM) is 'the ability of an institution to sustain effective and efficient use of digital assets to support teaching, learning and working, through continuous evaluation, selection and adoption of new technologies and acquiring necessary skills, for full utilisation'. My research is focused on the development of DCM in Tertiary Institutions of learning as means of supporting Digital Education programmes in tertiary institutions within the North West Zones of Nigeria.

This study is testing elements of digital capability derived from a literature review. The study is looking to see how well the theory matches up to real-world perceptions. The primary objective of this research is to arrive at a conclusion as to which elements contribute to digital capability maturity. I am interested to learn your perceptions of what elements/ factors contribute to digital capability as part of my postgraduate research work and the outcomes of the study may contribute towards a PhD. The responses you give will help assess the needs of tertiary institutions and provide the baseline for the proposal of a capability maturity model that supports the innovative use of digital tools in teaching and learning.

I am inviting your institution to participate in the study. This will involve students, academic staff, administrative staff, and technical staff to complete a short questionnaire sharing their perceptions on the outcomes of a literature review. Furthermore, I would like to engage with members of management or those involved in decision making within the institution. Participation is completely voluntary. This research has been approved by the University of Hertfordshire Ethics Committee, Health, Science, Engineering & Technology ECDA under protocol Number: ECS/PGR/UH/03871.

If you permit this study to be undertaken among members of xxxxxx then kindly accept my invitation in writing.

Yours sincerely,

Fatima-Zarah Musa Bello

(Email: f.z.bello@herts.ac.uk)

Post-graduate research student

Pen-to-paper Questionnaire

UNIVERSITY OF HERTFORDSHIRE

ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS

('ETHICS COMMITTEE')

FORM EC3

I, the undersigned *[please give your name here*, *in BLOCK CAPITALS]*

……

Of *[please give contact details here, sufficient to enable the investigator to get in touch with you, such as a postal or email address]*

…..……

Hereby freely agree to take part in the study entitled:

Investigating elements contributing to Digital Capability Maturity in Tertiary Institutions (DCMiTI) in North West Nigeria

UH Protocol number: ECS/PGR/UH/03871

I confirm that I have been given a Participant Information Sheet (a copy of which is attached to this form) giving particulars of the study, including its aim(s), methods and design, the names and contact details of key people and, as appropriate, the risks and potential benefits, how the information collected will be stored and for how long, and any plans for follow-up studies that might involve further approaches to participants. I have also been informed of how my personal information on this form will be stored and for how long. I have been given details of my involvement in the study. I have been told that in the event of any significant change to the aim(s) or design of the study I will be informed and asked to renew my consent to participate in it.

I have been assured that I may withdraw from the study at any time without disadvantage or having to give a reason.

In giving my consent to participate in this study, I understand that voice, video or photo-recording may take place and I have been informed of how/whether this recording will be transmitted/displayed.

I have been told how information relating to me (data obtained in the course of the study, and data provided by me about myself) will be handled: how it will be kept secure, who will have access to it, and how it will or may be used.

I understand that if there is any revelation of unlawful activity or any indication of non-medical circumstances that would or has put others at risk, the University may refer the matter to the appropriate authorities.

I have been told that I may at some time in the future be contacted again in connection with this or another study.

Signature of participant……..……..…Date……

Signature of (principal) investigator……..……Date…2/3/2020

Name of (principal) investigator: FATIMA ZARAH BELLO

About the Survey

Dear Participant,

Digital capability is 'the ability of an institution to sustain effective and efficient use of digital assets to support teaching, learning and working, through continuous evaluation, selection and adoption of new technologies and acquiring necessary skills, for full utilisation'.

I am interested to learn your perceptions of what elements/ factors contribute to digital capability as part of my postgraduate research work and the outcomes of the study may contribute towards a PhD. The purpose of this study is to find out how people feel about the digital capabilities of their respective institutions. The responses you give will help assess the needs of tertiary institutions and provide the baseline for the proposal of a capability maturity model that supports the development of digital education programmes.

I would appreciate you taking about 8-10 minutes to complete this survey with the assurance of full ethics adherence.

Thank you in advance for your time and assistance

Best wishes,

Fatima-Zarah Bello

About you

1. Which of the following best describes your role?

☐ Student ☐ Tutor/ lecturer

☐ Administrator ☐ Technical staff

2. Which age group do you best fit into?

☐ 18 – 24 ☐ 25 – 34 ☐ 35 – 44

☐ 45 – 55 ☐ 55 – 64 ☐ 65+

3. What best describes your gender?

☐ Male ☐ Female

4. Which Tertiary Institution are you associated with?

_ _

5. Which department do you belong to?

_ _

6. What is your current level of study?

☐ Diploma/ HND ☐ Bachelor's degree ☐ Master's degree ☐ Doctoral degree

7. What is your current course of study?

_ _

Question 1: On a 7-point scale (where 1 = strongly disagree and 7 = strongly agree), please rate how strongly you agree or disagree that the elements listed below are elements of digital capability maturity.

Theme		Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
		1	2	3	4	5	6	7
Stakeholders	(Students, staff, lecturers, management, ministry etc.)							
External Environment	(Country, society, national education policies…)							
Tertiary Institution	(Organisational structure and institutional policies…)							
Infrastructure	(Structural, networks, hardware, connectivity etc.)							
Individual skills	(Interpersonal skills and technical skills)							
Digital well-being	(Ability to maintain a healthy work-life balance and support learners)							
Resources, tools & content	(including learning management systems and social networks)							
Learning, training & development	(learning strategies, teaching pedagogies…)							
Collaboration	(A collaborative culture for working, learning, and teaching)							
Creation & innovation	(creation of digital content and media production)							

Question 2: On a 7-point scale (where 1 = strongly disagree and 7 = strongly agree), please indicate your level of agreement that each of the elements listed below makes a positive contribution to digital capability in tertiary institutions.

Theme		Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
		1	2	3	4	5	6	7
Stakeholders	(Students, staff, lecturers, management, ministry etc.)							
External Environment	(Country, society, national education policies…)							
Tertiary Institution	(Organisational structure and institutional policies…)							
Infrastructure	(Structural, networks, hardware, connectivity etc.)							
Individual skills	(Interpersonal skills and technical skills)							
Digital well-being	(Ability to maintain a healthy work-life balance and support learners)							
Resources, tools & content	(including learning management systems and social networks)							
Learning, training & development	(learning strategies, teaching pedagogies…)							
Collaboration	(A collaborative culture for working, learning, and teaching)							
Creation & innovation	(creation of digital content and media production)							

Ranking themes

Question 3:

Please rank the following elements in order of significance of their impact on digital capability in tertiary institutions on a scale of 1-10 (where 1= least impactful and 10=most impactful

Theme	**Least impactful**									**Most impactful**
	1	2	3	4	5	6	7	8	9	10
Stakeholders										
External Environment										
Tertiary Institution										
Infrastructure										
Individual skills										
Digital well-being										
Resources, tools & content										
Learning, training & development										
Collaboration										
Creation & innovation										

Question 4:

Are there any other elements that may contribute to the digital capability maturity of a tertiary institution? If so, please indicate the element and explain its impact on digital capability maturity.

_ _

_ _

_ _

_ _

Re-contact

Question 5: Re-Contact

In the event that we may require further information as part of this study, would you be happy for us to contact you?

Email address: _

Thank you for completing this survey!

I would like to remind you that the information you have provided in this survey will be anonymised and cannot be traced back to you. Furthermore, all the data will be held in accordance with GDPR and guidelines from the University of Hertfordshire Ethics Committee, Health, Science, Engineering and Technology

Interview Schedule

The following questions have been designed to gain an in-depth perception of tertiary education stakeholders on the elements that contribute to Digital Capability and how these elements impact Digital Capability Maturity in Tertiary Institutions.

In answering the following questions, kindly draw on your broad knowledge of the tertiary institution environment and your experiences as a member of management within the institution:

1. **What elements contribute to digital capability?** *(Probe)*

(Open-ended)

2. **In your opinion, how do these elements impact the digital capability maturity in Tertiary Institutions?** *(Probe)*

(Open-ended)

3. **In your opinion, which specific element have the most impact on learning and why?** *(Probe)*

(Open-ended)

4. **Are there any other opinions you wish to share in relation to DCMiTI?** *(Probe)*

(Open-ended)

Appendix W: Transcripts from Study 4

Interview Transcript 1
Date: 3rd March 2020
Time: 2:08 pm
Duration: 13.03 minutes
Interview transcript between 'PARTICIPANT1' and interviewer

Started audio recording
[Brief breakdown of research from interviewer]
Question 1:

ZB: Ok good afternoon, I've already introduced myself and I've told you a little bit about what my research is about. I've also sent you the participant information sheet, I don't know if you've had the chance to read that.

PARTICIPANT1: Yeah ... I'm going through some of the documents.

ZB: Ok brilliant. Like I said, the purpose of this interview is to gain an in in-depth understanding of your perception about tertiary institution stakeholders. You would be considered a stakeholder; so your perceptions on the elements which impact digital capability within this institution. So as you're answering the questions I'm going to ask you, I would like you to draw from your experiences as a member of this institution, so from the institutional environment, as well as your own personal experiences as the head of this department to tell me what elements do you think contribute to digital capability?

PARTICIPANT1: yeah from my own perspective and considering the university environment am I; the elements: management, infrastructure, services, staff, and students, from my own view these are the key elements

ZB: okay

PARTICIPANT1: yeah

ZB: can you tell me a little bit more about what you mean by each of these elements, I just want to be clear what we mean by each.

PARTICIPANT1: yeah. Management; they are responsible for running the university and they are the ones to budget for anything monetary wise and whatever. So whatever we are maybe looking for or requesting, we would get from the management let's say in terms of infrastructure, services. So without infrastructure and services, staff and student cannot do anything in terms of digital capability is concerned.

ZB: so by services you mean your… which services exactly?

PARTICIPANT1: yes by the time you have the infrastructure in place, let's say connectivity to all locations within the campus, we are looking at the… let's say open and online distance learning

ZB: okay

PARTICIPANT1: or massive open online courses like MOOC, OODM and other services that can be leveraged over the infrastructure that is been in place, yes.

ZB: okay. How about infrastructure, what would you say comes under infrastructure?

PARTICIPANT1: infrastructure can be connectivity, let's if I'm considering the XXX setup maybe we have firewall connectivity all over campus connecting all buildings and within the buildings we have wireless and LAN so maybe 70% coverage, so by the time we have…

ZB: so you mean that you're talking about the network infrastructure?

PARTICIPANT1: yes

ZB: okay.
So you talked about connectivity under network infrastructure and you also talked about connectivity under services, so is that…

PARTICIPANT1: no, what I'm saying is under infrastructure we have connectivity while under services we have open online and e-learn courses.

ZB: okay

PARTICIPANT1: then we have something like MOOCs
ZB: Okay I'm clear.

Question 2:

ZB: And then in terms of staff and students those are also able to impact capability and management. Ok so the next question is: In your opinion, how do you feel that these elements that you've mentioned Impact on the university's capability maturity?
because we've talked about it but we haven't really talked about the actual impact that they have whether it's positive or negative or you know, how do they affect the university's maturity level?

PARTICIPANT1: err let's say if I'm looking at the managements side, they should be able to measure; let's say something like SWOT analysis. Let's say they have set up an infrastructure, how are you going to monitor staff and student whether they are using it or not to a level, maybe from zero level to a certain level, so that is how you can measure the maturity level.

ZB: okay. Not necessarily to measure the maturity level but would you say that management staff if you were to talk a little bit more about management staff and their impact on the university, what could they do or not do to have a positive or negative impact on this university?

PARTICIPANT1: err they should be able to something like quality assurance and SWOT analysis where they are… what have they invested or how are they going to measure it, the quality assurance, how can they relate the blended learning and what have they put in place for digital capability.

ZB: Okay

PARTICIPANT1: yes

ZB: Ok so how about for some of the others, how about network infrastructure and what impact would you say the network infrastructure has on digital capability maturity?

PARTICIPANT1: err yeah, in the infrastructure, without infrastructure you can't do anything. You can only have something on paper whatever you going to build unlike services, you should have infrastructure in place, so it is the bedrock of whatever you are going to build. So management, if you have a management that is willing to invest, by the time you have your infrastructure in place, you should be able to implement whatever you're going to implement let's say maybe the services and you should have something like a monitoring tool, where let's say an enforcement. Let's say in relation to the services, you should have something like a road system where maybe the staff would be encouraged on how to use it.

ZB: Okay, on how to use the system?

PARTICIPANT1: Yeah how to use the system and something like a encouragement, let's say if you're considering developed countries, you have to have something to encourage the staff and the student to use the services.

ZB: Okay, yeah and then again in terms of services, how would you say the services would impact the …?

PARTICIPANT1: yeah let's say like if you setup… we are having challenges like MOOC, you know we already have some MOOC system and the distance learning system, we have CISCO, we have MIT, we have HUAWEI and different types of MOOCs and we have seen… you can measure like let's say CISCO. All the students that passed through CISCO even though it's not directly imbedded into the curriculum, they acquire some skill more than those that are only go through that online because of what is in place. So, if you have a general something like MOOCs covering all other courses, it's going to really help.

ZB: okay, so that's for both staff…

PARTICIPANT1: yes for both staff and student

ZB: and students?

PARTICIPANT1: because we are looking at both staff and students. What are we going to invest or implement for both the staff and student?

Question 3:

ZB: yeah, ok fantastic.
Then in your opinion, which of the elements that you've talked about would you say has the most impact on learning and why?

PARTICIPANT1: err from own perspective… (Interrupts)

ZB: and when I say learning I'm not only talking about student learning, I'm also talking about staff learning because staff too are learning when they do training, that's errm you know;

PARTICIPANT1: but as far as I'm concerned, the student; they are central
ZB: okay
PARTICIPANT1: because even the lecturers and instructors whatever, they try to learn before they can teach the students
ZB: yes
PARTICIPANT1: so the students, they are central so whatever the school and management are trying to do is to improve the skill of the students to meet up with the 21st century
ZB: exactly
PARTICIPANT1: and try to maybe have professional development courses to improve the skills of the instructors/ lecturers
ZB: yeah. Okay so which of these elements that we've just discussed… (Interrupts)
PARTICIPANT1: students!
ZB: and then from there which one would you say next, if could just kind off tell me which ones you feel are more significant and which ones you feel are less significant in terms of learning?
PARTICIPANT1: err in terms of learning… (Interrupts)
ZB: there is no right or wrong to it, I'm just looking for your opinion.
PARTICIPANT1: yeah because I cant…. ok so, the most significant is students
ZB: ok so students. When you say students, what specifically about the students is most significant?
PARTICIPANT1: what are the measures? Because we are looking at trying to graduate students that would meet up with the current changes globally
ZB: yeah
PARTICIPANT1: so what are the measures the university would put in place for the students to learn the skills
ZB: okay
PARTICIPANT1: so whatever, if the lecturers try to teach the students, if there is not infrastructure in place, they cannot even if they are trained in the best of universities around the world, they cannot impact their students
ZB: yeah, so what you're saying is that the students are the most significant, like they are the center point of attention
PARTICIPANT1: yes
ZB: But actually you said that actually if there is no management support for these things, so is that then… does management have more impact than students or students more impact than management
PARTICIPANT1: err the students have more impact
ZB: ok yeah
PARTICIPANT1: that is what I'm saying because the management they have resources to invest for the students but they can only invest based on how… because they look at the student population, here let's say population is our problem, then how are they going to invest in order to cover up. So as far as I'm concerned, students are central maybe management is second.
ZB: okay and then where would you say infrastructure and services and staff apply in terms of…
PARTICIPANT1: staff are the third, infrastructure and services they are; infrastructure then services.
ZB: okay
PARTICIPANT1: because services, we can talk about many things in services it's not only maybe MOOCs or DL or something. By the time we have infrastructure, university management and the staff would have a different way of trying to impact knowledge
ZB: yes
PARTICIPANT1: so services would come last.
ZB: okay.

Question 4:

ZB: So in terms of the last question, it's just to ask whether you have any other opinions that you would like to share in relation to digital capability maturity of tertiary institutions.

PARTICIPANT1: yeah as far as I'm concerned let's say in developing countries we should be able to have a workable strategic planning. So from the strategic plan, we should be able to know where we are, where we want to be in the near future let's say in how many years, 10yrs, 15yrs and how do you want to do it?
ZB: an action plan, kind of
PARTICIPANT1: yes, an action plan so we should be able to have a strategic planning… where we evaluate at stages
ZB: okay
PARTICIPANT1: yes
ZB: okay that's all the questions I have to ask, do you have any question you would like to ask me?
PARTICIPANT1: I'm already satisfied because you've already introduced yourself so….
ZB: in that case…
PARTICIPANT1: only that your doing a wonderful work so you should be able to… by the end of this you should be able to draft something and even share it with the university
ZB: hopefully!
So we would call the interview to a close, if you're happy for me to re-contact you at some future time in relation to the work, I may do so. And also just to reassure you that your data would be secured safely in adherence with the ethics, protocols that have been given from both universities and the data would not be traceable back to yourself, I would do a content analysis, it will be anonymized and then report it in the form of a report.
PARTICIPANT1: no problem
ZB: I think that's all! thank you very much.
PARTICIPANT1: you're most welcome.
ZB: thank you!
Audio recording ended

END OF TRANSCRIPT

Interview Transcript 2

Date: 3rd March 2020
Time: 4:40 pm
Duration: 36:16 minutes
Interview transcript between 'PARTICIPANT2' and interviewer

Started audio recording
[Brief breakdown of research from interviewer]
Question 1:
ZB: Good afternoon.
PARTICIPANT2: Yeah, Good afternoon.
ZB: As I've already introduced myself, my name is Fatima Zara and I'm doing a study on digital capabilities. I have conducted a systematic literature review that uncovered that there are 498 elements that contribute to digital capability based on literature. I was able to summarize these elements into about a lot less than 10. The purpose of this study is to gain an in-depth understanding into each of these elements that contribute to the concept of digital capability in tertiary education and I'm trying to find out from stake holders like yourself who have a stake in the tertiary institution setting. What elements you feel contribute to digital capability. The idea is that I will use your answers to compare literature with real world perceptions to see if it matches up; and use that towards developing a capability maturity model.
So in answering your questions, I've given you the interview guide already, you have the list of questions in front of you but in answering these questions you can draw from your broad knowledge of the tertiary institution environment that you're part of, which is this university and your experience

as a member of management within this institution, what elements would you say contribute to digital capability?

PARTICIPANT2: well ermm, in the first instance I would probably talk about the capacity of teachers in this case, lecturers. Capacity is very important in terms of their ability to convert their lectures into digital contents whether audio or video or textual. I know that over the years there has been efforts to ensure that lecturers convert their materials into digital form. Many things came up, partly the issue of ownership, the issue of plagiarism and so on and so forth. Secondly, equipment; equipment here ranges from audio visual equipment's or equipment; to access to what delivers the contents to learners and teachers. The good thing is, automation began in this university, when I say automation I mean internet services began around 2001 with the establishment of some cafés in the campuses. That time it was based on dialog… expensive; later around 2004 the VSAT was deployed so the internet access became much better and so on, up till when we succeeded in deploying imminent back up based on wireless to connect all campuses and then much later around 2011 we got our backup. I may say that to some extent we have overcome the issue of equipment but most initially delivering content to those who need it but the major problem is actually content. Capability of content which has to do with more capacity. Motivation, you know motivation is another important factor.

ZB: motivation of who?

PARTICIPANT2: of course the teaching staff for example, nowhere in their promotion guideline that says if you don't have digital content you cannot be promoted. So it's like an optional thing; if you like do it, if you like don't do it and as such you know, I'm sure that impacted on response to either (you know) being able or not.

Another one is perception, perception of the teaching staff that if they have PowerPoint presentations, it's like they have something to deliver in teaching and learning; and you would agree with me that PowerPoint presentation is not enough. Students need lectures, they need more materials than just the bullet points and so on. The other one is, ermm the major one is non availability of policy that says we must do things this way or that way so as such you know, you find that people choose to use technology or not to use it.

ZB: yeah.

PARTICIPANT2: ermm, those who use it unfortunately don't do it the way it should be done most especially the way I see it, you know when people give presentation thinking they have given lectures which is not enough. Another major aspect is access to the learners, I know there has been arguments in this university to impose the ownership of computers by students but majority kicked against it because of the fact that parents of maybe students might not be able to afford to give those systems to the students. So the university itself made effort to have what we call digital centers, where students can go in and do their work. There was one in each faculty but unfortunately maintenance became a problem. You hardly see a faculty that has those facilities all the time, the way they should. And for places like this, [referring to our current location where the interview was taking place]; we call this CBT center where we have about 300 computers. It's not open to students to come and work apart from assessments and exams so this would have helped in making access available.

ZB: yeah.

PARTICIPANT2: and we have quite a number of access places in the university, we have it here, we have it at the **** center, we have at the Distance Learning Centre and so on and so forth. What I'm saying in essence is, if you look at student computer ratio, it is so high but those computers provided by the university and the ownership of devices that would be used in accessing contents. And again we have the issue of coverage, though we have an expansive fiber backbone from our shift campus to our main campus.

ZB: is your backbone (shutters)….

PARTICIPANT2: it is owned by the university

ZB: what network do you….

PARTICIPANT2: it is fiber optic.

ZB: oh ok.

PARTICIPANT2: yes, I think we are talking about a strand of about 78KM of cable. We have some few access points. You agree with me that you know that access to internet is better on campus if it is wireless because of mobile devices and so on and so forth. So they are not adequate actually. We need to make them

more available to students so we can be able to connect their devices for those who have mobile or tablets or laptop computers, you understand. The other important issue is that there is lack of the software needed to deliver contents. Of course, one we may say that our MOODLE is okay, but you know there are much better ermm...

ZB: do you use MOODLE in this university?

PARTICIPANT2: we have MOODLE deployed in this university but it depends on whether you know the lecturer wishes to use it. It is only for those who want to use it. Some use it but the percentage is insignificant for those who use as against those who don't use it at all, but we have module deployed.

Training is a big issue, you understand; maybe because of the lack of policy, maybe because the motivation is not there we have an institute of computer here and we have a unit in charge of academic support but even with that, you find that it is difficult to train teaching staff. You call for a training, you find that out of the number people you have invited, only a small percentage not even up to 30% turn up. So it is a big problem making people adopt the resources, in fact there was a time the university deployed so many smart boxes to assist in the teaching in so many theater but they were not used, where they were used, they were merely used as projectors and screens for protections. The actual capabilities of the smart box where not used fully but of course you know I blame the university for not really looking at those facilities to understand the way that different categories of professionals use it, the way that somebody who does programming, mathematics, political science etc. may likely use it differs.

ZB: yeah.

PARTICIPANT2: maybe that is why it is looking difficult to adapt. The good thing is those advice that have issues of connecting to the network so of course smart box does not have a lot of difficulty in this day. The other thing is as, lack of expanding the IT capacity in the university. There is this fact that the more content you have, the more storage you acquire. So maybe because of again the lack of policy, we don't seem to have any plan on expanding our infrastructure of course we have a data center but with limited storage where you have videos, audios and so many other content in different forms; obviously you know that the issue of storage is going to come In and how to make fast access to those materials, though it is in our local network but still authorization is required. So requisite software, requisite infrastructure and then training are key in defining agents of digital capability; vice-versa you know the capacity of the students of course there is an effort made to ensure that every student has done a course at the point of entry to the university to prepare them to be able to use IT facilities but unfortunately, it is more concentrated on this campus, the other campus is not…

ZB: so its not part of the universities policy, it's just something that is offered to…

PARTICIPANT2: it is funny you know ehn, funny in the sense that ehn computer science department is here, when I say here, I mean the main campus. The institute of computing is also in the main campus. So those are places where you get the resources to teach those courses, the labs are also here though there are a few in the other campus, like the Kongo Campus. So because of the fact that there are some distances from there and the other campuses. You find that students of the other campus have not attained much in that program, in fact many of the courses domiciled in computer science department; the expected person from there have get them over, they got someone from outside who teaches on part-time basis so that you can see that lack of policy, lack of cohesion you get the point create that vacuum between the students in one campus and students in the other campus. I remember in one of the managements meetings, the vice chancellor not the ongoing, the former one; complained seriously about that development that departments are employing their own professions to teach certain courses instead of relying on departments that are mandated to teach those courses. It's a big problem so here I'm talking about distance policy, but of course with policy distance shouldn't be a problem.

The other fact is large number, population. Population is a big issue, teaching using technology requires management of class size. Unfortunately, some people believe maybe that the lectures come to assist in teaching those classes but you know I was opportuned to do a course 100% online, I saw how the instructors suffer in trying to go through your work and the work of everyone in the class. You find that the class is unmanageable using digital contents which is also not easy especially where assessment must be taken and where the questions are not multiple choice questions, maybe they require theory or where collaboration is required among members of a class in participating in a

particular issue. So you find that large classes also contribute to the problem. So marginal classes are better but I still await to see how technology can address the issue of large classes. Maybe this is what I can remember for now.

ZB: that was definitely a lot. That which is good.

Question 2:

ZB: Ok so considering these elements that you've mentioned in your opinion, how do they or any of them, whichever ones you choose to discuss; how do they feel the impact on the capability maturity of the institution itself. You know, the ability of the institution to continually develop?
I mean some of them to be honest, you mentioned as you were speaking like you said with the population, It's always easier to manage smaller class sizes, obviously large population is a disadvantage but on some of the other ones which one would you say has… or what kind of effect would you say it has on the university.

PARTICIPANT2: ok please before I answer your question, I remember another one; budget (funding) Funding is very essential. Quite unfortunately you know, some of these contents are not free so they require money especially the subscribed activities. It is a very big problem for the university to maintain subscriptions, you understand.

ZB: Yup!

PARTICIPANT2: So going to your point, well policy is key. You know, to me there must be a policy in place to guide learners and teachers, and management on the acquisition, usage, and adoption of technology in teaching and learning. Once a policy is put in place and backed up with adequate funding; any other thing I mentioned after the policy, I think we can get where we are meaning to get to in terms of the adoption of digital learning.

Question 3:

ZB: yeah, oh ok. Again considering the things you talked about in the first question. In your opinion which specific thing would you say have the most impact on learning and why?
You can pick any of the one you've mentioned previously. I've got the list if you want to remind yourself. So how would you rate them in order of significance?
You said policy is the most important, so which one would you say is the next most important and which ones are the most significant that impact learning.

PARTICIPANT2: let me try to list what I've mentioned [gets paper and a pen and start jotting them down] so that I can be able to rank them since you want that. I mentioned policy.

ZB: yes

PARTICIPANT2: I mentioned funding

ZB: you did

PARTICIPANT2: I mentioned access

ZB: yeah

PARTICIPANT2: I mentioned population

ZB: yes

PARTICIPANT2: I mentioned motivation

ZB: hmm… yes, you did motivation. You mentioned perception.

PARTICIPANT2: yeah perception

ZB: teachers' capacity

PARTICIPANT2: capacity

ZB: equipment

PARTICIPANT2: you know some most likely may mean the same thing like equipment and access though equipment maybe servers and network equipment

ZB: ok

PARTICIPANT2: and then any other audio-visual equipment, anyway you get the point

ZB: yeah

PARTICIPANT2: so capacity…

ZB: you mentioned software aswell, you talked about Moodle and things.

PARTICIPANT2: yeah, software

ZB: And then you mentioned coverage but again that comes under access doesn't it?

PARTICIPANT2: access yes! and then I mentioned intellectual property maybe I said it differently but that's what points I have been talking about ehmm intellectual property.

ZB: yeah, you talked a lot about Lack of expanding infrastructure like lack of a plan

PARTICIPANT2: it is access!

ZB: oh ok, but I think when you were talking, you mentioned something about strategic planning.

PARTICIPANT2: yeah when you have a policy, you can strategize and develop such a plan. So ehn if I am to rank this of course policy is going to be first, funding is second, motivation is three, capacity four, access five, software six and intellectual property number seven.

I don't know whether there are more (repeats ranking list).

I'm sure if there is motivation the issue of intellectual property would not come in, they would not talk about ownership of whatever content.

ZB: yeah

PARTICIPANT2: that comes in because you know, somebody may feel as if I authored something why should I give it for free? but if there is motivation for example let's say that if you want to be promoted, you must have x number of journal publications so that of you digitalize your lectures about 2 or 3 of them, takes over the journal publications… that is motivation. Nobody would talk about intellectual property there etc. ok population is important maybe number 8. Population impacts on the capacity negatively, digital capacity negatively you get the point.

ZB: yeah, negatively in…?

PARTICIPANT2: in the sense that if you have large number of students initially, first of all the issue of access would not be a problem, secondly ratio of equipment to students well let's say devices to students is going to also be high. So if it is high, it means you reduce number of contact hours to student etc. you're going to require more access points to support the large population etc. so I think software, you know some people would say that it's so much important but I put it as number six because there are lots of open source software one could use so it's given once you've decided to go in the direction though the subscribed ones are better but the open source can serve to a certain extent.

ZB: you talked about training, in the beginning but you didn't say anything about it later on

PARTICIPANT2: capacity building and training are they not the same.

ZB: yeah true. So how would you say capacity building impacts on learning?

PARTICIPANT2: yeah you know quite unfortunate (should I say unfortunately) the fact is using digital content in teaching and learning in this part of the world is still new. You find that people are not comfortable (let me put it that way) you understand. Remember I've given you something before we started talking you know. I want to believe you know that is still valid and is still part of our problem actually in this part of the world, they call it world development report 2016, they mentioned that there are five things you need to know about that. The first thing they said is that digital technologies can be transformational. We adopt distance learning, it means we have transformed the way, the pedagogy has shifted between firsthand probably to something else.

The contact would be more using technology than human to human though we can't avoid human contacts in learning. Then they say the benefits often remain unrealized, maybe because of certain reasons. The digital device is still wide, wide open! The largest barrier not in technology because you know the latest mobile or phone or tab in the world can be found in virtually every corner of the world in the shortest possible time. So it means technology is not the barrier. The last one is the major issue they said digital revolution needs a strong analog foundation, do we have it? You know unless if we have a system, a system that is adhered to; then you can be able to discharge and get things working otherwise we find that you don't have the system, if you aimed at digitizing when you don't have a system, a solid foundation then you do it on a wrong footing and at the end of the day, the item or two without realizing the benefits is difficult…

ZB: it's difficult, yeah.

Question 4:

ZB: So that's all the questions, are there any other opinions that you would like to share in relation to digital capability maturity in tertiary institutions.

PARTICIPANT2: well yes, In my own opinion I think we need to develop or rather put in place that foundation meaning that right from levels below the tertiary level, students should be introduced into digital learning to

some extents. Of course, I do see some schools making effort in that direction, in fact my 8yr old daughter collected my phone to do her assignment you know but of course it has to be done with caution. With caution in the sense that if they are just shown to browse, copy, paste and submit then they are not learning anything. So, I want to believe learners should be introduced to using computers from an early age with caution so by the time they are entering tertiary level, the foundation is already solid and they can build from there. That is the learners then the teachers, motivation must be there to encourage lecturers to really go digital but also with caution so that somebody would not rely so much on power point to say that I have my lectures digitized and I agree with you when we were discussing before you began to record that recording lectures is so much important. It gives the teacher ability to even review his own capacity. In fact I recorded something I'm not saying that I'm impressed but that gave me a level of comfort to the way I explain things in the class for example; so if such measures can be put in place, I think it would go a long way in addressing the issue of digital capacity In tertiary institutions.

ZB: so who would you say is responsible for this motivation, where would you say that this motivation would come from.

PARTICIPANT2: the senate! Well the senate is the highest academic body in a tertiary institution. In university we call it the senate in polytechnics we call it the academic boards. of course, council do the highest policy.

ZB: so that's basically the top level of management in the university.

PARTICIPANT2: obviously. Topmost level. But you know, knowing fully what our country is regarding issues to do with labor, labour related matters, unions should also be involved in this matter.

ZB: and in terms of policies, being a member of management who having attended a lot of meetings yourself, is policy something that often comes up as a topic of discussion in management, whether there should be more policies and reasons why there may not be.

PARTICIPANT2: yes, I can say yes but mind you, you know there are so many levels of management when you talk about management, I don't know which one you're talking about. You know we have the main management comprising of VC etc.

ZB: yeah, I mean even from lower down, it is something that has been pushed towards top level management.

PARTICIPANT2: yeah, like in our institute, institute of ICT we are always about development of ICT policies and my argument has been let that policy be an all-encompassing policy and let everyone contribute to it because if you don't actually allow stakeholders contribute to the policy that you put in place, you will find that implementing the policy becomes a big issue. So maybe different levels can develop policies and send to management for ratification. I think that approach is better.

ZB: yeah.
is that something that has been done before or something that's in the process maybe?

PARTICIPANT2: well there are so many drafts but no one seems to look at it critically to say that is an acceptable policy. Not long ago we reviewed our structure, the institute of computing. I try to encourage my colleagues to say that lets have an arm of the institute that interfaces with the public with our stakeholders; the users of services because we are virtually you know a service-oriented institute. If you don't give a service that satisfies those we are serving, it means we are not doing our work. Most importantly we are supposed to provide ICT to support learning and teaching, I mean teaching and learning. We have been talking about policies, I want to believe that the incoming administration will push it forward. In short its part of what we discussed with the incoming VC, policy, expansion, access, and many other things. We're thinking about creating an opportunity for students to maybe own tabs or laptops to serve their needs. We are thinking about so many things to address those issues we identified as the problems of digital learning.

ZB: I think that's all the questions I have unless you have anything else to say, we can move it to the door close.

PARTICIPANT2: well unless you hear from the students, you will understand probably their predicament but I would say that if part of the policy we can allow for things like this, for students to be used. I remember when we were students, that was during the earlier days; all students of the university have equal opportunities to access, we know of those who were doing languages and education don't mind much. Someone like me would go and get their username and book times for the hours that I need it. What

I'm saying in essence is that everybody needs access to opportunities, whatever services we have on the ground should be made available for the students to use.

ZB: is it something that's considered when looking at the numbers for intake, you know the access population ratio?

PARTICIPANT2: I would be sincere, admission is not based on IGR, quite sincerely management of universities admit more than they can handle because the more the number, the more money they get but I don't believe in that, I believe in quality.

ZB: so, if they have that, does that not solve some of the issues of funding?

PARTICIPANT2: it would not because it is creating too much overhead because the more people you need, the more resources you will need, so it is not a good idea to say that you know... Well, there are competing need for resources actually. They may tell you that its not only IT that requires money, there are other areas that need money. So, while the money comes in you will find that the need for money is much more than what is available, the number also creates more problems in my opinion.

ZB: I would go ahead and transcribe our interview; and If you are happy for me to make contacts with any questions that would be great. And like I said full ethics adherence from both *** and university of Hertfordshire. If you have any other questions about my study, don't hesitate to contact me from my contact detail. Thank you.

PARTICIPANT2: yeah, you're welcome.

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 3

Date: 3rd March 2020
Time: 12:14 pm
Duration: 23:22 minutes
Interview transcript between 'PARTICIPANT3' and interviewer

Started audio recording
[Brief breakdown of research from interviewer]
Question 1:

ZB: So good afternoon.

PARTICIPANT3: Good afternoon.

ZB: I've already introduced myself; my name is Fatima Bello and I'm a PHD research student in the University of Hertfordshire. I hope you've had a chance to look through the participant information sheet. The purpose of this interview is to get an in depth understanding from you. So, as a stakeholder of this institution with regards to the elements that you feel contributes to digital capability maturity and how these elements impact this institution so in answering the questions that I'm going to ask you, if you could draw from your broad knowledge of the tertiary institutional requirements and your experience as a member of this institution.

PARTICIPANT3: Yeah.

ZB: What element would you say contributes to digital capability?

PARTICIPANT3: There are quite a number of them. In this part of the country, economy before we come to the technological.

ZB: Okay.

PARTICIPANT3: Economy plays a very important role in someone being able to become digitally capable and relating to using computers to surf the internet to record data, analyse it. So, you find students are admitted, if not for now that the university entrance exam forces students to start the examination online, a very good number see computer maybe, or have physical contact with the computer when they are admitted into the university. So, I'd say the economy plays a very important role because not so many

people will be able to buy computers for their children but thank God for the social media -the advent of the social media and mobile phones we now have. Quiet a good number are becoming capable digitally, starting from their phones before they actually move into the system. So that is number one, the economy plays a part. Coming down here on the campus, there are quite a number of things. This is a university that has over fifty thousand students and when you look at the facilities around certainly, they cannot go round. Here in the ICT directorate, when we started about 10 years ago, we had what are known as the digital centres. A digital centre is basically a lab where the university put in some computer systems that students can actually come and make use of. But in a whole lab, you find out that there are about 30-50 computers at most and you find that digital centre is per faculty. A faculty may have well over 2000,3000, 4000 students. So, such number of students coming to use very limited number of computers actually limits it. So, there's that factor. The other factor is the internet availability. Still here, internet access is a challenge but we thank God, here in Ahmadu Bello University a lot of investments have been made. Nearly everywhere you go on campus, you have Wi-Fi and students are being given access credentials to be able to access such networks but still the bandwidth that we have is still limited, apart from the over 50,000 students there are over 10,000 staffs. Presently we are on 155 megabytes per seconds but it can't go round so internet access is a challenge. You may not be able to have the right experience that will enable you to become digitally capable because of such limitations that we have as far as our internet access is concerned.

ZB: Okay.

PARTICIPANT3: The technology also, in the advanced world, there are so many things that has actually aided one's capability but we are still way back. At some point, the ICT convinced the management to bring electronic smart box that would be used for lecture delivery and so on. The boxes are there

ZB: (Laughs)

PARTICIPANT3: (Laughs) the boxes are there but, the other angle -the people to drag: it's not only students. Before you can have digitally capable students you should have digitally capable lecturers or staffs. So that is another challenge, when you look at the students end you have to look at the staffs end too. From the staff end, there are issues. From the student end there are issues and then the social behaviour, you would go to many lecture halls and the university has tried in putting electronic devices, projectors, some communication equipment but overnight you go and find out that the place is vandalized. The projectors are nowhere to be found and other things like that. So, such attitudes limits instead of contributing, limits the digital capabilities of most students. So, in a nutshell, those are about 4 points I have said, basically summarize a little of some of the elements that may contribute or hinder digital capability among our students here in this tertiary institution.

ZB: Okay. You mentioned the smart box and you were able to convince the management to buy smart boxes, in making these type of management decisions, was anything like trainings discussed?

PARTICIPANT3: Not really, that is one of the elements also but some few training was held. But you know concerning these top decisions, it doesn't have to be advised by the ICT directorate, something can come from up. So training was actually a major issue, on the smart box yes, it is an issue but efforts are being made sometimes.

ZB: You said it's an issue with the smart box but how about in other terms of general digital capabilities within this university?

PARTICIPANT3: Our institution tries as much in organizing some workshops especially on how to use the available software devices that we have in the university. Periodically, far back as 2007-2008 we went round to all the faculties including the satellite bodies but our target then was the staff not the students. We went as far as the arewa house to bring faculties together to enlighten them on the changes we have for better lecture deliveries and contact with students. But I can't remember how many times we have gone on smart box specifically.

Question 2:

ZB: On to the next question. In your opinion how do you feel these elements that you've just talked about impact the maturity of this institution? I mean you mentioned in terms of social behaviour, you said it limits. So how about some of the other things you've talked about, how would you say that they impact the university?

PARTICIPANT3: They do impact positively, for example the digital centres I said earlier, it helped the serious ones because this an institution that everybody is on his own but we've had a good number of students that made use of the available devices then to increase their digital capabilities. So, it does but what we have to contribute better is the internet access. The availability of the internet access around the campus has helped greatly in increasing the digital capabilities of the students around. There was a proposal at some time which didn't see the light of the day making some soft loans to students to acquire iPad or whatever devices that would aid them in learning. Well as I said, it didn't see the light of the day because of the differences between the school management and the people who proposed such systems. But had it been the proposal saw the light of the day perhaps it would have helped greatly but as good as that may be, we thank God for the revolution in mobile technology. A very good number now have handsets that are digitally capable. More than average of the students in the campus have a way and means of interacting and accessing information.

Question 3:

ZB: So, which specific elements would you say have the most impact on learning and why sir?

PARTICIPANT3: Maybe I didn't look at the position of the question but I think I've answered that. The availability of the internet facilities that we have. I've been to quiet a number of institutions and at least we can pride ourselves that anywhere you go on this campus you have one access point. Some are for obvious reasons while some are restricted. You have to be authenticated before they access them. And we have about two layers of security like for you to access the university network here you must have a valid username and password. But some access points are also protected. So, I think that is the most specific element that has the most impact -people being able to have internet access. If the other proposal saw the light of the day whereby every student perhaps has something that he can take his notes or browse the net, it would have impacted much more. But we have deployed some level management technologies specifically module for example, it doing quite a lot in helping to pass knowledge around, online classes, assignments, lecture notes. We have that and it helps us a lot.

ZB: Is it being utilized by both the staff and the students?

PARTICIPANT3: Yes, A staff would create a class, enrol a student, send assignments there, some even write tests, give lecture notes and so on. Thank God that hundreds of courses are running on our module.

Question 4:

ZB: Fantastic. Lastly, any other opinions that you would like to share in relation to the research on digital capabilities.

PARTICIPANT3: Well, I wish that in your study, you know the first problem I started with was on the economy. It plays a very vital and critical role in almost everything so I wish a model can be made to assist children from less financially capable homes have access to mobile devices to improve their digital capabilities, to gain more knowledge and data and information that exist on the internet. Quite a number do not have up till now and digital centres that we have cannot go round them. Some are also in states of repair. We are a little bit lucky here because of the investments the institution has made in having a good data centre that we don't have to rely or pay heavily for hosting. The major thing is just to maintain that equipment. So, in my opinion if something can be done in pushing the effect of the economy, I think that will help.

ZB: So, we talked about which element had the most impact and you said the internet so where will you put the economy in terms of the level of impact that it has?

PARTICIPANT3: Economy has negative impact while the internet has positive impact.

ZB: (Laughs) I mean if you were to rank them on a scale of 1-10 how impactful would you say the economy is?

PARTICIPANT3: Well, if you want me to rank them together, economy place in higher. Like I said earlier, what we have in the university is not enough for everybody so students who are economically buoyant compliment by subscribing to some data when they are not able to go ahead. So, in that aspect I would say economy places in higher than internet.

ZB: Okay.

PARTICIPANT3: And the question number 2 there's something I forgot to add, even though I mentioned module, here in the university we have a google chrome solution for computer-based assessment and in the first levels that is 100 levels and 200 levels, there are some general courses that student must write them

computer based. So that also has helped a good number of students to become digitally capable. In that aspect, I think it has also impacted positively, I mean the computer-based test we have now.

ZB: My last question, so you mentioned the students using the internet for social purposes, would you say that there's a relationship between social media and the digital capability maturity of the institution?

PARTICIPANT3: Yeah, sure.

ZB: Okay. What kind of relationship?

PARTICIPANT3: Well, we are in an influential age now, before you hear something even from the frontline media, it's already on social media. News, lecture notes and so on is shared on social media. Someone who is in a module class can share that material -don't ask me about the ethics of that anyway (Laughs) with someone who is not in that class for some reason through social media. So, the social media is a driving factor. Most of the student we have now didn't go to any conventional school to learn, they were carried mostly by the social media and it has helped them also positively.

ZB: Fantastic, and that's all the questions I have to ask. Do you have any more questions or any other input you will like to add?

PARTICIPANT3: For now, no.

ZB: Okay brilliant. So, in that case we would call the interview to a close. Thank you very much for your time and if you do have any further questions please don't hesitate to contact me and I will further assure you that your data would be kept securely in accordance with the regulations that have been documented in ethics of approval from both institutions and it would be anonymized and then transferred for content analysis at which point the data cannot be referred back to yourself or anybody else. Thank you very much.

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 4

Date: 6th March 2020
Time: 2:29 pm
Duration: 16:01 minutes
Interview transcript between 'PARTICIPANT4' and interviewer

Started audio recording
[Brief breakdown of research from interviewer]
Question 1:

ZB: Good afternoon, thank you for being willing to participate in my research, I really appreciate that. As I've already explained what the research is about, this particular interview has been designed to gain an in-depth perception of stakeholders like yourself, tertiary institutions stakeholders and their opinions about the elements that contribute to digital capability and specifically how that impacts the capability maturity of tertiary institutions. So in answering the questions I'm about to ask you, if you could draw from your own broad knowledge of the tertiary institution environment and your experience as a member of management within this institution, what would you say are the elements that contribute to digital capability maturity?

PARTICIPANT4: erm the university must have its own policy on e-learning and then the tutors of this institution must have the knowledge on how to deliver it; and then there should be internet connectivity throughout the institution and then there should be interactive boards in all the classes. That's it.

ZB: okay, so when you say tutors knowledge on how to deliver, do you mean their knowledge on the subject or their knowledge of how to deliver in terms of…

PARTICIPANT4: ermm in terms of knowledge on the subject and in terms of knowledge on how to deliver it and then how to use the interactive boards for example.

ZB: okay
PARTICIPANT4: the package
ZB: like the technical skills?
PARTICIPANT4: their technical skills yes, they must have the technical skills
ZB: okay ermm, any others? You've listed four, you said policy on E-learning policy, only E-learning cost on policy or in your opinion would there be any other policies that would impact on
PARTICIPANT4: then there is strategic goal of the university
ZB: okay any other elements that you can think of?
PARTICIPANT4: not really

Question 2:

ZB: okay that's fine, excellent. So in your opinion, this elements that we've discussed, how would you say they impact the digital capability maturity of tertiary institutions if we look at them kind of one by one, the impact that they actually have on the university
PARTICIPANT4: the impact?
ZB: yeah the impact; how they impact the capability maturity of the university
PARTICIPANT4: yeah, this would now bring out ermm the level of the university in terms of ranking and it will increase the visibility of the university and then the products of the university also
ZB: products in terms of what?
PARTICIPANT4: products in terms of graduates.
ZB: okay
PARTICIPANT4: you know the products in terms of the graduates and in then in terms of research would be more visible than those that did not have this opportunity
ZB: okay so specifically, what impact would you say policy has on capability maturity?
PARTICIPANT4: specifically ermm…
ZB: I mean would you say the advantages of having policies on certain things is a positive impact or … (Interrupts)
PARTICIPANT4: no, of course it's positive
ZB: so what would be the difference between the institutions that have E-learning policy and those without
PARTICIPANT4: the difference is that those that have E-learning policy, the lecturers and students would have been exposed to modern techniques, you know and modern technology, and then would now be at the fore front of knowledge than those who have not been exposed
ZB: yeah and then how about tutors knowledge, what impact would that have on... (Interrupts)
PARTICIPANT4: you need to train the tutors, that is capacity building of the tutors, it's also very very important
ZB: hmm
PARTICIPANT4: in fact this is the first stage, you need to build the capacity of the tutors
ZB: okay
PARTICIPANT4: then once they have this confidence and they have the capacity, then they can now deliver both in terms of knowledge and then the technical skills.
ZB: okay. and then how about internet connectivity and access to interactive boards?
PARTICIPANT4: internet connectivity is very very important
ZB: ok, why is that?
PARTICIPANT4: and then because in the interactive board for example, you can leave after delivering your lecture, you can leave there, the part of the lecture on the board and then somebody can have access to it. So if the students are not trained to do that they cannot have access, if the internet is not working they cannot have access, they can even download other materials from the internet and then compare with what you have given so they will be more involved in the subject. The student will be more involved in the subject because they can now go into the subject through internet to find more materials
ZB: so then it gives them more access to… (Interrupts)
PARTICIPANT4: more access yes.

ZB: and then lastly what would you say is the impact of… I mean what impact would the university have on strategic goal, I mean what impact would that have on the capability maturity of the institution?

PARTICIPANT4: the strategic goal is for the university to set that from within a certain period we want to reach a certain level and then the university would have to aim at that over a period of time maybe 3yrs, 5yrs depending on the strategic goal of the university and this is one of it that must be captured in the strategic goals.

ZB: okay so what advantage would they have by having that strategic goal?

PARTICIPANT4: yeah because it's already designed and then the university must work towards that to make sure that it achieves its goal within that period

ZB: and then how would you… (Interrupts)

PARTICIPANT4: without delaying

ZB: yeah exactly… and so what impact would that have on their maturity

PARTICIPANT4: yeah by the time the university reaches the level it wants, then the university is now said to be matured

ZB: perfect, I just wanted to be clear on what you're saying, I don't want there to be any miss…

PARTICIPANT4: yes.

Question 3:

ZB: so the next question is, in your opinion which specific element would have the most impact on learning, so I know you've talked about a few but if you were to write them in order of most important to least important, which ones would you say have the most impact on learning and why?

PARTICIPANT4: most as I said is the capacity building of the tutors, then second is for the university to have internet connectivity 24/7 that possibly the fiber optics, the wireless and most of it.
High speed internet is very important!

ZB: okay, why so?

PARTICIPANT4: yeah because during the 24/7 every minute counts

ZB: okay

PARTICIPANT4: yes every minute counts

ZB: so that internet access, are you talking about access for who specifically within the institution

PARTICIPANT4: for both the lecturers and the students, for students to learn and for lecturers to have their research

ZB: okay ermm so the capacity building of tutors first and then 24/7 internet is the second most important, and then what would you say… like how significant would you consider the others like policy and tutors knowledge and ermm… no, sorry tutors knowledge is capacity building. We've talked about internet so we've got remaining interactive boards, strategic goals and policy

PARTICIPANT4: yeah

ZB: so which of this would you say is the most significant of the three that I've just mentioned

PARTICIPANT4: interactive?

ZB: interactive boards and then you also talked about policy on E-learning and then you also talked about strategic goals

PARTICIPANT4: yeah strategic goals

ZB: so having a helping you plan right?

PARTICIPANT4: yes, then within the strategic goals you must have an e-learning policy

Question 4:

ZB: okay ermm perfect, so onto the last question which is to ask; do you have any other opinions that you wish to share in relation to digital capability maturity in tertiary institutions

PARTICIPANT4: yeah, my own opinion is that I would like to suggest to all Nigerian institutions of higher learning to have digital capability, to build digital capability for both lecturers and students, tutors and students

ZB: okay, what positive (interrupts)

PARTICIPANT4: but then I don't, what I am not sure of is how they are going to go about it because of cost implications

ZB: okay

PARTICIPANT4: but then it's worth it.

ZB: yeah okay. So what are the benefits?

PARTICIPANT4: the benefit is that both the tutors and students would always be at the forefront of knowledge, anything that is happening in any area they would be informed and they are always there to see it first once they are connected to internet.

ZB: okay

PARTICIPANT4: yes!

ZB: so I've just got one more question which is; has a member of management in this institution, what kind of issues or like barriers or like inhibiting factors do you face when discussing things like development of capability or looking at things like capacity building are there any specific challenges that you face

PARTICIPANT4: yeah yeah yeah, finance

ZB: okay, any others?

PARTICIPANT4: commitment from the side of the government

ZB: around the institution, I've seen you have a number of buildings and facilities that are provided by the tertiary education fund (TET Fund) and national…

PARTICIPANT4: yeah TET Fund and NITDA

ZB: yeah so you were saying lack of commitment from the government, if they are providing these facilities can you tell me exactly what lack of commitment your talking about

PARTICIPANT4: yeah the overall facilities is for construction of buildings but then the technical aspect, you know they don't provide that and that's the most expensive

ZB: when you say technical, do you like training?

PARTICIPANT4: like training

ZB: do they provide the hardware and software

PARTICIPANT4: they don't provide the hardware, the university has to source for money on its own to acquire these; so you see it's very expensive on the part of the institution. So the institution usually spends all its revenue on acquiring these

ZB: okay so in terms of software quickly, do you have software licensing for all the software that you provide for the students?

PARTICIPANT4: yeah that's supposed to…

ZB: is that budgeted for?

PARTICIPANT4: yes we have a center called *** Centre for information and communication technology, that center is the one in charge of getting license

ZB: ok

PARTICIPANT4: yeah for the institution but the subscription is usually for E-journals, E-books subscriptions are sometimes expensive and especially E-journals are very expensive, even the internet its self… because the federal government doesn't bare the cost. The cost bared by individual institutions. So if the institution cannot get enough revenue to settle all those… then it's a problem.

ZB: ok so once you have the hardware and software that you've acquired and the various E-resources, are they being utilized by the students?

PARTICIPANT4: yeah yeah, students are given free access

ZB: okay

PARTICIPANT4: yes students are given free access

ZB: I think that is all the questions I have to ask so unless you have anything else that you would like to ask me, then we can call the interview to a close and thank you very much for your time and willingness to participate.

PARTICIPANT4: Toh.

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 5

Date: 4th March 2020

Time: 5.33 pm

Duration: 22:38 minutes

Interview transcript between 'PARTICIPANT5' and interviewer

Started audio recording
[Brief breakdown of research from interviewer]
Question 1:

ZB: ok so good evening, as I've already introduced myself my name is Fatima Zarah and I'm a post graduate research student in the University of Hertfordshire. Ermm I understand you've already received the documentation that I've sent you with the participant information sheet telling you about the research and what it's about. So this particular interview is just to gain an in-depth ermm understanding of your perception of the tertiary education ermm as a tertiary education stakeholder. Tell us your perception about the elements that you feel contribute to digital capability and how specifically these elements impact the capability maturity of your institution and so in answering these questions, if you could draw from your broad knowledge of the tertiary institution environment and your experiences as a member of management in your institution. What element would you say contribute to digital capability?

PARTICIPANT5: ermm thank you very much. I actually read through the submission you have made and ermm I asked some questions and what I was made to understand is that you're trying to understand the capacity of the institution which I represent, Federal College of Education Technical. First of all, I would like to highlight the fact that federal college of education technical ****, is a teacher training institution with the mandate of producing teachers that are going to teach at the basic education level, that is primary and junior secondary school. You know that we have seven teaching faculties (schools you call them). We have ermm school of technical education, school of science, school of basic education, school of childhood care and primary education, school of business education and then school of adult and informal education, these are the seven faculties that constitute the school. The college is technically based, for that reason the college is into a number of IT related subjects as well as IT related activities. In fact we have a whole department of computer science, apart from that we do have a technical education that is all IT based as well as our school of business education. In essence, the college is into IT technology so i can say that our digital capability is at a higher level going by the fact that the college has for instance at the moment a whole directorate of information and technology management. Part of our capacity ehn include ehn i mean federal government funded ehn IT coalition, ehn IT equipment, as well as eh subscription, ehn we use that for both staff and student in the college.

ZB: subscription for internet access?

PARTICIPANT5: ermm also the college has received a number of intervention from other federal government agencies for example the college has received ICT intervention from national communication commissions, national institute, national information and communication agency ermm, the national commission for colleges of education as in they in conjunction with TET Fund established what we call micro teaching laboratory which is exclusively IT based, ehh the college has an IT based library where they have over 250 personal computers (PC) for the use of both staff and student. This constitutes some of the IT facilities that are present in the college that are put to use, which I believe should inform the capability of our institution. It is not without some challenges certainly, where bands in some cases would do breakdown or maintenance problems, in some cases, the width of the... Or the band maybe restricted and ermm in terms of utilization we face some challenges actually sometimes as an institution in terms of utilization of the IT facilities particularly the internet, students accessing irrelevant sites rather than focusing on education based sites. All these ones are in form or provide the elements that constitute capability in the institution.

Question 2:

ZB: ermm ok, we are going to the second question. How would you say that these elements affect the capability maturity in tertiary institutions, what kind of impact would you say they have on the ability of the institution to....? (Interrupted)

PARTICIPANT5: to be specific in my own institution, in our own college it made tremendous impact because already the college has transferred some administrative as well as academic activities online that go on digitally for example registration, new students registration is online, result processing is online,

transcript development is online so all these ones actually have impacted in the development of the college. In fact it is known globally. you can access the activities of the college from wherever you are, you can register from wherever you are and the college uses ICT based technology in teaching and research, for instance we have interactive boards that can store information that was discussed with students, students can retrieve whatever was discussed during classes. We have also trained all our staff, all our staff are computer literate; there is no teaching staff that is not computer literate in our college and all these in an effort to digitalize the system, allow the students and staff to have general broad access to IT based technology and the college is still working

ZB: so are the staff, you said there are no staff that are not ICT trained

PARTICIPANT5: teaching staff

ZB: so were the staff trained within your institution or did you recruit them.... (Interrupted)

PARTICIPANT5: there are a number of training courses, in fact there is institution-based training, out of institution training and in fact of recent right now that we are speaking there is a training on ICT technology being sponsored by TET Fund which is supposed to commence very soon in the college that is going to involve a good number of staff. There are interventions from federal government agencies we listed with TET Fund to enhance the training and there is also provision that is appropriated to the college not partaking in the training of staff on ICT and there is also internally sponsored trainings, teach the teacher training

ZB: yeah yeah, train the trainer

PARTICIPANT5: yes, in the program. So all these are part of the strategies we used overtime to ensure that our staff are computer literate

ZB: yeah

PARTICIPANT5: ICT related

ZB: so in terms of resource acquisition, is training something that you usually consider when you're deciding on what new technologies to bring into your organisation?

PARTICIPANT5: in terms of resource acquisition?

ZB: yeah, so if you're like going to purchase a new software, ermm do you budget for training when you're purchasing the software or.....

PARTICIPANT5: yeah yeah, you know annually the college is expected to make budgets and submit to the national assembly for approval, so there is a budget line meant for training and that training includes ICT training so every year, each year there is going to be certain amount of money that is meant to be set aside at the national level to train, particularly in ICT. The same thing with the college, it used to generate what we call the internally generated revenue

ZB: okay

PARTICIPANT5: and we use the internally generated revenue to train staff of the college in terms of ICT.

ZB: so after the training, do you... is the training compulsory for your staff?

PARTICIPANT5: yeah

ZB: how about retraining, you do it annually?

PARTICIPANT5: yeah, it's both training and retraining

ZB: ok

PARTICIPANT5: depending on the module, depending on what we want the staff to partake in.

ZB: ok ermm.... so you mentioned about technology and earlier on you talked about government funding, talked a bit about internet access and you mentioned IT labs and E-library. Could you tell me a bit more about how they impact the maturity of your institution?

PARTICIPANT5: ermm actually if you look at the facilities I mentioned earlier on like the library, it is expected that we would continue to widen the access in terms of the facilities that can be made available to students in both teaching and learning and so far, we have been doing that. In fact we are in the process of acquiring major E-Library proving co-host, err what do you call it; all these software that are meant for teaching, we are expanding our access rates

ZB: okay. So how do your students use the ICT laboratories, is it a compulsory part of your programs? Can you tell me a bit more about...? (Interrupted)

PARTICIPANT5: there is a part of it that is compulsory especially for those students that are pursuing courses in IT related subjects computer science, information technology for them it is compulsory, it is ensured that

all students must participate. For others, it depends on their elective courses. If you chose courses that are IT related, computer based you have to participate and actually like I've said earlier on we have equipped the library to accommodate a very good number.

Question 3:

ZB: so unto the third question, which is in your opinion which element would you say has the most specific impact on learning and why?

PARTICIPANT5: the specific element that has the highest impact could be the E-library

ZB: okay

PARTICIPANT5: the E-library has allowed access to students, to a wide range of information and it has been utilized to upmost most especially off-recent we realized the performance of students especially the overall performance of students at NCE level, we began to have students graduating with better results which we believe is as a result of access they have been having as provided by the E-library section.

ZB: so you just said something really interesting which is that students are graduating with a better result, is that something you've seen in reporting as in is that something you've been keeping your eye on how the results are improving with the use of technology

PARTICIPANT5: yeah, yes actually we set up a committee to analyse the performance of students over the last decade year by year and we have noticed a trend of increased performance over the period especially that's why I write from the period when we made available access to more information particularly in terms of the E-library.

ZB: so if E-library is the most important, what would you say is the next most important element would you say impact on learning?

PARTICIPANT5: err the other one that I may say after E-library is internet access which covered a very significant part of the college. The college is covered with a WI-FI and through the WI-FI you can access the E-library, you can access other units so students and staff within the library in the comfort of their rooms can make use of the WI-FI and then that is ... (interrupted)

ZB: so when you say access, is just the accessibility or is there so, in terms of using, having accessibility for doing, for researching or looking at class notes or for using the student portal, can you just expand?

PARTICIPANT5: all

ZB: oh okay all, and you've had sufficient bandwidth to do that?

PARTICIPANT5: hmmn not really, you see that's why band of area was my challenges, you know the bandwidth are usually provided for a period mostly access for a year for instance, I've made mention of the tertiary education trust fund which provided the bandwidth access for about a year which amounted to about 10 or so million naira and whenever the bandwidth access was adjusted, to get it re-engaged that is where the problem is and sometimes there could be time lapse for about a month or two but we are trying hard to make sure that it doesn't happen anymore.

Question 4:

ZB: and then finally the last question, if there are any other opinions that you wish to share based on the overall research on digital capability maturity in tertiary level institutions.

PARTICIPANT5: ok if there is anything I would like ehn maybe it's to be a little bit more specific as regards to what you expect from the institutions ehn involve your institution in defining what you consider to be digital capability maturity. If you had told us earlier a lot more about the concept, we would have understood it more and then maybe our contribution would have been better.

ZB: the contribution was great as it was, so thank you very much

PARTICIPANT5: you're welcome

ZB: ermm just quickly, how much do you.. What's your opinion on social media with relation to learning within tertiary institutions?

PARTICIPANT5: you see social media has been both a blessing and a curse as far as tertiary institution learning is concerned. A blessing in the sense that you can easily share information and you can easily have access to information particularly if you're on twitter, Facebook, err Instagram, all these easily can share information but the unfortunate thing is that it could also easily share rumour and false information. So from trying to decipher between the two is where the problem arises; where you know this is true and where you know this is not and it may tend to interfere with the line of sequence of a particular subject, for instance somebody that is trying hard to teach for instance algebra and then the student

while studying the algebra is browsing music. So you know all these ones will create interaction. Sometimes like I've said earlier all these ones can be put to a very good advantage by making use of it judiciously but you know if care is not taken it can drain student of focusing on a particular subject and developing that, there is strife in that particular area.

ZB: ok fine. One more question sorry

PARTICIPANT5: yes

ZB: you talked earlier on about government funding (intervention) to the institution to support certain areas that you feel impact on digital capability, so how do you feel you would fare without that government intervention?

PARTICIPANT5: without government intervention?

ZB: yes.

PARTICIPANT5: you see this is one area that generally across the country people really don't want to talk or think about

ZB: okay(chuckles)..

PARTICIPANT5: you see without government intervention; it means becoming self-reliant and then developing your own revenue base. This ideally under normal circumstances should have been the way, should have been the practise but so far, so it has proved very difficult for most institutions. Partly because in government owned institutions, you're not allowed to charge fees, for instance tuition fee. You don't charge tuition fee in government owned institutions and then even the registration fee you know is a fee that is paid for a particular purpose. So if a student registers, he is going to pay for examinations and the money is going to be used for examinations and he pays for accommodation and makes use of the accommodation, so actually it's not a revenue per say. So to think of rolling the institutions particularly in ICT related subject areas without government intervention is close to a very ---- task. That is one way to go about it but you see generally and naturally education is supposed to be funded, education is not free; there has never been free education anywhere. So if we are to develop our education, we have to fund it, be it by the government or whoever but education has to be funded.

ZB: okay, I think on my part that's all the questions I have to ask. So do you have any more questions or opinions that you would like to share?

PARTICIPANT5: the question that I would just like to ask is that, will you share the result of this investigation?

ZB: yes of course ermm so as I've explained on the ethics documents, the data that you've given me is going to be kept safely and securely, the data will be anonymised and won't be traceable back to yourself. I am going to merge all the data together, do a content analysis and provide a report based on that and I would be happy to share that report with you when I'm done.

PARTICIPANT5: I will be glad.

ZB: thank you.

PARTICIPANT5: you're welcome.

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 6

Date: 5th March 2020

Time: 3.27 pm

Duration: 12:43 minutes

Interview transcript between 'PARTICIPANT6' and interviewer

Started audio recording
[Brief breakdown of research from interviewer]
Question 1:

ZB: okay good afternoon sir,

PARTICIPANT6: good afternoon,

ZB: as I've already introduced myself, my name is Fatima Bello and I've already explained what my research is about. Now specifically, this interview is designed for me to gain an in-depth perception of you as a stakeholder in this college of education and how you feel or what elements you feel contributes towards digital capability maturity and how those elements or factors would impact on the maturity of this institution here.
So if you can just draw from your broad knowledge of tertiary institution environment and the experiences that you've had a member of management here, what element would you say contribute to digital capability?

PARTICIPANT6: yes, the digital capability in this our college for instance we have the micro teaching lab, we have the directorate of information which is de-com sit and we also have our E-Library setup, and we also have internet café in the college. These are the facilities that we have in the college that if properly utilized can be of immense contribution to at least learning in the college

ZB: okay so you've said that these ones are the ones that you have, are there any other elements that you think would impact digital capability which you don't have here but you feel would make a difference?

PARTICIPANT6: of course, there would be others but for now you find out that there are some environmental factors that would even affect capability or usage of digital 'this thing' in this college, for example you find out that the college is having problem of power supply, electricity supply and then no digital 'this thing' can be used without power supply and one of the aspects is also the type of students we receive here, we are in a rural setting, the type of students we receive here are also from the rural setting and therefore, majority of them do not have the capability of digital knowledge and that one itself is a very big factor that can contribute to… even if we have all the necessary factors, it can contribute to non-utilization or non-effective utilization of the digital capabilities in this college.

Question 2:

ZB: okay, so we move on to the next question. In your opinion, how do these elements impact the digital capability maturity in this institution? You've already answered some of them in the previous question but can you tell me more about the micro teaching lab, the directorate of information and the E-library because you kind off mentioned the impact of the student capability and environmental factor?

PARTICIPANT6: yes the micro teaching lab is that aspect that our teachers use in impacting to students especially those that are still learning teaching methods, so they use that aspect to teach students on how they can be able to utilize the teaching methodology. The equipment there are okay for now, but you find out that even the technicalities involved in using those equipment is another issue because for one, you find out that not all the lecturers themselves can be able to use that one without any guide. Then we also find out that even the students themselves because of the environment we come from here, it's even difficult for some of them to utilize the micro teaching laboratories but we feel that with more effort put towards training and retraining of both teachers and students, they can be able to cope. Like presently, the TET Fund has come up with a training in this college which maybe in the next one month or so, some people shall be trained on digital capability which may enhance their capacity to utilizing those inputs.

Question 3:

ZB: okay so in your opinion which specific elements of the ones that we've just discussed would you say has the most impact on learning and why?

PARTICIPANT6: in fact the impact that I would identify as the most which would have impact on learning is that issue of the level of students having knowledge in digital capacity because even if you have all the facility, even if you have all the electricity supply, without the student having the 'know-how' it would be difficult for you to utilize it the way you want, so that is one of the major factors.

ZB: okay

PARTICIPANT6: yes

ZB: so after students, what would you say because we talked about quite a few factors, after students level of knowledge and capacity, what would you say is the next most significant or next most impactful element?

PARTICIPANT6: okay, the next one is the power supply because you find out that even if they have all the knowledge, without power supply, it is problematic and then I think today you were there and then you've seen this office that there is no power supply here now so this one can equally affect the utilization because without power supply even if the students have the know-how, lecturers have the know-how, it would still be a problem.

ZB: okay, any other of the elements that you feel would impact learning because you talked about E-libraries, we talked about environmental factors, we talked about the rural setting and the nature of the students coming from the rural backgrounds, you've talked about teaching methods, you've talked about staff capability so which…

PARTICIPANT6: other factors like I said earlier, you know that at this end of the society, we have to subscribe to bandwidth and then sometimes even subscribing to bandwidth like our own here we have to rely on TET Fund and TET Fund sometimes makes such provision once in a whole year, so by the time we miss it out, we have to wait for a whole year, so this could be another inhibiting factor

ZB: okay

PARTICIPANT6: yes

ZB: okay, does the college generate its own funding like internal funds that… because you're saying basically that it kind of relies on the support from the fund

PARTICIPANT6: in fact, if we are talking about funding, the major source of funding is TET Fund

ZB: okay

PARTICIPANT6: for internally generated revenue for a rural setting like ours, it only compliments what we get from TET Fund because we cannot generate enough, the number of students are not more and therefore we cannot generate what can be able to sustain some of this capabilities but the major source of funding is TET Fund which comes in yearly and it depends on areas, it's either library intervention or maybe infrastructural development and what have you but majorly for ICT like what we have for ICT is also once in a whole year and it's also not much but none the less, whenever we have that one, we utilize it very well.

Question 4:

ZB: okay I think that's pretty much it in terms of question 3. The last question I wish to ask is if there are any other opinions you wish to share in relation to this research on digital capability maturity in tertiary level institutions?

PARTICIPANT6: my experience in this area that I want to share, in fact it's a very good a very good aspect and I even appreciate someone going into this aspect because most of the researches I've come across are not in relation to this digital utilization capacity. So for you to have even come up with this area, I think it's commendable.

ZB: thank you sir

PARTICIPANT6: I want to appreciate your effort in coming up with this area because at the end of the research, it is believed that we should be able to understand and see digital utilization from the perspective of tertiary institutions especially in the north-west of Nigeria

ZB: okay thank you sir. So just… sorry sir one more question on my part, does TET Fund support any other activity within the school apart from funding of bandwidth, internet facilities?

PARTICIPANT6: yes

ZB: so they do quite a bit or?

PARTICIPANT6: they support us in library intervention, they also support in the training of ICT, they also support in web development because presently we have some people developing the website of this college

ZB: yeah

PARTICIPANT6: and it's also sponsored by TET Fund

ZB: yeah

PARTICIPANT6: it is not only on the bandwidth but they support us in training and even developing our college website

ZB: okay alright and if you've got any more questions to ask, we would call the interview to a close and I would just remind you that your information would be kept completely anonymous and it will be kept

safely and securely in accordance with ethics that has been provided and the information will not be traceable back to yourself, I would transcribe it for content analysis.

PARTICIPANT6: no problem

ZB: thank you very much for your time.

PARTICIPANT6: thank you very much.

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 7

Date: 5th March 2020

Time: 4.11 pm

Duration: 30:42 minutes

Interview transcript between 'PARTICIPANT7' and interviewer

Started audio recording

[Brief breakdown of research from interviewer]

Question 1:

ZB: so good afternoon, as I've already introduced myself my, my name is Zarah Fatima Bello and err I'm a post graduate research student at the University of Hertfordshire. I have already explained myself to you and so the purpose of this interview is to gain an in-depth perception of tertiary institution stakeholders as yourself and what elements do you feel contribute to digital capability and also how these elements would impact on the capability maturity of this institution. So in answering these questions that I'm going to ask you, if you could draw from your own experiences from your broad knowledge of this institution and your experiences as a member of management, what element would you say contribute to digital capability?

PARTICIPANT7: thank you, we have facilities to that effect spread in different unit of academic processes, for instance in school of science we have computer department with their computer lab well equipped with computer facilities for training computer students, we have E-library in our college library also well equipped with computer facilities and linked with internet bandwidth to access eBooks. We have a Step B, a project funded by TET Fund also well equipped with the computer facility linked with internet network where students visit to access the net for their academic exploration, as well we have the micro teaching lab also equipped with computer facilities to enable them retrain on how to use computer or ICT in teaching and learning process. All these facilities are in the college and are functioning everywhere.

On the other hand there are some issues that might affect the effectiveness of utilizing these ICT facilities among which power supply is there, networking or linkage or internet particularly to other areas or units; the college internet is restricted to particular areas, it's not accessible from other units as well the level of ICT literacy among the staff, as well as the student themselves, these are also important factors that might limit the extent of utilization of these facilities we have on ground and really most of the administrative work we use computers to operate and process in our administrative block section and even in the academic section we use ICT to process result and do some administrative work. So to some extent we are utilizing ICT in our academic activities in general.

Question 2:

ZB: ok ermm you did mention some.... ok so we move on to the second question which is really to ask how much you feel these elements impact the capability maturity of this institution although you mentioned some of the impacts, can you just elaborate on the issues in terms of connectivity and how that ....(interrupted)

PARTICIPANT7: you see actually the college is made up of seven schools synonymous to faculties in universities each schools with number of department which are placed in different part of the college compound, the fact that internet connectivity or accessibility is limited to a particular area is not extended to all parts

of the college. You find that those units, if they want to utilize the net for so many academic activities like for example you're in lecture, if it is available everywhere, the lecturer can simply during lecture access or link to net for sourcing some information that would help him in making his lecture very clear to the students. Lack of net connectivity limit the extent which academic learning activities can be so effective, you see so that is a factor. On the issue of power supply, you see NEPA or electricity supply is not regular and there is no certainty of when you can receive electricity or even if there is, you're not sure of when it would go off so that will have a very serious impact on the success or otherwise of teaching/learning process. You might start with light, when you reach a crucial point where you want to do a very good demonstration to the student, power can then seize. The college has made a lot of effort to see such problem is limited but financial issue also is there because all units in the college regimen has in its own effort made available to ensure that they have standby generators so that they can have electricity to support the inefficient or erratic supply of power from the national grid but all the same like I said, financial constrain is another challenge for maintenance and continuous operation of the generators. Also looking at our location at the student background, you find that most students though in their curriculum might they have computer training but that training is just very partial, so abstract to the extent that most of them know what is computer from street, in school they can only see picture of computer in books so they have no access to it to operate and what have you. So when they come to higher institution popularly, even the foundation to learn does not permit them to access to a simple laptop that they can be using for their academic activities, well thank God for the availability of minicomputer in the name phone, it's assisting them to some extent and even that one not every student can afford android computer that's can link them with net to browse necessary academic information. All such limitations are there and err in fact making the teaching and learning process a bit ineffective for... these are some of the challenges

Question 3:

ZB: okay so the next question I was going to ask you is about which of the elements would you say has the most impact on learning and why? you kind of mentioned some of the ones that have impact on learning but if you were to order them from most important to least important, which ones would you say are more important than others?

PARTICIPANT7: err you see really if we look at the side of student, background is very crucial in learning, since our students I mean from primary secondary do not have exposure to such facilities, they only see it close to them or within their reach when they come to the college

ZB: yes

PARTICIPANT7: you see, it's difficult for them to learn and even in the college, it's not everywhere that the facilities are available and the number is not so sufficient that it can conveniently go round to the students so you see, it's a complex mixture of factors being that they don't have background, they have poor background in computer literacy, this.. That factor has a major impact then followed by availability of the facilities; sufficient enough to make accessibility to it by the students very easy. Like I said our supply for electricity because if individual students own their personal laptop, even if there is... the power supply is not available all over within the college or throughout 24hrs, the few hours that power is available, they can charge their system and err save it until when they need to use it for internet since the point where the accessibility is for internet there is standby generator, that one is 24hrs so connectivity can be easy but the fact that they cannot be able to possess it personally make it difficult

ZB: yeah.... challenging

PARTICIPANT7: then though sincerely speaking our staff are coming up seriously. I can bet you that now, more than 60% of our academic staff are computer literate, they can operate, they can access, and they can link with internet so their factor is not all that serious.

ZB: ok and where do they (sorry to interrupt you) is there other skills that they've developed within this institution or do they come in with the skills

PARTICIPANT7: you see for academic staff it's compulsory that you must be computer literate, so err some join the system with their knowledge of computer, some acquired that skill while they are staff because they know they cannot get promotion without it. So they enrol in computer literacy training centres (certified centres) so that they can have the skill and you see like you as a student once they move for their further education they realize that the literacy is very important. You cannot just rely on a

commercial somebody to be working on your behalf, you will suffer seriously but if you help your personal self, you know what you need and what you want to say and what have you. One is forced to learn and process the ICT facility that can make his work faster and simpler.

ZB: yeah

PARTICIPANT7: so that helps seriously, it makes most of our academic staff computer literate.

ZB: ok so basically, computer literacy is one of the conditions of your promotion.

PARTICIPANT7: yes

ZB: are there any other conditions towards promotion and staff development that you feel would have that impact on digital capability

PARTICIPANT7: well you see, the intervention by TET fund has made and is making very positive impact on the ICT capability for this in the college because it is the TET fund sponsorship that finance the development of our E-library and a lot of ... even the micro teaching is the TET Fund intervention sponsoring our staff to go for further education is also another factor, you see like I said one can just not go for higher education and come back without being computer being computer literate because of the exposure of challenges like I told you so the encouragement staff receive from TET Fund sponsorship has so greatly influenced the digital capability of the college and also the college receive the blessing of other supporters like NITDA

ZB: they are all government agencies, are they?

PARTICIPANT7: yes, I think recently, which organisation supplied the college with computers and iPads - the National Communications Commission (NCC) also, because it has relieved a lot of problem of our digital incapability.

ZB: so in terms of impact on learning, because you said quite a bit on governmental support or the support of the different government agencies and it seems like it's quite impactful when it comes to supporting institutions like they are giving, so if we refer back to question 3 where I said which of the elements have the most impact on learning, how would you rank governmental support in terms of the impact that that has on digital capability

PARTICIPANT7: you see actually like I mentioned the StepB I mentioned, the E-library, the micro teaching lab

ZB: yeah you've mentioned more but I'm just wondering because in terms of the impact on learning you've talked about student background, and the computer laboratories

PARTICIPANT7: you see, the student background is more of a negative impact, if we are talking of positive impact, TET Fund is going to be ranked the first.

ZB: yeah

PARTICIPANT7: why? because like I said the E-library, the StepB, the micro teaching lab are all financed by TET Fund so actually they should be ranked first in bringing positive development in our digital capability.

ZB: one more question from me, you talked about encouragement and how their support provides encouragement to staff. As an institution or as a college, what kind of sport do you provide to your staff in terms of developing their capability? If any.

PARTICIPANT7: err you see, year by year ehn the college sent group of staff to go for 6 weeks computer training that is an internal arrangement. So the college is sending staff without computer literacy batch by batch to go for computer training, short term computer training so that they become also computer literate.

ZB: yes

PARTICIPANT7: which help a lot because any moment one can find himself in an assignment that require utilization of computer, if you don't have that exposure then that means you cannot fit into that assignment, then you're more or less not in the system, yes! To ensure that everybody becomes a computer literate, the college came up with that plan and err individuals are drawn from all unit of the college and sent in group for such training

ZB: yeah

PARTICIPANT7: then after a while another set will be drawn for such training.

Question 4:

ZB: yeah. I mean on my part that's all the questions I've got to ask, do you have any other comments that you would like to share about my research or any other opinions that you have in regards to digital capability

PARTICIPANT7: yes errmm, this approach of trying to errm maybe explore the extent to which digital capability is available in higher institution is very good because the whole process in life is now becoming digital educational setting is an area that is supposed to be in the fore front, so trying to identify areas of challenges in such areas would help a lot in maybe bringing awareness to government maybe when research institutions make a cry, they would listen since this research is not restricted to a particular small environment, it's a broad, northern scope

ZB: yeah North West zones of Nigeria

PARTICIPANT7: you see it's a very broad scope so the peculiarity becomes similar in all part this zone you have taken that means it's not a particular place so that would attract government attention to make sure that something is done especially if similar research is done in other parts of the country and it is found that there is a very great gap between the something (chuckles) that would tell the government particularly the immediate government to know that yes something has to be done to bridge the wide gap existing between entities that are within the same country.

ZB: yes

PARTICIPANT7: it's a very good research.

ZB: thank you very much, thank you. So at this point I would just like to remind you that the information you've given me would be kept safe and secure according to the ethical guidelines for this study. Your data will be anonymised and the transcribed for further content analysis and will not be traceable back to yourself. If you have any further questions that you wish to ask me about my research, feel free to contact me, I will provide you with my contact details and thank you very much for your time.

PARTICIPANT7: you're welcome. Thank you

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 8

Date: 9th March 2020
Time: 12:53 pm
Duration: 24:2503 minutes
Interview transcript between 'PARTICIPANT8' and interviewer

Started audio recording

[Brief breakdown of research from interviewer]

Question 1:

ZB: Good afternoon sir,

PARTICIPANT8: Afternoon.

ZB: as I have already introduced myself, my name is Fatima; and I'm a post graduate research student in the University of Hertfordshire. I believe you already understand the concept behind my research and what Digital Capability Maturity is all about. So, the purpose of this interview is to gain an in-depth understanding of your own perceptions as member of management within this institution as to what you think the elements that contribute to digital capability maturity are and more so how they impact the capability maturity of tertiary institutions. So, in answering the questions I'm about to ask you, if you can draw from your broad knowledge of the polytechnic environment and your own experience as the member of management within this institution, what element would you say contribute to digital capability?

PARTICIPANT8: Thank you so much. Honestly, I've been looking forward to a day like this because I have always been thinking at how to improve our system and as an ICT person, I've always been looking at how we can use ICT to improve one of our core objectives/ core mandate which is teaching and learning. In ***, one of our objectives is to see how we can improve teaching and learning and to conduct research. So, coming to the first one that I just mentioned, digital capability that means how we can use ICT to enhance our core objective. In ***, firstly one of the elements that contribute to digital capability is funding. When you look at ***, It is important to note that we are a polytechnic not a university so

the funding from the federal government (we are under the federal government of Nigeria) is low compared to other institution and you know in getting this ICT infrastructure, it involves a lot of money so funding is a key issue. In fact, one may have a very intelligent idea and infrastructure to deploy in an institution but you may not get the funds for it. It is really a very big challenge. Secondly, from what I have observed over here, some of the ICT facilities available here have been poorly managed because of lack of expertise so there are no people who can manage these facilities so it's not just about getting the funds but also, do you have the capacity to manage the infrastructure.

ZB: is that capacity in terms of technical staff?

PARTICIPANT8: Yes. Manpower that is what I mean. Technical staff. Thirdly, another challenge that we have is corruption. That is the inability to use funds in the appropriate way. Some people call it diversion and in ***, that has really brought us back, it has really caused serious challenge. So those are what I can say are the key factors that contribute to digital capability. One, I have spoken about funding. Two, I have talked about man power, to manage the infrastructure. Those are basically the factors that I can mention.

ZB: Okay.

PARTICIPANT8: or do you want me to mention more?

ZB: I mean if you think of any others but if not, it's fine.

PARTICIPANT8: Okay.

Question 2:

ZB: So, in your opinion, these factors that you've mentioned, how would you say they impact the digital capability maturity of this institution or of a tertiary institution?

PARTICIPANT8: When you are talking about maturity, I think for the few ones we have got that I can remember vividly, the only major organization that really helped in using ICT to improve teaching and learning is World Bank. We got a World Bank project called STEP-B. It is establishing a centre for research and development - that's exactly what that project is about, they want to establish a world class, a centre of excellence for us. At that point, I remember the head of the project at that time said, well of course there's no way you can manage this kind of project without the ICT component, they asked us to provide internet. Initially it started with providing internet for the centre of excellence, but he thought of it and realized that one of the way the world bank go on projects is that they look at their immediate community and how this project can make impact, so they asked us to extend it to our immediate community, it shouldn't be limited to this centre alone but it should be extended to our environment here.

ZB: (Interrupts) other institutions?

PARTICIPANT8: No, our institution. Then thirdly, we should try to look into our neighbouring community (because we have four campuses) to the main campus here, people around the neighbourhood should be able to benefit from that too.

So, in that regard, they actually provided the fund, we were able to deploy the internet service for the community which provided the infrastructure, the radios, the routers and all that. And we were able to pay for the bandwidth from the service provider. I mentioned that the first factor is funding because once the project was completed and World Bank exited, there was a very big challenge in maintaining those infrastructures. I can authoritatively tell you that these infrastructures have dropped down to 5%, they are dead. Secondly, the issue of paying for the bandwidth, it could not be continued, so presently everyone is using their own local internet, a modem of your phone for tethering. So, this is how we are presently sustaining it and it boils down to funding. And if you look at it, the funding coming to the management as an institution is very low and so there many be other pressures on the rector, and he give in to those other pressures above these ICT issues.

ZB: so just quickly you talked about the step-B project from the World Bank, when did that start?

PARTICIPANT8: 2012

ZB: until when did they exit?

PARTICIPANT8: 2015.

ZB: Okay. So, between 2012 and 2015, what progress did you make as an institution?

PARTICIPANT8: It was very immense. In the sense that people can go online now and have access to materials, lecture notes. Apart from that students can also go online to get information about their assignments,

information about their tests, they can even have access to course materials from the best professors in the world. They can also watch and download videos online because they don't have to pay for bandwidth, so its very easy for they, so that has really helped a lot.

ZB: What about since 2015 to now?

PARTICIPANT8: Since 2015, we only continued for a year. After that year, we couldn't continue because the fund wasn't able to cater for it. Considering when the rector came in and he met backlog of debts that he has to settle sequentially.

ZB: Asides from the issue of funding and maintenance, what impact would you say it had on student outcome and staff motivation?

PARTICIPANT8: It really had an impact. Because when the internet was there, the motivation was fantastic. I can really tell you authoritatively because I was the one handling the facilities at that time. I got positive feedback from them at the time and even know people still ask saying about how we can bring back those day. Many of them even when they went for further studies outside this country, some went Malaysia, some went to England, and they realized that what we were actually deploying at that time is not quite different from what they saw over there, so the feedback was positive. Not only that again, even the student's response to submitting their assignments, like I can tell you because I was a lecturer too at that time. I can use my own case study as an example. The response from my students when I give them their assignment and the kind of score that they get is better because they actually getting the real material that work for them.

ZB: Yes, that supports them. Brilliant! Ok so we've talked about my funding; previously, you mentioned ICT infrastructure, so what effect will you say ICT infrastructure has on capability maturity?

PARTICIPANT8: It has, its really fantastic in the sense that it helped a lot in ICT. It helped in prompt delivery, compared to the manual way of doing things. It also helped in achieving the core objectives, for example in teaching, it is easier for a lecturer to use a projector instead of writing or dictating for the students, this has aided a faster delivery of lecture. So, I can say ICT has positive impact on both teaching and learning. And maturity is that, I think I have explained it; the issue of funding has a lot to do with the maturity, because when the fund was not there, the project was stopped, the facility decayed and there was no replacement.

ZB: and the last element you mentioned was manpower capability, so what impact will you say manpower has on digital capability maturity?

PARTICIPANT8: It has a big impact. For example, let me give you a very simple example, like most ICT services were provided by an outsider, so it was not properly managed and the delivery was slow mostly because these consultants were also engaged in other things. We could not really get information from them at the exact time it is needed. This is because we also at the ICT department do not have the capacity to develop a website for ourselves and this was a setback that the rector noticed when he came on board (being a very intelligent and experienced person) who has lectured in different parts of the world; when he came in he realized that ICT is key in teaching and learning and research. He employs expertise who can really assist ICT in service delivery. Since then, I can tell you that our hospital that has been operated in Bamalli has now been 'e'. When you go to the hospital now, you don't need to go with your card, the doctor does his work electronically like prescriptions and other things. Apart from that we have personally developed and own website, the response we are getting from students are better in terms of the information the website should be using, it's a dynamic one; providing the actual information that is supposed to provide to the immediate community.

ZB: Ok! You talked about bringing contractors to support the ICT staffing in completing their provide work, are there any conversations that happen amongst management around ways of developing your own staff capacity?

PARTICIPANT8: Yes. When the rector came in he employed some key staff who could assist in ICT service delivery and then the challenge we had was we didn't have enough manpower, so we had to see how we can do that locally. So we started organizing trainings for ourselves, the ICT made use of people that are coming for Industrial Training (IT) and we trained them in how they can assist us in doing the work and when there was a window to employ low cadre staff, that was done, few were employed for ICT. Now

with the competency of the key staff that we have, we were able to do local training and it has helped us improve on our functions.

Question 3:

ZB: Excellent. So, moving on the third question, which specific element would you say has the most impact on learning and why? For recap, we've talked about funding, ICT infrastructure, maintenance or management of the facilities, manpower capabilities and you also mentioned corruption. So, from those, if you were to rate the impact on learning which one would you say is the most?

PARTICIPANT8: I think I will start with funding because if you have the capacity and ability to maintain those services and you are not corrupt, if the fund is not there how do you do it? It's not possible. So, I will categorize funding first then then second thing is to talk about the issue of capacity; capacity of the technical staff. Can they really deliver? Thirdly, Maintenance, it is also very very important. Then lastly, I will put the issue of corruption there too. Yes, it affects!

ZB: Okay. So where would you place infrastructure then?

PARTICIPANT8: Let me see, funding, competence, capacity then we have; I think It should be ICT and maintenance, we can combine them. Its only when you have the infrastructure that you can maintain it, so the infrastructure should come first or they can be combined together.

Question 4:

ZB: That's all the questions I've got to ask. Are there any other opinions you would wish to share in the relation to my research on digital capability maturity?

PARTICIPANT8: I think I've mentioned them.

ZB: Alright. Sorry I do actually have one last question, so you talk about the world bank step B project and you talked about government funding, is that the only government funding that is received in this institution and in terms of government funding, do they provide you with any ICT infrastructure like internet or do they provide you with hardware as well or does it just include software? Do they provide support with training of the staff as well like what kind of things are provided as part of the government intervention and which government intervention has been provided, in the past?

PARTICIPANT8: When we are talking about this intervention, firstly, government gives you fund. Secondly, we generate our IGR. To start with, let's talk about the federal government funding itself, for ICT they have an agency or an establishment responsible for that called TETFUND (Tertiary Education Trust Fund). Under that, a component of it is for ICT. They started with 10 million, if you are not able to access it, it drops down to 7.5 million. Like in the first year, there was no clear-cut guideline on how to access the fund, we using our need description of what do we really need and when we prepared the proposal and sent to them, there was no response from TETfund that year. In that regard, by the second year, it dropped to 7.5 million. We prepared another one for obtaining key software that will be of great help to our lecturers and students but we lost it again to 5 million. They also discovered that they have not given a clear-cut guideline so in view of that they asked us to access the entire 3-year intermission, for the third year, it also dropped to 5 million Naira. What I'm saying is that when you get these funds, they actually specify what you are to use it for and that's another bad aspect of it, they should have allowed institution to use it for what it really needs. In our own case we have a developed website and now they are insisting that the funds be used for website development when we have other things to use it for. In our own regard we don't have funds to get appropriate infrastructures like the routers, radios and paying for the bandwidth. While what they are saying what it is meant for is website development and secondly ICDL (International Computer Driver License) training. That they believe that our staff should go for that, how we look at it as an institution in these days now people on their own have mad ethe effort. Even before getting to the level, they are coming to teach in ***, many of them have acquired this ICT experience so in that regard ICDL and website wasn't our own priority but we're not allowed it here.

So that is one of the fund. Another fund meant for this is they give an overhead every month but that overhead has been dwindling, it has been dropping. So they expect from that overhead again.

ZB: is it still TETfund that provides this overhead?

PARTICIPANT8: No, it is the federal government that provides it directly.

ZB: from the ministry of education?

PARTICIPANT8: No, from the office of the finance minister. So that fund is coming from them, the overhead that federal government is paying to every institution.
Secondly, they know as an institution; we generate IGR for example school fees paid by students, that's where the head of institution also get funds from to be able to fund some of the projects that we have.

ZB: Ok, brilliant! I think I've got a good understanding.

PARTICIPANT8: (Interrupts) I think I remember something I have not said before. Lastly, asides world bank we should be able to get support from foundations, individuals, alumni and others. The experience here has been very poor but I think in recent times, it has improved. We have just from a foundation in India on how we can provide virtual learning on this campus. We have started, presently as I'm talking to you now, we are conducting a training and it is really marvellous. The way it is now, it is has really made impact on the digital capability of ***.

ZB: How have you seen that impact?

PARTICIPANT8: Yes, we have seen that impact one from the comments and how they were using the resources. An example is for instance now: lecture materials have been provided in the platform where lecturer is, how can I say, it is a replacement for lecturers' notes. So, it is very easy for students really look, it could take students a day or two, even a week to get lecture materials from the lecturers; but these days now everything is available online, on the intranet. They can actually go there and get this thing done. So apart from that, if there is a training that is to be conducted, for large audience it is normally a challenge. Now it can be conducted virtually, everybody can remain in their various location and actually attend that training.

ZB: So, one last you just mentioned, you said people's comments actually help, so do you actually obtain feedback from learners after trainings and use it?

PARTICIPANT8: Yes, we process the feedbacks to see how we can improve and provide a better service for our people because our overall goal is our core mandate on how we can improve teaching and learning, and actually improve in conducting research.

ZB: Thank you very much Doctor. I appreciate you participating in my study and taking your time to share your opinions with me. Thank you so much.

PARTICIPANT8: Thank you so much!

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 9

Date: 9th March 2020
Time: 2:54 pm
Duration: 18.38 minutes
Interview transcript between 'PARTICIPANT9' and interviewer

Started audio recording
[Brief breakdown of research from interviewer]
Question 1:

ZB: Ok good afternoon sir, my name is Fatima Zarah Bello and I've already explained a little bit about my research to you and what digital capability is all about. So the purpose of this interview is for me to get an in depth understanding of your perceptions as the dean of this school and as a stakeholder on the elements that contribute to digital capability and also the impacts that these elements have on the ability of the institution to mature. So in answering the questions that i'm about to ask you, you can draw for your broad knowledge of the tertiary education environment and also from your experiences as the dean and someone who recommends to the members of management on certain decisions, what elements would you say contributes to digital capability?

PARTICIPANT9: thank you very much, there are very many elements within the concept of tertiary institution that would impact digital capability. First and foremost, the most fundamental I think is the cost of procurement of digital equipment; at times the cost is huge and within the long run there is an

advantage. Another thing is the cost of training and retraining of staff, mirage of areas of digital IT knowledge for example, to procure the digital equipment, they can't work for themselves, so people need to tarin the staff to be able to work with them. So cost of procurement, cost of training and retraining and the political wheel.

ZB: political wheel?

PARTICIPANT9: yeah, the political will also.

ZB: what do you mean by political will?

PARTICIPANT9: Yeah, even if the procurement cost is high for procuring the digital equipment, if you have the political will sometimes it will.. its just like it has a long run advantage. Initial cost is high but along the line, the cost of running manual systems and other things overtime will overshadow the cost of the initial procurement of the digital equipment so its also the need to have the political will and understanding the advantages, the merits of using the digital equipment and then another factor also…

ZB: yeah

PARTICIPANT9: I made mention of political will from the management.

ZB: yes

PARTICIPANT9: and then commitment and willingness from the staff to play along because a lot of them have phobia. Phobia could be viewed in two perspective; 1. some believe that with the introduction of these facilities, some people will be out of jobs within a short period of time if you look at it from that angle. 2.Then another angle some feel that they are too old to key into these kinds of things at this age. There are also many concomitant factors too, like the environment.

ZB: okay,

PARTICIPANT9: which has to do with electricity supply also sometimes.

ZB: Any other factors that you can think of?

PARTICIPANT9: Yeah another factor that is there.. is.. we call it the digital appreciation, it's the appreciation of the people. You know if you appreciate that these kind of thing will help you and also the system, no matter the cost, no matter the political will even towards professional development, one could key in.

ZB: yeah

PARTICIPANT9: like many of us now, use our own resources to be able to improve ourselves as part of our continued professional development. So we have the appreciation like we appreciate them that this thing is good for us so we don't have many staff that do..

ZB: okay so is that something that you do personally or is that something that the institution provides ?

PARTICIPANT9: Yeah, the institution do provide from time to time but look a the size of the institution and the time. At times we are up to 3000 staff and maybe a short training consist of maybe 40 - 50people, so look at how long it will take to train everyone and after that you know retraining maybe perhaps. A few I can say have the appreciation that maybe this thing is good for me, and without it I cannot not move with time. Now digital knowledge, IT background is nearly becoming like the ability to read and write. In the near future, if you don't have this background it's as good as you cannot read and write.

Question 2:

ZB: okay, so onto the next question, in your opinion how do these elements that we've just discussed impact on the capability maturity of the institution, tertiary institution?

PARTICIPANT9: yeah we have a lot of them

ZB: ok can you describe some of them?

PARTICIPANT9: mostly negative. 1. without these the institution would find it mostly difficult to find it's rightful position among the committee of tertiary institutions. I know very recently many of the university rankings, those that rank high had that advantage too.. I hear that University of Jos came first in the university ranking in Nigeria. They had that purposely because of digital you know.. university of Ilorin , *** too.

ZB: okay

PARTICIPANT9: so without that you're nowhere to be found within the committee of tertiary institutions which is a sort of mark up even if you're ranking below. Secondly, it makes a lot of things slow. You would have to use paper and pencil to do some of the things that ideally you could have just one or two lines send it via email, you have that advantage. We also have the disadvantage of slowing the process, the

process would be slower if you have to do, send the mail runner to take things and transparency also, things would be transparent if all the students, since we are having equipment's now, I also have to mention that there is a lot of improvement. But transparency in the sense that whatever records, financial records would be made available and would be clear and understandable to everybody.

ZB: so what about impact in the sense of training and retraining what ... you say I'm just drawing back from the answers that you gave that you gave to the first question

PARTICIPANT9: yeah the procurement, training and retraining are somehow interwoven because the equipment's are not so.. that factor would not make the training so elaborate as we do say but if the equipment's are there somehow, there are trainings on going but the size od the training even now, there is an IT training going on but the size of the training because some of the equipment's are not there, they are only in offices like ours. I know the management has made effort also to provide chief lecturers sometimes with laptops. Most of them have not been trained on how to use it, I remember one of the lecturers was saying they gave him a laptop without a manual, thinking that he would need the manual to know how to operate a computer. So the training and retraining is a bye-product of the availability of the equipment. So government is making effort even without the equipment to train people probably to come with their personal laptops, a few others that are privileged to have the office laptops, even the few that we have, some of them are not up to date some have to use their own personal laptop. So if you look at all these, they have an impact on the institution. Even in the delivery of instructions, teaching, they carry notes, papers, make power point slides, temporary instruction, even give students sites to the materials they can get it. It's even... lack of digital capability is even making, is even impacting on time management. If I would use 2hrs to deliver my instructions with digital support, without that maybe I would use half of the time dictating notes and some other things.

ZB: okay

PARTICIPANT9: that's all, time management as well.

ZB: you talked about the political will?

PARTICIPANT9: yes until now, the management have shown some commitments to that, you know because of the cumulative... The key of the yeah, the impact would come slowly. You know generally, educational growths are slow

ZB: yeah

PARTICIPANT9: maybe they have started now, maybe the impact would show over time, not necessarily immediately. Political will and the sustainability also. If you have an administration that has a political will, that administration leaves and another one comes onboard not showing the same commitment or even better, it's a kind off 'kick forwards, kick backwards' as well.

Question 3:

ZB: yeah erm ok what else… ok we'll move forward to the next question, in your opinion which elements have the most impact on learning and why?

PARTICIPANT9: the training and retraining, you know why?

ZB: why sir?

PARTICIPANT9: because even without the equipment, if people have trained (have received training) some of them would have voluntarily purchased some of the equipment and they can use them, seeing the advantages they derive from making their instruction and lecture notes. So training and retraining are the most important because you can procure if you don't train people, but if you train people, say you train 100 people, 50 may have the will to go and purchase the equipment; the ones they can use and they can start using them. I know some of our lecturers that prepare slides for the students and even some are even gingering their own students to submit assignments through a kind of link, through websites etc. by that they are even making the students also to start learning. So training and retraining, it's just like knowledge, if you have that knowledge you can even train and retrain more staff both staff and student anyway, but you know the teachers/ lecturers that are trained, their training can also impact on the students

ZB: exactly

PARTICIPANT9: can cascade down to the students

ZB: yeah ok, so training and retraining is most important, what would you say is the next most important after that?

PARTICIPANT9: next most important is availability of equipment and electricity supply sometimes. This is a factor wherever you go in Nigeria. Equipment is one factor, second is electricity supply. For instance this is office hour, there is no electricity and there is nothing I can do. If I'm at home now maybe I could use my small generator

ZB: yeah ok, so of the things that we discussed which you know was cost of procurement, training and retraining, political will, commitment and willingness of the staff, environment, digital appreciation, keeping up with the continuous professional development, keeping up with technology which would you say is the least important

PARTICIPANT9: the least important is the appreciation because that can be built into the others like when you're being trained by your institution, the appreciation would come gradually, spontaneously on its own, it will come.

ZB: yeah

PARTICIPANT9: for instance if I don't know anything about IT but there is a training, and I go and listen even if I don't have a computer, somewhere along the line, the advantages of digital appreciation is mentioned, that would now give me the appreciation that you know computer can do this, not knowing how to use the computer but I understand that with computer you can do this, with computer you can cut cost.

Question 4:

ZB: erm yeah really… ok so unto the last question, which is asking are there any other opinions that you would wish to share in relation to my research which is on digital capability maturity in tertiary institutions?

PARTICIPANT9: yeah, what I have to share is that this is a good research, very well. The little I want to share is that this digital capability, there should be an overhaul of all computers used in tertiary institutions, to infuse all these teacher capability even in professional examinations and others. Like now you see parents have being crying when the CBT was introduced by joint admissions matriculation board (JAMB). Overtime now the students are getting over it. Any student that sits for this exam would have had a little knowledge of at least how to open, how to answer questions on the screen, and that's something. So the same thing here with us if it is built into our curriculum, that you have to go to this site, download this material, download this and that, by that people would start learning and gradually it will add up.

ZB: ok

PARTICIPANT9: so the review of the curriculum to include most of these, curriculum review to include digital capability somehow. It will help.

ZB: ok so that is all the questions I have to ask unless you have any other questions for me then we can call the interview to a close. Thank you very much for your time and for willing to participate in my research, I really appreciate that. This is to remind you that the interview will be anonymized and your data would be held under the regulations observed, ethics and protocols. If you have any further questions please contact me via my contact details, thank you.

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 10

Date: 9th March 2020
Time: 3.35pm
Duration: 24:02 minutes
Interview transcript between 'Parti'ant10' and interviewer

Started audio recording
[Brief breakdown of research from interviewer]

Question 1:

ZB: Good afternoon. My name is Fatima Zarah Bello and I'm a post graduate research student at the University of Hertfordshire. I believe you've already received the participant information sheet telling

you what the research is about and what digital capability means. The purpose of this interview is to gain in depth perception of stakeholders like you in the tertiary institution setting and understand what your opinions are towards elements that contribute to digital capability and how these elements impact on digital capability maturity. So in answering the questions that I'm about to ask you, If you can draw from the broad knowledge of the tertiary institution environment and also from the experiences you've had as the Dean of student affairs within this institution, what elements would you say contribute to digital capability?

PARTI'ANT10: Thank you. I just want to start on this background that if you're doing your research on digital capability, it should be digital capability in education because the research should be more centred on students of *** and students of ***, when we talk about digital capability, there are a lot of factors that hinder the digital capability of *** students ranging from lack of adequate technological facilities such as the computers. Another factor that affect the digital capability of students again is the lack of adequate knowledge of the technology by the academic staffs who are supposed to impact this knowledge to the students. Another factor I want to tell you is the policy implementation of the institution. I want to inform you that as a statistics lecturer from my department, I find it very difficult in inculcating or impacting knowledge to students who are supposed to be practically oriented with respect to statistical analysis, instead they are more interested in the theoretical aspect of it that is the analogue part. When you ask a student to design a simple chart, he would want to use his pencil and paper to design a simple chart and research has gone beyond that, the knowledge has gone beyond that. So, if at all most of the lecturers of this department have this basic knowledge of statistical packages even if it's ordinary excel, the students will tend to learn more. So that is why I'm saying the lack of technical know-how by the academic staffs will impact the knowledge of computer/ICT/technology into the students of this various departments also affect the students. Like in computer science if I may tell you, I used to even crack a joke with them that the roadside/normal business centres that offer diploma in computer science are better than them because a student of computer science would graduate without having a basic knowledge of even a single program, they would rather go to the roadside and learn how to design a program. So, these are some of those factors that affect or hinder the digital capability of students. I want to tell you, out of 100% it is very difficult you get 30%-40% who are very good technologically with respect to the digital capability.

ZB: Okay. Any other factor you can think of or should we move to the next question?

PARTI'ANT10: No. So far so good these are the most.

Question 2:

ZB: Okay. So, in your opinion although you've mentioned the impact that some of these factors have but the next is how do these elements impact the digital capability maturity in tertiary institutions? You explained about using technology on the students using excel. Can you go into a bit more depth from what you mean by policy implementation?

PARTI'ANT10: o thank you, the policy implementation, for example in the past we had a lot of rectors come into *** and leave. There was a time one of the rectors said every lecturer must be ICT compliant, they must have a certificate in word to enable you impact the knowledge better to our students. I remember vividly that time as lecturers were running around to get a diploma certification. You can see that it was a policy that came but the policy needs to go deep down asking, checking, come, test. The lecturer that is about to be impacting using technology, should be able to operate a particular technology, even if it is an ordinary computer. But the policy implementation, that time the policy did not go down well because some of the lecturers just went to the roadside to get a certificate and even if you give them a computer to work on they would be picking the buttons, meaning the policy has succeeded in making the lecturers get a certificate in ICT but it has not succeeded in making them understand the actual need of that certificate. Why were they asked to go and get that certificate? They don't know! That is what I'm saying when we talk about policy implementation, I'm very proud of Professor Idris Bugaje who is a student-oriented lecturer, there was a time he suggested we go digital and stop paper communication with the university. I don't need to send a messenger, and it eased communication. That is number one. Number two, you can see the last conference they conducted, the conference is not even for the lecturers, it is for the benefit of the student. Even if your lecturer is not around, he

can be wherever he is and communicate with the student. These are part of the policy I have been telling you that the management is trying to implement.

ZB: Okay. So, while they are trying to implement, are there any digital program that are running at this institution at the moment?

PARTI'ANT10: Digital what?

ZB: Digital program. Are there any program digitally...

PARTI'ANT10: (Interrupts). No no no no no. We have only a course known as computer science. I keep telling my students here that there is a difference between a computer scientist and a computer programmer. So, there is no specific course that has to do with ICT in ***.

ZB: Okay. That was policy implementation, how about the knowledge of staff and how that impacts on digital capability maturity?

PARTI'ANT10: Let me just tell you. The ***, if not now that the rector is trying to change the psyche of the environment by bringing in new crops of lecturers that are not analogue, that are into the digital world. I remember in those days when I came into the department and started teaching my students with the computer, most of the lecturers were looking at me as an enemy trying to take away what they know how to do very well. Now in my department, students no longer carry out their analysis manually, they carry it out using statistical software that are ICT compliant and this is a plus to my department.

ZB: So that kind of hits on knowledge of the staff and also using technology.

PARTI'ANT10: Yes. Most of the staffs are analogue. So, what we are trying to do with this latest conference conducted, you can see what they did, from each of the departments of ***, 2 lecturers were invited for the conference. These two lecturers would come back to the department to impact that knowledge to the various departments. So, invariably the departments are changing from analogue to digital. So, you can see this is one of those achievements of Professor Idris Bugaje and all is student centred.

ZB: Okay. Do you get any feedbacks from the students with regards to some of these...?

PARTI'ANT10: (Interrupts). Yes. They will you themselves.

ZB: Is it in the form of a questionnaire and how is that feedback used?

PARTI'ANT10: There is what we mean by feedback studies of some of our students. You see I have more knowledge of computer science and statistics because we used to be together. I knew students who had gone the extra mile to learn about ICT and are doing very well in the labour market. Recently, some of our students developed a software in computing examination results from the department of computer science that guy won an award. He went the extra mile and has learnt those things not within the walls of the polytechnic, although he graduated from ***. Then if you come to my department I have about 5 students who have graduated here, they have gone to *** they are even first class graduates now, lecturing there and they were able to make this because digitally.

ZB: Okay. And the last question I would ask for a bit more in-depth and understanding of is you talked of lack of adequate technology.

PARTI'ANT10: Yes, I just want to buttress on that point. You see when we talk of lack of adequate technology, you see: -1. *** is not networked: - You can see my smile modem that I use here, if you go to various offices you would see they have one of these. If at all we had access to internet without having to go out to buy anything from anyone, it is a plus to us. 2. Our lecturers find it difficult to access network if not for the android phone and they don't make use of it the way they are supposed to academically to boost their knowledge so that the students would benefit from what they are doing.

ZB: How are they making use of it...?

PARTI'ANT10: Yes, as an academic staff, if you have a laptop and you want to use it for a particular knowledge. You are supposed to use it in line with your field of study so that you can impact positively to your students. I was to present a paper on time management and entrepreneurship, so I was telling one of that students that he could plant maize today and it would germinate in 2 weeks and he was surprised. I explained that there are technologies now which can make that happen. If he was an Agricultural technology student it shows that their lecturer has not been teaching them based on modern trends, to know that I can plant my crop today and it would cultivate it in two weeks just as it happened in Israel and others places. There are a lot of things they don't know and this is why I said the lecturers

are not adequately using the technology to impact the knowledge of their field of study to their students.

ZB: Yeah and even to upscale themselves because they are not aware of the new technologies.

PARTI'ANT10: Yeah.

Question 3:

ZB: Okay, brilliant. So, unto the third question which is, in your opinion which specific elements have the most impact on learning and why?

PARTI'ANT10: The most specific element that has the most impact on learning is: - 1. I want to tell you the network, the technological network. For instance, in my own field, you can go to class and produce some books on SPSS designs and what have you. Students look as this SPSS as very difficult but immediately I produced the book, I showed them the steps on how to compute statistical analysis without looking for anyone to do it for you and all them are rushing it, even from the western part of the country because I have simplified the problem. This is pure technology but in theory. I explained things like how to design a questionnaire and so many more. I even used some of my lecture notes from my post graduate school, I even carried out some analysis by myself so that whoever comes to me will find it very especially when I give you this textbook, then you would not even need me again. These are the things I'm trying to pass to a lot of people. These are the things we expect our lecturers to do but they are not upgrading themselves technologically. That is why I said the adequate use of network is important. Then there is the negligence of the student towards learning, we have to improve of the negligence of the students towards learning.

ZB: what do you mean the negligence? Are you talking about their attitude?

PARTI'ANT10: Yes, their attitude towards learning. Students no longer take copying notes seriously, they use technology here by snapping the notes but in this case the technology is being used wrongly. They do not perform adequate research even when they are using their phone. These days one can have a lecture on their phone and teach themselves, but they don't do that. I personally still watch videos, understand these videos, try to learn from them and come back to teach my students in the class. These are the things students should also do but their attitude now is negative towards positive learning.

They kept snapping, selfies, portraits snapping pictures and all these thing affects their learning.

ZB: and is this something that you would say you battle with in terms of delivery learning?

PARTI'ANT10: Yes.

ZB: Okay. Of the things we have discussed which will you say is the least important?

PARTI'ANT10: The least important has to be the inability of the student to use the technology they have in improving their knowledge. So, I'm advising that the student should make sure they grab the modern technology so that it would improve their way of learning.

ZB: Okay. How or where would you place policy implementation from the least important to the most important?

PARTI'ANT10: Policy implementation?

ZB: Yeah, how would you place that?

PARTI'ANT10: Policy implementation should be the most important not the least important.

ZB: (Interrupts) Even more ... How about ...because we've got technological network as the important.

PARTI'ANT10: Yes. You see in terms of technology know how; the lecturers are not having an in-depth knowledge of the technology in order to impact knowledge but there is what we mean by push. Do you know what I mean by push?

ZB: (shaking head) No.

PARTI'ANT10: A push is when a policy is being implemented, let there be a follow up study. I have sent you to learn something, just like these people they sent for a workshop, these people will have to come back to the department to teach the departmental members. Then in teaching the departmental members we aught to have like 4 or 5 that are very good in what they are taught. Those that went to learn at the conference and their ability to pass the knowledge to their fellow staffs and the inability to pass this knowledge should be sanctioned. There is a rule that says if you are sent on a conference or workshop and you are unable to pass the knowledge you are supposed to have learnt then you will be charged as untrainable. An untrainable staff will have to find his way out of the institution. If there

is a stringent policy that would work on this, everybody will sit tight and they would make sure they understand. There is a story I tell my student about a statistics professor in the UK whom I read his research, he taught them manually and gave them an assignment. One of his students used excel to solve the assignment and the professor failed him. So, he went to report at the senate saying he got the right answer and the professor failed him. The professor was summoned and questioned and he said he taught the students manually while this student answered the assignment digitally. The senate judged the case telling the professor that it means the student is ahead of him and he is supposed to be ahead of the student. The professor came back to the department, taught a set of the students digitally and taught another set manually. It turned out that the first set of students did way better than the second set. It further went to prove that students tend to learn faster using technology than using the old method of teaching. Which is much more difficult. That is why I'm telling you that if a policy is introduced where it is compulsory for all these things to be learnt with the use of technology, we will sit tight and we would learn it. Then the technical know how will now follow.

ZB: So, policy implementation would come and as the most important?

PARTI'ANT10: Yes, as the most important.

ZB: Okay. Got that. Going back to something you mentioned, you talked about noticing the difference in students' grades using technology, is that something that has been noticed within this institution?

PARTI'ANT10: Personally, in my classes, I notice that some of my students who are doing very well in statistical data analysis, are not doing very well in class. Statistics is basically about the practical aspect and not the theory e.g. the ability to administer and interpret the data being given to you that is what makes you a very good statistician and not just your ability to solve a statistical theory question. You could get your distinction but when you get to the labour market and you are asked to define standard deviation and you wouldn't be able to define it. In this case if you are given a formula to solve a problem you would be able to do that but you cannot define standard deviation and that is where the professional statistician comes in.

ZB: So, does that mean it has positive and negative effect on learning?

PARTI'ANT10: Yes. In terms of learning you have to be a little bit good manually and that is what would upgrade you to the digital.

Question 4:

ZB: Okay, brilliant. I think that is all the questions I have to ask you. The last one is just to ask if you have any other opinions that you would like to share in relation to my research on digital capability maturity in tertiary institutions.

PARTI'ANT10: My opinion would be, since you talk about digital capability, I know what you mean by digital capability is maturity -that ability of institutions to hold on to a longer period of digital capability if I understand your question in that aspect, in that case, based on my preamble I was telling you on policy implementation, if there is a very good policy on ground, *** would prescribe a particular laptop for every lecturer. Then there should be adequate network, conferences for academic and non-academic staffs that would create a challenge of new things that these staffs were able to develop, this is what makes them researchers and academics. These are those things I want us to improve on to maintain the maturity because it would lead to sustainability.

ZB: Okay brilliant! That's all the questions I have to ask you so if you don't have any other questions for me then we can call the interview to a close. I would like to thank you very much for your time and reassure you that your data would be kept safe and secure. Thank you!

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 11

Date: 4th March 2020

Time: 11.34 am

Duration: 15:54 minutes

Interview transcript between 'PARTI'ANT11' and interviewer

Started audio recording

[Brief breakdown of research from interviewer]

Question 1:

ZB: so good afternoon, as I've already introduced myself, my name is Fatima Zarah and I'm conducting a short study to gain your perceptions on in-depth.. I mean to get some in depth perceptions on tertiary institution stakeholders about what they feel are the elements that contribute to digital capability and the impact that digital capability has on tertiary level institutions. So when answering my questions, if you could draw from your own personal experiences as a head and your experiences in decision making within this institution, what element would you say contribute to digital capability?

PARTI'ANT11: you're welcome, the digital capability in this place, first most we have to understand that the institution is a government institution and so the management have their decision and choice of what they want to happen, like of this institution just like you said personal experience, I said earlier it's a new department in this institution so ICT is already coming up gradually from the installation of the internet to development of software that can handle the portal, the websites and so on. This took time because the government policies have affected it, poor funding have affected it and choice at times from the management and also poor installation has also affected it but with the coming of this management, we were given the opportunity of upgrading the network of this place which is now accessible at all departments and directorates since the internet is a tool that students use, lecturers use for their research work and teaching also and still coming up just like I've said. We just posted the website and the portals are still under construction. One of the factors also (elements) that is affecting it negatively is funding for example if subscription is over if there is no funds for renewal, it can bring a stop the flow of the internet and the hosting of the site

ZB: okay so are there any other elements that you would say contribute to the digital capability apart from the one that you've just mentioned?

PARTI'ANT11: yeah, apart from poor funding, we have poor attitude or inadequate knowledge of ICT around, a lot of people are yet to fully enabled as in well informed about ICT itself, what it does, how they can use it, so a lot of training have to be done to enable and then the modems being used are also some of the factors that can affect ICT. The impact of the ICT even at the level we are, some people are finding it difficult to access the internet because of poor facility

ZB: yeah

PARTI'ANT11: so there is upgrading of facilities to cope with what we have around they would be able to enjoy the facility

ZB: ok so in your opinion, some of the elements that you've just mentioned which of them would you say impacts the capability maturity of this institution? you know the ability of the university to continuously improve or continuously progress

PARTI'ANT11: yeah if we can have continuous funding, trainings and then constant power supply then we would definitely get matured day by day

Question 2:

ZB: Ok so the funding, training and constant power supply, can you tell me a little bit more about how you feel it impacts this institution

PARTI'ANT11: concerning?

ZB: As in the funding can you just elaborate on how funding impacts (interrupts)

PARTI'ANT11: yeah it has been improving that's why we just started and moving at this snail speed. You know the funding now is improving, previously there was no money; if we have to do this no money nothing was happening

ZB: okay

PARTI'ANT11: then gradually we are able to get the restoration of the internet though it's small, now we are yearning, and we are talking to the management to give us a bigger bandwidth, you know that also involves money

ZB: yeah

PARTI'ANT11: so if we can get constant supply of money to give us the adequate or what is actually required of this community, we would appreciate it

ZB: and then a bit more about training, so what impact does training have, what kind of things have been...

PARTI'ANT11: yeah training like I said earlier you know we are just starting, just like I have said, we are just how many, a lot of them apart from me who is ermm a master holder in computer and information technology, they other ones are still like diploma level so they cannot do much so if we can get more hands, then trainings which we think collaborating with *** would help us in that area which we are already doing.

ZB: yeah

PARTI'ANT11: so trainings on how to handle ICT equipment and issues generally and then giving us more hands, it would help this department to grow and to give a matured ICT in this place

ZB: okay, and then constant power supply, so power supply has been a barrier?

PARTI'ANT11: yeah power supply has been, like now you can see there is no light. The standby generators are not up maybe due to still funding, if they are being fueled they should be on by now. So partly some of this elements could be from government, some partly from management

Question 3:

ZB: yeah okay, we would move on to the third question which is; in your opinion which of this elements would you say has the most impact on learning and why?

PARTI'ANT11: just one?

ZB: no, as many as you want or even from some of the things you've mentioned, just say which ones are the most the most impactful and which ones are the less…

PARTI'ANT11: for me, adequate funding and then adequate power supply or let's say constant power supply because these gadgets are almost 100% reliable on power, anyhow either solar…

ZB: so you have hardware and gadgets available within this institution?

PARTI'ANT11: yeah and then we need adequate gadgets also, upgrading some of them to maybe bigger capacity like that and a good data center to be able to accommodate as the institution would keep growing

ZB: Yeah, o what would the data center ermm... How would you say the data center would contribute towards digital capability and what impact would that have for learning?

PARTI'ANT11: yeah you know with the data center, if we start operating CBT here it would be a good one to accommodate the data base of this place and it would support the CBT center whereby students can take their exams online, lectures online etc.

ZB: yeah okay, earlier on before we started the interview, you mentioned something about NITDA

PARTI'ANT11: yeah NITDA as an agency, they've been supportive to institutions such as this, to initiate and the ICT department even in this institution was done by NITDA

ZB: who are NITDA, as in are they a government agency?

PARTI'ANT11: yeah, just like NCC. I'm trying to remember the full meaning of the acronym, it's a national body/agency

ZB: yeah it's National Information Technology Development Agency

PARTI'ANT11: they are serving the responsibility of controlling all these ermm…

ZB: yeah okay, so they've… would you has they've positively impacted this institution?

PARTI'ANT11: yes, for them to start this particular unit that has taken us to this level

ZB: yeah ok, have you had any other support from any other…?

PARTI'ANT11: yes like NCC, they've given us some systems which enables the lecturers to use in carrying out their research, laptops, tablets, yes so they have also contributed though we've already requested again if they can give us because the last one they gave us some years back. So if we can get constant support from these kind of agencies to keep us going

Question 4:

ZB: okay so we move on to the last question which is just to ask if there are any other opinions that you wish to share in relation to digital capability in tertiary institutions?

PARTI'ANT11: yeah so seeing all these elements negative which have been affecting the growth of ICT into maturity in this place and that's why we are now collaborating with *** to give us support to get strength in order to move from this level to the next as in getting trainings, then upgrading of the networks and even the software design

ZB: okay do you collaborate with them in terms of other things outside of ICT support

PARTI'ANT11: yes, you know when you talk of a training institution such as this, you cannot keep the library aside. When we are talking of library, there are lots and lots of information on the internet so the library can be sharing resources with that of ***, to make our own library come up

ZB: okay interesting ermm. You said most of the elements you talked about have been negatively contributing, what would you say could be the positive contribution that some of these elements can have towards this institution?

PARTI'ANT11: if they are been made available

ZB: okay

PARTI'ANT11: yeah it's going to take us to a more matured level in the ICT, you can see us in the nearest future having a very big bandwidth, subscriptions in terms of internet supply, then power supply you know if we can get very good power stands that can give us light if NEPA fails, then just like I've spoken about training, you know constant trainings, upgrading when new things are coming to carry the place along, you know it's going to impact very well in this very place which we hope *** would help us a lot in that area.

ZB: ***? Okay… (ermm what else).
So would it be fair to say or am I right to understand that all the elements that we've discussed have a negative contribution but if adequate and if developed, we then have a positive contribution?

PARTI'ANT11: yeah

ZB: okay, I think on my part that's all the questions I have to ask. Do you have any questions or any other contributions that you wish to make based on some of the experiences that you've had within this institution?

PARTI'ANT11: yeah I have had about this internet society, have you had about it?

ZB: no I've not

PARTI'ANT11: whereby they assist institutions like this

ZB: okay?

PARTI'ANT11: so that this internet issue will not be an issue as in if *** is strong you know they can allow us use part of their internet so that it can elevate us in learning, in research work,

ZB: ok if you lean on them, do you have plans in terms of this institutions strategic plan, you know what the management have in plan for growth, do you have plans in making sure that you're able to sustain yourself independently?

PARTI'ANT11: yeah we do but since we are starting, if we can get such societies to come up and give us leverages in this kind of area, it would go a long way in helping us get established since we have a small one already.

ZB: so prior to your collaborations with ***, you did not have access to the internet?

PARTI'ANT11: we did, just epileptic.
So we hope that if there is continuous funding, we would soon subscribe maybe go to a higher one, better one that can carry everybody maybe a 3/4G together to cater for everyone

ZB: okay perfect. So if you've got no more questions, we would call the interview to a close, thank you very much for your time and I would just like to remind you that all the data that you've given me would be kept safe and secure and according to the ethics, protocol numbers that I have provided you and the data would be anonymized and not be back traceable to yourself and it would be use for content analysis then to produce a report.
Thank you!

PARTI'ANT11: you're welcome.

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 12

Date: 6th March 2020
Time: 9.19am
Duration: 17:49 minutes
Interview transcript between 'PARTI'ANT12' and interviewer

Started audio recording

[Brief breakdown of research from interviewer]

Question 1:

ZB: good morning Mr stan, as I've already introduced myself, my name is Fatima Bello. I've introduced a little bit about my research to you and thank you for agreeing to participate in my study.

PARTI'ANT12: you're welcome

ZB: thank you. The purpose of this interview as I've explained is to understand or gain an in-depth insight into stakeholders like yourself, your perceptions on what elements contribute to digital capability maturity and also how these elements might impact tertiary institutions of learning and so as I'm asking you these questions, I would like you to draw on your broad knowledge of the tertiary institution setting and from your experiences on being a member of management in this institution. What elements would you say contribute to digital capability?

PARTI'ANT12: thank you Fatima for allowing me to participate in your research work. To go straight to the questions, I would say the elements that contribute to digital capabilities include ICT okay?

ZB: yes sir

PARTI'ANT12: also as a technical institution I think one other thing is innovation, our institute finds it a very important element of digital capabilities. Another is (how do I explain) it has to do with power point, media sort of element that has to do with imaging.

ZB: okay

I don't know but for me, this are some of the elements I think contributes

ZB: okay. So, when you say ICT, which part of ICT do you mean specifically because ICT is quite a broad term that includes...

PARTI'ANT12: yes it's more of the technological aspect of ICT. ICT being information, communication and technology, the technological aspect of it that has to do with developing programs for design purposes and how we can communicate with students using those design software and how that software could actually help to develop student capability in their work, so that I think is the aspect that concerns us the most.

ZB: okay

PARTI'ANT12: yes

ZB: okay, any other elements that...

PARTI'ANT12: of course, the other element has to do with how you access information through... in the library, we call it E-library, so that again is another element that as an institution, it's very key to learning

Question 2:

ZB: okay. In your opinion, how do these element impact digital capability maturity in a tertiary institution, so some of these elements you just talked about, what impact do they have?

PARTI'ANT12: great impact because learning in 21st century requires that both the lecturers and students are able to use these elements effectively to impact on learning. So specifically, there are certain aspects of learning that have to do with all these elements, let me say learning in this modern society has to utilize these elements for effective teaching and learning process because generally we would not be able to impact on these students learning except to utilize this tools or elements effectively with regards to helping them to develop their ideas and to be able to bring such ideas into real practise in terms of developing models or their projects which automatically will help in developing their skills

ZB: yes

PARTI'ANT12: okay so the impact really is to enable the students develop their ideas unto bringing out products or let me say prototypes that could be internationally accepted, we cannot go back to developing prototypes and products manually which is always difficult to step up to international standards, we need to be able to step up to meet up with international standards if these elements are not utilized.

ZB: okay. Can expand a little bit more on any of the other ones we've talked about initially because you've talked about media and imaging

PARTI'ANT12: media and imaging, yeah. Again the sort of things we do with regards to teaching and learning... we've discovered over the years that learning process is enhanced through the use of some of these media aids. If you have some audio or visual presentations of some of the ideas or some of the things you want to pass across, if you do not use some of these media aids it would be difficult to pass on

information or such ideas to students particularly. So just as you can see, even in my office I have this screen also helps me maybe if I have some small group of students to be able to show them maybe some media, some videos etc. and that helps them to be able to remember quickly some of the processes you need to carry out as you go to the workshop for practical's. It is the aspect of audio and video kind of presentation among my days and we utilize some of these to be able to impact student teaching and learning process.

Question 3:

ZB: okay, so of these things that you've just mentioned which specific element would you say is the most impactful in learning and why?

PARTI'ANT12: I think the ICT is more impactful because virtually I think some other elements are somehow tied to that. The good knowledge of the internet for example good knowledge of some technological tools will automatically influence other elements when we talk about innovation, you discover that the use if ICT is involved because we discover that there is no way you would be able to do certain things differently from the way they are usually done if you're not able to employ some of this ICT tools, so I found out that ICT could be more impactful than other elements though each of them has its own role.

ZB: yeah so which one would you say is the next most important after ICT

PARTI'ANT12: media

ZB: okay

PARTI'ANT12: yes. because particularly in this institution that part of our teaching and learning process has to with helping students to develop their entrepreneurial skills to be able to develop prototypes or yes prototypes or certain artifacts that would reflect on their learning process. The use of audios and videos to help explain to students some of the processes they need to follow is quite key also.

ZB: okay, so would you say media could possibly fall under ICT since it's a technology like you talked about… things like that

PARTI'ANT12: yeah I think so, see it has to do with ways of communicating

ZB: okay. So if we took those two as one, what would you say is the next most impactful?

PARTI'ANT12: the innovation

ZB: okay

PARTI'ANT12: yes innovation because both teachers and students must learn how to do things differently if we must expect a different result on whatever we are doing

ZB: yeah

PARTI'ANT12: so I find the aspect of innovation very key also

Question 4:

ZB: okay. And then lastly, are there any other questions you have for me or opinions rather that you would like to share in relation to my research on digital capability maturity in tertiary institutions?

PARTI'ANT12: yes. First and foremost I would like to commend your courage to go into this area of research because I think it's an area that we need to step up in this part of the world. For me personally I discovered that I would not be able to utilize this tools properly to enhance learning, we struggle many times with certain categories of students because of their background and if we must be able to take our learning and teaching process in tertiary institution to global competitiveness, then we must be able to find a way for a way of incorporating these elements into our teaching and learning process. So I would like to say that right from secondary schools, there is the need to help students to begin to put these tools into use so that as they are entering tertiary institution, they must have gotten some skills on usage of these elements

ZB: yeah

PARTI'ANT12: I look forward to seeing the outcome of the research which I believe to impact on our society and tertiary institution in our country, thank you.

ZB: thank you sir. Sorry just one more question, as you were speaking just now I thought of a question. So you said, you talked about student background, is the previous educational background of the student something that typically impacts digital capability like you said or…

PARTI'ANT12: yes

ZB: okay in what way?

PARTI'ANT12: you know normally, curriculum has a way of influencing the learning process, if the curriculum used in tertiary institution does not incorporate this, definitely the students being graduated from secondary school would be deficient in some of these areas. Actually it was off recent that the educational section that is in-charge of curriculum development tried to introduce this ICT aspect in secondary school curriculum but the problem is that some of them do not have equipment or the system to be able to even teach the curriculum

ZB: yeah

PARTI'ANT12: so you would discover that there are certain schools that have the equipment that could have while some do not have. So when you have students that are coming from such background, they may be brilliant but they may not have been exposed to the use of some of those system, so by the time they are into the system definitely it would show but however you need to carry everyone along but those ones would need to work extra hard to step up and catch up with other students that have previous background.

ZB: yeah, so what does the institution do to support them; or rather does the institution have anything in place to support those students who struggle to keep up?

yes we do, we do encourage the students to explore the opportunity of tutorials, we do have tutors for each program, such tutors are given the opportunity to interact with the students and to kind of direct their learning process so the tutors by that interaction get to know certain deficiency some student may have and guide them on how to go about it and sometimes we also encourage them to have tutorials amongst themselves among the students and that will also lead to better learning process.

okay, that's all the questions I have to ask. Thank you very much for your time, I really appreciate you participating in my study.

PARTI'ANT12: thank you so much Fatima

ZB: thank you.

PARTI'ANT12: thank you so much, welcome.

Audio recording ended

END OF TRANSCRIPT

Interview Transcript 13

Date: 6th March 2020
Time: 12.105pm
Duration: 18:11 minutes
Interview transcript between 'PARTI'ANT13' and interviewer

Started audio recording
[Brief breakdown of research from interviewer]
Question 1:

ZB: Okay, hello good afternoon. Thank you for agreeing to meet with me and thank you for your willingness to participate in my research work. As I have already explained to you, my research is about digital capability maturity and how it impacts tertiary institutions of learning. So, the purpose of this interview today is to get an in-depth understanding of your perception as a tertiary institution stakeholder about what element you feel impact on digital capability and specifically how they impact tertiary institutions. So, when answering the questions, I am about to ask you, if you could draw from your broader knowledge of the tertiary institution environment and also from your experience from being a member of management in this institution, what element would you say contribute to digital capability?

PARTI'ANT13: you are welcome. In my own view, at the tertiary level, the contribution of the digital capability starts with the acknowledgement of the fact that it is more or better than the manual or analogue system of teaching and learning in the environment. So, the first thing is required is to acknowledge that the digital approach in teaching and learning is more or better that that of the analogue system, so in that regard, it will make people embrace digital capability in the process of teaching and learning. But this

can only come to be if we have the manpower to be able to deliver or the people that have the know-how, the in-depth understanding of the digital mechanism of teaching and learning so that they can be able to deliver. In that case, we need to train staff in that area of digitalization so that we can have enough manpower to be able to meet the need in this time we need to go digital.

Apart from manpower, we need to have the facility that are going to be implored in the process of teaching and learning in our institution. This is very vital because if the facility is not there, even if we have the manpower, nothing can be done and vice versa. So, with these three items, I believe if we acknowledge that we need digitalization, we train people that is we have the necessary man power and we have the facilities that we can employ in teaching and learning in our tertiary institutions, it will go a long way in achieving the goal and getting the digitalization capability in our teaching and learning processes.

Question 2:

ZB: So, in your opinion, how do these elements that you've talked about impact on the capability maturity in tertiary institutions. So, I mean can you tell me more about how you feel the acknowledgement of digitalization would impact the institutions' ability to mature?

PARTI'ANT13: The digital capability maturity can be impacted by the above-mentioned elements because if we employ that, 1. it would give the people learning, convenience. For example, if the person that is going to receive the knowledge maybe is not strong enough or their health condition is not good enough to be at a venue where they receive the learning, then he or she can stay where they are and learn, that makes learning more convenient. In the course of interaction in the classrooms between the teacher and the students, if we employ digital means in that area, the interaction and the absorption by the student would be better in an area of maybe trying to give specifics and emphasis on issues where by if we have visual aid in the classroom, the students are hearing and seeing and it would enhance the interaction between the teachers and the students in terms of asking questions and relating examples so that it will bring the idea at home to the students. So, it has a positive impact in the teaching and learning processes if we employ the digital means. If we have a large number of students in a class at a time, for audibility we can employ audio means that can enhance the sound of the lecturer, in that way you will discover that the understanding of the student will be better when the student get to hear exactly what is being said. So, employing digital means in our tertiary institution will go a long way in solving our problems.

ZB: Fantastic! So, you talked about facilities; can you tell me more about the facilities you're referring to?

PARTI'ANT13: In the facility, we have our computer system, we use smartboards, projectors, these are facilities that will aid in teaching and learning if you are using the digital means of teaching, but these facilities make it easier to understand what is being taught. One can place a question to a lecturer via email and reply can be gotten easily, this is when computer system is being used. The you discovered the learning will be much, much better. For the projectors, students would have a visual understanding of what they are being taught and they can ask questions as required. Using a smart board to teach equally has advantages over the analogue boards for teaching and helps enhance understanding.

ZB: You talked about training and manpower?

PARTI'ANT13: In the first instance on the impact of digital capability, before we have manpower, we have to train them. Since they are not on ground and considering the number of institutions that we have it means they have to be put in place a means whereby we can be able the train a required number of people that will be able to come and deliver the services of digitalization because that will be the only way we would be able to switch from the contemporary to the digital way of teaching.

ZB: Okay. What type of trainings do you offer within the institution?

PARTI'ANT13: We train students at the national in SLT and then we have higher national diploma in Chemistry, Microbiology and Biochemistry. These trainings are vital because they have to do with laboratories and how well a person is trained goes a long way in impacting the society. At a higher national level, these are people that can work within the industries, for the microbiology and chemistry option, they can work in hospitals, that is laboratory hospitals. Therefore, It is very important that at this level, they get it right so that when they go to the outer society, they can deliver it right too. Thank you

Question 3:

ZB: lastly, in your opinion which element(s) would you say have the most impact on learning and why?

PARTI'ANT13: the most important element, in my opinion, is the manpower. That is why I emphasis on the fact that we need to train manpower, you cannot give what you don't have and then if we need a good outcome then the input has to be equally good enough. That is why they have the garbage in garbage out saying. So, manpower is one and the facility must be there. I want to believe that if the facility is there, people will embrace it. Naturally, when you go to a class and people are complaining about the boring lecture it will be traced back to the person delivering it. Once the delivering of lecture is good you will notice that people will be more willing to be in that class. So, we have the manpower, facility and other things will follow. Thank you.

ZB: Okay brilliant. When you are talking about manpower, are you talking about it relating to the staff or the students?

PARTI'ANT13: No, the staff. The staff have to be trained so they can train the students.

Question 4:

ZB: Okay, I just wanted to be clear on that. On my part, that's all the questions I have. Are there any other opinions you would like to share on my research on digital capability maturity in tertiary institutions of learning?

PARTI'ANT13: Yes, you said your topic is digital capability maturity, Am I correct?

ZB: Yes.

PARTI'ANT13: I want to ask a little question then I can say what I want to say. Because when you say digital capability maturity, I don't know whether you are looking at it as for us to come to a high level of digitalization.

ZB: Exactly, something like that.

PARTI'ANT13: You are convinced that we have started well?

ZB: I am not in any position to judge sir; I am only collecting data (Laughs)

PARTI'ANT13: considering the fact that digitalization has not been fully embraced in tertiary institutions in Nigeria, it is important for us to acknowledge the need for digitalization and then embrace it and all will be well.

ZB: thank you very much sir for taking the time out to speak with me and I appreciate it very much. I want to remind you that your data will be anonymized and kept in line with the ethics protocol.

Audio recording ended

END OF TRANSCRIPT

Appendix X: Synthesis of RQ2 Data from Qualitative Analysis of Study 4

***Note: this data was used to ?**

Narrative for Q2: How do these elements affect Capability Maturity in TI?

Tertiary Institution + Management		External Environment		AFFECTS and Uncertain	
Infrastructure		RTC		EE	
Skills LTD (services)		Government Interventions		C&I	

University

1. Management should be able to use measuring tools such as SWOT analysis or QA techniques to measure how well staff and students are using the technology provided and how frequent the usage is I comparison to the invest made.
2. Maturity levels will a useful measuring tool for management.
3. Network infrastructure is the bedrock of whatever you are going to build within the institution.
4. If management are willing to invest and adequate infrastructure is in place, then any services or tools should be easier to implement.
5. Services have a road system which encourages staff on how to improve their skills.
6. Having general courses like MOOC covering all other courses really helps the development of student's capabilities. Eg. All students that passed through CISCO even though it is not directly embedded in the curriculum, they acquire skills that those who do not pass through that route would not have.

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7. There must be policy in place to guide learners, teachers and management on acquisition, usage and adoption of technology in teaching and learning.
8. Once a policy is put in place and backed with adequate funding; any other factors can be achieved in terms of adoption of digital learning.

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9. The elements impact the university positively.
10. Digital centres help the willing students who made use of available devices to increase their DC.
11. We have to contribute better in terms of internet access because availability of the internet has also helped greatly in increasing students DC.
12. Some differences between management and tutors may be a limitation to developing DCMiTII
13. Mobile technology has the use of mobile devices for learning also means that many students are learning skills from their mobile devices.
14. More than an average number of students have a way/ means of interacting or accessing information.

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15. Developing DCM in the university would then bring out the level of the university in terms of ranking and increase the visibility of the university and then the products of the university.
16. Products of the University are graduates and research.
17. The products of the university would be more visible than those who did not have the opportunity to develop their capabilities.
18. The difference is that those universities that have e-Learning policies is that their learners and tutors would have been exposed to modern techniques and technology and therefore would be at the forefront of knowledge in comparison to those who have not been exposed.
19. Capacity building of tutors is the first stage as it builds confidence, then they can deliver learning both in terms of knowledge and technical skills.
20. Digital technology (e.g., Interactive boards) increase accessibility to content. (for example after delivering a lecture the content remains on the board then somebody can have access to it later).
    However, if students are trained to use them, they cannot have access, and if the internet is not working, they cannot have access.
    With internet access, student can download other materials from the internet and get more involved in learning the subject. (Improved student engagement/ involvement)
21. The strategic goals of the university documents certain goals they want to achieve within a fixed period.
    Once it is designed and approved, the university must work towards it and its advantage is because certain things are pre-planned, it reduces the chances of delay.
22. By the time the university reaches the level it wants then the university is said to be matured.

College of Education - Technical

23. Deleted.
24. Interactive boards that can store information discussed during a lecture and students are able to retrieve this information later.
25. Computer literacy training is mandatory.
26. Allow students and staff broad access to ICT technology.
27. ICT Literacy training courses sponsored by TETFUND.

28. Internally sponsored – institution-based training also available.
29. Other interventions from federal government agencies as part of national training budget.

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30. Teachers use micro-teaching laboratories to impact students, especially those tutors that are still learning teaching methods.
31. Tutors use labs to train student-teachers on how best to utilise teaching methodologies.
32. Not all teachers can use technical equipment without help so more efforts needs to be into training and re-training staff so they are digitally literate and can cope with independent use of technology.
33. Students also find it difficult to cope in the micro-teaching labs because of the environment they come from.
34. TETFUND intervention in the way of training for digital skills which will enhance their capacity and allow them to utilise those inputs (inputs meaning interventions monetary and technical).

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35. Lack of internet connectivity limits the extent to which academic learning activities can be effective.
36. Inefficient power supply from the national grid impacts the success of teaching/ learning using technology. Despite efforts to use standby generators and other resources, financial constraints is another challenge that makes it difficult to keep up with maintenance and continuous operation of standby solutions.
37. Student educational background means they come into the university with very little or poor computer literacy skills and this foundation and background does not permit access to a simple laptop (because they cannot afford it).
38. Availability of minicomputers (better known as mobile phones) have assisted in providing access to hardware to browse the internet for academic purposes.
39. The limitations contribute to making the teaching and learning process ineffective.

National Institute of Teaching

40. Utilising elements effectively with regards to helping them to develop their ideas and to be able to bring such ideas into real practise in terms of developing models or their projects which automatically will help in developing their skills.
41. we need to be able to step up to meet up with international standards if these elements are not utilized.
42. we have discovered over the years that learning process is enhanced through the use of some of these media aids. If you have some audio or visual presentations of some of the ideas or some of the things you want to pass across, if you do not use some of these media aids it would be difficult to pass on information or such ideas to students particularly.

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43. Without funding development of capabilities is not possible.
44. Internet access also linked to funding.
45. Most teachers are of diploma level so better qualified staff would help us do better.
46. General ICT training for all staff would help us grow and to give a matured ICT.
47. collaborating with *** would help us in that area which we are already doing.
48. Power supply is an issue. Standby generators require running and maintenance cost. This is partly a government issues and partly management.

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49. Learning convenience even for those with health issues, or not strong enough to go to go to class physically.
50. Better interaction been learner and tutor, and absorption. The use of visual aid means students are both seeing and hearing which enhances interaction and promotes questions asking.
51. Large number of students often means poor audibility, but technology can enhance the sound of the lecture. Understanding will be better when students can hear what is being said. Employing digital tools in TEI goes a long way in solving these problems.
52. Facilities such as smartboards and projectors aid teaching and learning and make it easier to understand what is being taught. (Enhance understanding)
53. Before we have manpower, we must train them. Train the number of people that will be able to come and deliver the services offered.
54. Here they say students are trained – suggesting training and teaching are synonymous.
55. How well a person is trained goes a long way in impacting society.
56. It is very important that at this level, they get it right so that when they go to the outer society, they can deliver it right too.

Polytechnic

57. The world bank StepB project establishing centres for research and development had a very big impact of CM in the institution. They required that projects extend to the neighbouring communities so they could also benefit from gaining access the internet. The provided funding to make this possible and the institutions and the immediate environment had stable access to the internet.
58. After the World bank (2012-2015) excited, funding and maintenance because and issue and the project could only be maintained for about and year and they whole thing started deteriorating.
59. When there is no internet access available, both students and teachers use their own personal modems or mobile phone tethering to access the internet.
60. Institutions receive limited funding and struggle to allocate it across all the facilities within the institutions.
61. Adequate bandwidth means students can access materials online and also download note sand videos which helps with learning and also improves motivation.
62. Positive feedback from former students who went onto further studies abroad.
63. Students demonstrated positive response to submitting assignments when internet access was readily available, and they scored better grades.
64. ICT facilities assisted a lot in helping achieve the core objectives: making teaching easier for learners and tutors by using projectors for smooth delivery and less dictation.
65. Funding is directly linked to maturity because when the funds were not available, the project stopped, and the existing facilities decayed.
66. Contracting ICT work means the work is often poorly managed, slow delivery because consultants maybe otherwise engaged etc.
67. The internal ICT department often does not have the capacity to do things themselves. So expertise are employed to assist in ICT service delivery.
68. Recent realisation that ICT is the key to teaching, learning and research,
69. When we developed our website internally the response from students was positive in terms of the information provided being exactly the information that is need from community members.
70. Often there is insufficient manpower so additional staff are required and ICT training must be provided for them.
71. ICT training results in improved functions.

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72. In University rankings we can see that those that are digital rank higher than those that are not.
73. Digital = getting things done faster = efficiency
74. Digital also means transparency in records, financial records etc are made available, clear and understandable.
75. Procurement, training and retraining are interwoven.
76. Political will from management, that is showing commitment and sustainability – if an administration with political will leaves and the new administration come onboard not showing the same commitment then the progress goes backwards.
77. Generally, educational growth is slow – the impact shows overtime.
78. Providing laptops without training on how to use them demonstrates how training is a by-product of availability of equipment.
79. Time management is a negative of effect of poor capabilities – everything takes longer – for example dictating instead of trying to understand, send mailer boys instead of emails etc.

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80. Management is trying to implement many policies but are issues with the policy implementation process:
    A mandate came out that all learners must be ICT literate with a certificate as proof. All staff had to provide evidence of their certification but because they were not made the understand why this was required of them, many went and got poor quality certifications and did not fully understand the ICT.
81. Digitalisation = eased communication and makes distance learning possible.
82. New more digitally literate staff are required because there is difficulty in getting existing staff to change/ adapt what they know so well and are used to.
83. ICT compliant lecturer who are digitally capable = capable student = capable department
84. Conferences have been held on the need for ICT skills regularly, at least 2 members per department to attend and take the knowledge back and impact it on their respective departments – invariable tis has supported the shift from analogue to digital.

85. Lack of adequate technology because the institutions I not networked. Even if they provide staff with laptops, many staff and students are required to use person modems of mobile phone to access the internet.
86. Internet and a computer mean lecturer can learner and boost their knowledge in the subject area and impart that knowledge to the students. However, if lecturers are not adequately using the technology to impact the knowledge of their field to the students the full benefits of the digital are not seen.

Appendix Y: The Proposed DCMiTI Framework v1.1

	Maturity Level	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
Domain Elements	**Level descriptors**	**Not possible/ Not available and/or not considered**	**Possible/ Ad hoc/ Unpredictable / reactive / poorly controlled**	**Often reactive / encouraged**	**Proactive / practised/ Defined/ standards/ procedures in place.**	**Managed/ Measured and controlled/ quantitively surveyed**	**Optimizing/ Stable and flexible / continuous improvement**
1 Infrastructure: the basic physical structures, network infrastructure, connectivity, infrastructure hardware and operating software that supports the functions and operation of the institution.							
Sub-elements	**1.1 Basic physical infrastructure**	Not available	Basic physical infrastructure available	Infrastructure supported with periodic maintenance.	Regular maintenance and availability of individual, group, and community spaces	Detailed maintenance log kept and monitoring usage of learning spaces	Wellbeing consideration in physical infrastructure with aesthetic considerations
	1.2 Network infrastructure	Insufficient network	Limited network infrastructure (available in some areas) and erratic	Network infrastructure available but insufficient for full service	Infrastructure is sufficient but often slow	Infrastructure maintenance plan in place	Network stable and seeking upgrade opportunities for optimisation
	1.3 Connectivity	Not available	Availability and some linkage	Connected with insufficient bandwidth to support all services	Connected and bandwidth sufficient for services	Internet connection speeds are checked and managed	Continuously optimising networks
	1.4 Hardware & software	Insufficient	Some hardware and software are available	Available in shared facilities (teaching labs and e-Libraries)	Range of software available for free student downloads	Maintenance, upgrades, and usage is monitored and controlled	Processes stable and flexible – capable of smooth migration
	1.5 Power solutions	Power dependent on EE	Limited backup power solutions available	Backup power solutions are available	Sufficient backup power solutions are available and serviced frequently	Regular service and updates	Service plan for backup power maintenance
	1.6 Technical support	Support not available	Ad hoc support is available	Technical support available	Technical support runs regular maintenance and upgrades. Support process in place for individual support	Technical support performance is monitored for efficiency (time scales)	Technical support process and team appraisal process
	1.7 Usability considerations	None	None	Some consideration of hardware and software	Some consideration of aesthetics in infrastructural design and hardware/ software usability	Usability measured and outcomes used to support decision making	Ergonomic, aesthetic and well-being considerations made
	1.8 ICT Maintenance & upgrades	No provision for maintenance	Irregular maintenance	Provisions made when problems arise	Routine maintenance checks at regular intervals	Maintenance logs monitored and controlled for efficiency	Maintenance processes are stable, and a review plan is in place
2 Tertiary Institutions: those elements that impact the manageability and sustainability of the TI, including organisational structure, corporate strategies, leadership commitment and practice guidelines that govern the institution.							
Sub-elements	**2.1 Management responsibilities**	No formalised management oversight of DC	Management assumes some responsibility for the implementation of DC	Management encouraged to assume responsibilities concerning specific tasks/ duties	Management duties documented as part of institutional policies	Policy adherence is reviewed and assessed	Outcomes of DC policies reviewed and used to offer flexibility to reflect localised needs.
	2.2 Capital investment	No internally generated investments toward digital	Digital investments are made on an ad hoc basis	Digital investments are characterised on a project per project basis	Digital investments are planned in line with TI's strategic plan	Investments and outcomes are monitored and reviewed	Review results are used to optimise capital investments
	2.3 Institutional policies	No policies that support digital education/ e-learning and other ICT related matters	Limited availability of policies, standards and procedures related to digital education and other ICT related matters	Policies and guidelines support digital education and cover social, professional, and ethical issues in compliance with national regulations.	A comprehensive set of policies, standards, and procedures in place to guide digital education, including support for wellbeing	Policy implementation plans are available for all policies to enable measured and controlled implementation.	Wellbeing matters are included in policies and guidelines, and implementation plans are reviewed regularly.
	2.4 Institutional culture	No digital culture or mirrors the social and cultural norms	Localised informal institutional cultures	The institution has its own defined social/ learning culture that promotes collaborative working, learning and innovation.	Institutional culture is actively disseminated and promoted.	Adherence to institutional culture is monitored.	Institutional culture is reviewed and updated as a result of feedback.
	2.5 Digital analytics	None	Some ad hoc data collections	The emergence of organised data collection	Data collection is standardised, and some data analysis is done	High-quality quantitative data is efficiently collected with systematic analysis to better understand specific areas	Data is exploited for management and planning

	2.6 Digital presence	None	Patchy and informal digital presence	Emerging digital presence	A standardised digital presence, including social network accounts. Members are encouraged to contribute their own pages.	Managing and monitoring digital presence	Decisions are made based on digital analytics.
3 Stakeholders: All levels of learner, tutor, technical and administrative roles with the institution. (Note all stakeholders are considered learners at some point in time in a digital learning environment, often as part of broader responsibilities).							
Sub-elements	**3.1 Roles & responsibilities**	No discernible roles and responsibilities	Roles taken up informally or not at all	Roles are defined with guidance on the responsibilities under each role	TI actively encourages the assumption of roles	Adherence and guidelines are monitored and assessed	Assessments are reviewed regularly for optimisation of roles and responsibilities
	3.2 Online presence	No online presence	Inactive online presence	Active online presence, both personal and academic	TI encourages and supports active online participation	Online academic engagement is measured	Decisions are informed by analytics of online engagement.
	3.3 Knowledge of wellbeing	No-existent	Limited knowledge of wellbeing	Sound knowledge and understanding of wellbeing as an interpersonal skill	TI encourages the understanding of wellbeing and provides support services	Knowledge of the ability to measure engagement and screen time	Continuously developing new skills to manage screen time and achieve a stable work-life balance
4 Learning, training & development: learning and teaching practices, methodologies, and delivery techniques, including staff training.							
Sub-elements	**4.1 Multiple learning modes**	Single learning mode available (analogue/ physical/ manual/ classroom) No digital learning is available	At least 2 learning modes are available (manual and digital)	A hybrid learning approach is encouraged by the TI	Multiple learning modes are available, and the learning approach is well-defined	Usage/ experience and outcomes of learning modes are measured	Learner experience and outcomes are used to review learning modes for optimisation.
	4.2 Learning strategies	No digital learning strategies in place	Ah hoc digital learning strategies	Digital learning strategies are encouraged	The use of digital learning strategies are well- defined and mandated in TI guidelines.	Adoption of learning strategies is assessed.	Assessment outcomes are leveraged for the optimisation of teaching and learning.
	4.3 Use of digital aids (usage)	No digital aids are used for teaching and learning	Digital aids are used on an ad hoc basis	The use of digital aid is encouraged by the TI	The use of digital aid is rewarded, and members are encouraged to utilise personalisation and intelligent features.	Usage is monitored and assessed.	Assessment outcomes are used for the visualisation and optimisation of teaching and learning.
	4.4 Continuous professional development	None of the CPD courses offered by the TI are related to DC	Some CPD courses on digital skills are available	CPD courses on digital skills are encouraged by the TI	CPD courses on digital skills are mandated as part of the TI regulations	CPD course experiences are monitored and assessed	CPD courses assessments are used to review and improve courses offered
	4.5 Learning support services	Support services are unavailable	Support services are available but unpredictable	Support services are readily available	Support services are well-defined and standardised.	Support services are monitored and assessed.	Service assessments are reviewed with a focus on improving services.
	4.6 Learner feedback loop	Learner feedback is not considered	Learner feedback is obtained informally	TI encourages learner feedback to be obtained	Learner feedback is obtained and used qualitatively	Learner feedback is quantitively managed and analysed	The learner feedback loop is used to optimise teaching and learning, and the learner experience
	4.7 Digital mentorship	Digital mentorship is not available	Mentorship is informal	TI encourages mentorship	TI has a defined mentorship programme tailored to specific needs	The mentorship programme is monitored and assessed	Assessment data is used to make improvements to the programme
5 Resources, tools & content: used in teaching and learning and running the administrative aspects of digital education programmes.							
Sub-elements	**5.1 Digital tools (hardware)**	No digital tools available for teaching and learning	The availability of digital tools is unpredictable	Sufficient provision of digital tools and TI encourages usage	Use of digital tools standardised and embedded into the curriculum	Usage of digital tools is measured and controlled	Data used to influence scheduling, planning and acquisition decisions
	5.2 Digital resources (software)	Insufficient digital resources	Digital resources available	TI encourages the use of digital resources, both generic and subject-specific	Digital resources are standardised and embedded into the curriculum	Digital resource availability and usage is monitored and controlled	Feedback is leveraged to ensure continuous availability and utilisation of relevant resources
	5.3 Procurement considerations	Digital capability is not considered during procurement	DC is considered on an ad hoc basis in procurement decisions	TI encourages DC input into procurement decisions	DC has a formal input into the procurement process	The procurement process is quantitatively managed and decisions based on DC needs	Data analysis and data visualisation are used to improve the procurement process.

	5.4 Content (learning material)	Content is manual/ No access to digital content	Hybrid content (manual and digital)	Digital content is available, and TI encourages the use of digital learning materials.	Digital content is organised and easily accessible according to TI content standards/ guidelines.	Content is managed using quantitative measures.	Content optimised based on quantitative measures.
6 Individual Skills: the range of personal, technical, and digital competencies required to support stakeholders in developing their personal capabilities.							
Sub-elements	**6.1 Interpersonal skills**	The TI pays no attention to interpersonal skills development	Interpersonal skills are developed on an ad hoc basis	Interpersonal skill development is offered and encouraged by the TI	Interpersonal skills development is well-defined as part of the TI standards/ guidelines	Interpersonal skills development programmes are monitored and controlled	Results of monitoring are exploited to drive improvement
	6.2 Information & communication literacy (Digital skills)	No attention paid by the TI to digital skills	Digital skills are developed on an ad hoc basis	Digital skills acquisition is offered and encouraged by the TI	Digital skills are recognised and rewarded as defined in TI standards/ guidelines	Digital skills programmes are monitored and controlled	Results of monitoring exploited to drive digital skills development
	6.3 Disciplinary knowledge	No attention is paid to disciplinary knowledge.	Disciplinary knowledge is developed on an ad hoc basis	Disciplinary knowledge acquisition is offered and encouraged by the TI	Disciplinary knowledge is practised and regularly developed as defined in TI standards/ guidelines.	Disciplinary knowledge is monitored and controlled by the TI	Results of monitoring are used to drive motivation techniques for disciplinary knowledge acquisition
	6.4 Pedagogical skills	No attention is paid to pedagogical skills.	Pedagogical skills are developed on an ad hoc basis	Pedagogical skills development is offered and encouraged by the TI	Pedagogical skills are practised as defined in TI standards	Tutors' pedagogical skills are monitored and controlled by the TI	Results of monitoring are used to drive pedagogical skills development
7 Digital Identity & Wellbeing: the sense of belonging to a safe and secure institution where individuals feel free to communicate, participate and work towards achieving personal development goals while maintaining a healthy work-life balance.							
Sub-elements	**7.1 Wellbeing**	Non-existent	The concept of wellbeing is acknowledged but not defined or controlled within the TI.	Wellbeing is understood and encouraged by the TI.	Wellbeing is well defined and included in institutional policies and guidelines.	Wellbeing is monitored and controlled.	Reports on learners' physical and psychological well-being inform policies, guidelines, and procurement decisions.
	7.2 Support	No support available	Ad hoc support services are available	TI provides and encourages support services	Support services are defined in the TIs strategy	Support services are managed, and service and outcomes are monitored and controlled.	Support services have improvement targets and use data analytics to support their services.
	7.3 Psychological safety	Psychological safety is not considered.	Psychological safety measures are introduced on an ad hoc basis	Psychological safety measures are encouraged but not consistently applied	Psychological safety measures are consistently applied across all areas of the TI	Psychological safety measures are monitored and controlled	Learner experience feedback is leveraged to improve psychological safety measures
8 Creation & Innovation: those elements that support design innovation and the creation of new ideas and approaches and support the creation of digital media and content.							
Sub-elements	**8.1 Innovation culture**	No innovation culture exists	Some evidence of an informal innovation culture	TI fosters an innovation culture in which innovations are encouraged & supported.	TI has a well-defined innovation culture embedded into the institutional culture and policies.	Innovation culture is quantitively monitored and controlled	Survey data is used to improve the innovation culture
	8.2 Content creation	No digital content creation (manual only)	Hybrid content creation with manual and some online content available	Online content creation is encouraged by TI	Online content creation is recognised/ promoted in line with TI policies	Online content creation managed and assessed	Assessments are reviewed for optimisation
9 Collaboration: collaborative working, learning, and teaching activities, methods and strategies are driven mainly by cooperation and participation and facilitated by infrastructure.							
Sub-elements	**9.1 Collaborative working**	Online collaborative working is not available	Online collaborative working ad hoc	Online collaborative working is encouraged	Collaborative working is well-defined in the TI teaching, and learning guidelines and adherence are rewarded.	Collaborative working is monitored and analysed.	Analysis outcomes are reviewed to improve collaborative working tasks and processes.
	9.2 Collaborative learning	Online collaborative learning is not available	Online collaborative learning is ad hoc	Online collaborative learning is encouraged	Collaborative learning is defined in teaching and learning guidelines and embedded into academic activities.	Collaborative learning is measured, and outcomes analysed	Analytics are reviewed to optimise collaborative learning activities and processes
	9.3 Social networking	Social networking for academic purposes is non-existent	Ad hoc use of social networks for academic purposes	The TI supports social and academic networks	TI actively promotes standardised engagement in academic and social networks.	Engagement in social networking activities for teaching and learning is monitored and controlled.	Monitoring data is exploited to optimise social networking for academic purposes.
10 External Environment: the socio-economic and socio-cultural factors of the environment in which the institution is physically situated (city/ country), including the role of government agencies.							

Sub-elements	**10.1 Role of government agencies and ministries**	Agencies and ministries do not assume their role in supporting the TI	Agencies and ministries take some responsibility but do not assume their full role in supporting the TI	Agencies and ministries generally assume their role in response to circumstances and often require motivation	The role of government agencies and ministries is well defined and aligned with the institutional policies. Agencies and ministries are fully committed to their role of supporting TI	The commitment of government agencies is measured and reported by the TI	A harmonious relationship exists between ministries, agencies, and TIs
	10.2 Access to external interventions	Seldom external investments and little knowledge of how to access intervention support.	Infrequent external investments from the public and private sector	Intervention support with no continuation plan	Intervention support with a clear long-term continuation plan for sustainability	Measured intervention support and future requirements	Intervention support is allocated to areas needed to ensure maturity
	10.3 Consideration of external factors	External factors are not considered by the TI	The impact of external factors is acknowledged	The TI understands the impact of external factors but has no formal plan of action to overcome the issues.	The impact of external factors is formally identified as part of risk factors in a strategic plan. [Social and cultural issues are addressed in the TI's learning culture].	Progress against the strategic plan is measured, and TI has a clear vision of what is controllable.	Progress against the strategic plan is reviewed, and outcomes are used for regular audits. Internal institutional culture is embedded into all aspects of the TI.

Guidance Notes for Adopting the DCMiTI Framework

Digital Capability Maturity in Tertiary Institutions (DCMiTI) is the extent to which a Tertiary Education institution's culture, policies, and infrastructure enable and support digital practices.

This proposed **DCMiTI Framework** is based on the Capability Maturity Model Integration (CMMI®) principles and is designed to assess the ability of Tertiary Education Institutions (TEI) to deliver Digital Education.

There are six progressive stages of maturity running from Level 0, indicating the Institution does not have the capacity to deliver digital education programmes; through to Level 5, where digital practices are established and in a state of constant optimisation.

The Framework consists of 10 **domain elements**, each comprising multiple **sub-elements**. The stages of maturity are accompanied by **level descriptors** indicating the key achievement at each stage of maturity; more detailed level definitions support these. **Meta descriptors** then detail the criteria that must be satisfied for each sub-element for each level to be attained. A complete glossary defining all the terms used in the Framework is available.

Before an institution can adopt the **DCMiTI Framework**, it must be configured to the organisational needs and peculiarities of the educational setting. The **assessment process** leading to a conclusion on the current level of a TEI requires the Institution to review each sub-element against the meta descriptors to determine if the criteria are satisfied and then assign a self-assessment rating to each sub-element accordingly.

The **DCMiTI TOOL** then combines the sub-element ratings to calculate a rating for the 10 domain elements and an overall Digital Capability Maturity rating for the Institution.

For larger institutions, assessments can be undertaken by different departments and collated at higher organisational levels.

The assessment outcome allows the Institution to evaluate progress toward its digital capability goals. Additional benefits of using the **DCMiTI Framework** are:

- Showcase the strengths of the Institution.
- Identify inhibiting factors to education delivery.
- Provide a roadmap for institutions aiming to improve their capabilities.
- Help mitigate risks.
- Support resource allocation decisions.
- Support the development of improvement strategies that prioritise vital areas.
- Provides the organisation with a CMMI based Maturity rating.
- Delivers a means for inter and intra-institutional benchmarking.

The Proposed DCMiTI TOOL

https://herts365-my.sharepoint.com/personal/zb17aaf_herts_ac_uk/Documents/BELLO,%20Zarah%20PhD/DCMiTI%20TOOL%20(artefact)/DCMiTI%20framework%20draft%200.9.xlsx

Appendix Z: Ethics Approval Notification for Study 5

University of Hertfordshire UH

HEALTH, SCIENCE, ENGINEERING AND TECHNOLOGY ECDA

ETHICS APPROVAL NOTIFICATION

TO	Fatima Zarah Bello
CC	Dr. Nathan Baddoo
FROM	Dr Simon Trainis, Health, Science, Engineering & Technology ECDA Chair
DATE	04/05/2022

Protocol number: **SPECS/PGR/UH/04959**

Title of study: Investigating the efficacy of a proposed DCMiTI Framework

Your application for ethics approval has been accepted and approved with the following conditions by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

Dr. Mariana Lilley 719128
Dr. Paul Wernick 714486

General conditions of approval:

Ethics approval has been granted subject to the standard conditions below:

Permissions: Any necessary permissions for the use of premises/location and accessing participants for your study must be obtained in writing prior to any data collection commencing. Failure to obtain adequate permissions may be considered a breach of this protocol.

External communications: Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Invasive procedures: If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and copies of your completed consent paperwork to this ECDA once your study is complete.

Submission: Students must include this Approval Notification with their submission.

Validity:

This approval is valid:

From: 04/5/2022

To: 31/10/2022

Appendix AA: Protocol for Study 5

Protocol for a Qualitative Study Investigating the efficacy of a proposed Digital Capability Maturity Framework for Tertiary Education Institutions

1. Introduction

An extensive review of academic peer-reviewed literature [1] identified existing maturity models in education and provided sufficient evidence to justify the need for developing a more comprehensive Digital Capability framework, specific to the CMM domain with emphasis on the roadmap to maturity.

Maturity models are used as evaluative and comparative basis for improvement, to derive an informed approach for increasing the capability of a specific area with an organisation. The review confirmed that academics, practitioners, and government shared a strong interest in the development of a DCMiTI model. Therefore, the goal was to develop a model specific to Digital Capabilities (DC) domain that would assist institutions in better understanding the complexities of capabilities and further enable the improvement of capabilities specific to the delivery of Digital Education in TEIs.

This study is the last in a chain of studies towards the development of a DCMiTI framework. To begin, I conducted a Systematic Literature Review (SLR) [1] to uncover the elements contributing to DCMiTI, followed by a series of empirical studies among UK [2] and Nigerian institutions to confirm the elements and the nature of their impact on institutional capability. I then utilised the outcome of all the studies to construct the first version of the DCMiTI framework (see attached), designed to support TEI wishing to develop their capabilities; specifically, their ability to deploy and deliver digital education.

The objective of this study is to gather experts' opinions on the reasonability of the proposed DCMiTI framework. The study aims to elicit participants' perceptions on the applicability and usefulness of the framework in supporting the continuous development of Digital Capabilities in TEIs.

I aim to establish as objectively as possible, some rationale as to how reasonable the proposed framework will be as a tool to support continuous development of capabilities by allowing institutions to self-assess their level of DC and propose steps towards maturity.

2. Model Construction

The proposed framework was constructed based on [3] where the main phases of constructing a maturity assessment model are described as: scope, design, populate, test, and deploy, as shown in

figure1. The three middle phases happen in an iterative loop until the outcomes of the testing is satisfactory for deployment, with each iteration adding more value and accuracy to the framework.

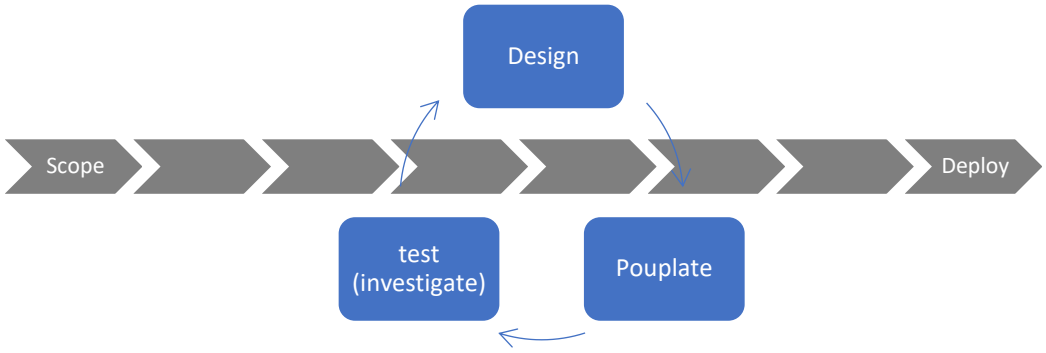

Figure 0-1: Model development phases

Th advantage of the model construction phases being iterative is that it makes it possible is that it is possible to revisit and make changes to decisions made in earlier phases. For example, the results of this investigation may show the need to further scope or the need to make changes to the design phase; this is what makes this last study so valuable.

The outcome of this study will satisfy the third objective of the overall PhD research work, and the fourth phase of the model development; by investigating the perceived usefulness of the proposed tool. The phase is called 'test' however, the duration of my programme is not sufficient for me to fully populate and test the framework, there I have opted to conduct a perception study to confirm whether experts in the field believe that the proposed model thus far is a reasonable proposal for the intended purpose. The methodology which I will be using to conduct this perception study is detailed in the section below.

3. Methodology

A qualitative investigation will be undertaken to collect data via a semi-structured online workshop. During this workshop, the proposed framework will be presented along with its envisioned mode of usage and experts (participants) will be asked to share their views and opinions of the framework.

Conversations will be guided by the following questions:

1. The proposed framework is intended as a basis for assessing the level of capability of a TEI. How reasonable is this framework in that regard?
2. Comment on the usefulness of the proposed framework towards developing DC in TEI.
3. Discuss the usefulness of this framework in supporting digital education programmes.
4. Do you have any suggestions concerning the current wording of the level descriptors (words used to describe the level0 to Level5 of maturity)?
5. Any other comments or observations?

4. Proposed data analysis

The study will employ a combination of both quantitative and data analysis techniques to provide a full qualitative result. The reason for using quantitative analysis will be simply to comment on the number of participants who provide similar answers. It is important to note that the target sample size for the entire study is quite small and therefore the quantitative data will not be as meaningful as the qualitative analysis, however for completeness I will do both.

The audio recording from the 2-hour workshop will be transcribed verbatim and the text will be used for content analysis. A multipart summative approach to content analysis will be used to analyse the workshop text and the questionnaire data for underlying meaning, repeating trends and relationships, finally the interpretation of this data will be used to justify the argument as to the appropriateness of the proposed DCMiTI framework.

5. Limitations of the study

As with all data collection techniques, there are limitations and possible threats to validity of the study. Identification of the potential problems that may arise in conducting this virtual workshop can be mitigated through knowledge and awareness making the host better able to deal with matters as they arise. Some potential issues that have been considered are:

- Safe space -being mindful of comfort to promote interaction and group dynamic
- Ensure the use of open-ended questions so as not to introduce bias
- Avoid leading questions – allowing participants to shape the discussions
- Avoid power differentials

6. Strengths of the study

I have researched several workshops methodologies and the lessons learnt from other researchers. Some of the matters that have been addressed in the design of this study include:

- Clear objectives to manage expectation and stay on point

- Providing invites with background information on the study before the workshops date
- Having clear tangible gaols and communicating them effectively
- Facilitation techniques
- A clear and realistic schedule

The study also has numerous strengths that if conducted successfully would make an invaluable contribution to the research effort.

7. Reporting

Upon completion of the analysis, the results from this study may be used to make changes to the proposed framework. The results will also be used to conclude arguments on the reasonability of the proposed framework. Matters which may arise that cannot be included in the research work due to time limitations, will be addressed accordingly in the future work section of the thesis.

8. Making changes to the protocol

There may be a need to apply changes to this document as the study progresses and in the event of applying these procedures in a different situation. While some of these changes will be useful to improve the current process as documented, other changes will be necessary to suite the context of the situation in which the protocol is being applied. All changes will be recorded, and the protocol will be updated accordingly using version control.

9. Dissemination plan

I plan to use the results of this study to make some changes to the proposed framework and then present it at a conference for peer review and feedback. The conference that has been targeted for this publication will be the Australasian Society for Computers in Learning in Tertiary Education conference (commonly referred to as ASCILITE). The conference usually takes place around December and is befitting for this study, because it is one of the leading conference s in technology in higher education and the source of many publications in relation to maturity frameworks.

Draft Invitation to participate

Dear Participant,

RE: Invitation to Participate in research project (Digital Capability Framework)

I am writing to invite you to participate in a postgraduate research study on developing digital capabilities in Tertiary Education Institutions (TEIs). Over the past 4 years I have investigated the factors affecting digital capabilities in TEIs and their impact on digital education. As a results of my research data, I have proposed a capability maturity framework aimed at supporting TEIs with continuous development of their capabilities, which would have multiple, positive knock-on effects.

To get practitioners views on the real-world applicability and usefulness of my research output, I invite you to a 2-hour workshop where I will present my proposed framework to a small group of higher education stakeholders and ask for your opinions and feedback.

Your contributions would be an integral part of my research output and the findings/ learning from the workshop will directly contribute towards the framework development.

Attached to this email are two documents, the first is a participant information sheet providing the detailed information you need to know about the study and the second is a consent form which you will need to sign and return to me by [date].

You are not obligated to take part in this study. If you do agree to participate you remain free to withdraw from the study at any time and may do so without any disadvantage to yourself and without any obligation to give a reason.

Thank you for taking the time to read this information.

Yours sincerely,

Zarah Bello

PhD Researcher

Email: z.f.bello@herts.ac.uk

Attachments: EC3 and EC6

Draft Thank you/ and framework for review

Dear Participant,

RE: Accepting the invitation to participate in research project (Digital Capability Framework)

Thank you for accepting the invitation to participate in my study. I look forward to working with you.

I have attached a copy of the proposed DCMiTI framework, along with a glossary of terms used. Kindly take some time to familiarise yourself with the content of the framework prior to the workshop.

What to expect during the workshop?

- A brief presentation of the framework
- Some detail about the intended mode of use of the framework
- Invite participants to have a free-flowing discussion surrounding the workshop questions
- Invite participants to share any other view or observations

Digital workshop date and time:

The workshop will take place via zoom on [date]. Click here for the zoom link [zoom link].

Finally, here is a link to an online questionnaire

If you have further questions, please do not hesitate to contact me.

Best regards,

Zarah Bello

PhD Researcher

Email: z.f.bello@herts.ac.uk

Attachments: Proposed DCMiTI Framework and Glossary

[First Email to participants]

[Dear Participant,

RE: Accepting the Invitation to participate in a PGR Study on Digital Capabilities

Thank you for accepting the invitation to participate in my study **'Investigating the Efficacy of a Proposed Digital Capability Maturity in Tertiary Institutions (DCMiTI) Framework'**. I look forward to working with you. Please see attached a participant Information sheet with additional details about the study.

What to expect?

Before the workshop:

- Complete a doodle poll indicating your availability between **Monday 23rd May – Thursday 9th June 2022**.
- Sign the attached consent form agreeing to participate in the study and return it to me (a scanned copy will be fine) before the agreed workshop date; this is an ethics requirement to ensure I have your written consent to record the zoom call and the data collected therein.
- Once I have confirmed a suitable date for all participants, I will circulate a copy of the proposed framework for your review.
- I expect that you will have reviewed the documents emailed to you prior to the workshop date.

During the workshop:

- The workshop is expected to last no longer than 1 hour.
- I will give participants a brief presentation and overview of the exercise that we will be conducting.
- Participants will be asked to 'rate' the Proposed Framework using a 5-point Likert scale.
  - The proposed framework is intended as a basis for assessing the level of maturity of a TEI. How reasonable is this framework in that regard?
  - How applicable is the proposed framework for supporting the development of Digital Capabilities in Tertiary Education Institutions?
  - How useful do you think the proposed framework would be in supporting the implementation of Digital Education Programmes.
- Participants will also be asked to comment on the current wording of the 'level descriptors' in the framework (the words used to describe maturity levels 0-5).
- Lastly, participants will be presented with an open-ended question allowing for additional comments and feedback.

Digital workshop date and time:

Please click the following link https://doodle.com/meeting/participate/id/ejR9ERye to indicate your availability over a three-week period. If none of the times I have indicated suit you, kindly send me an email with alternative dates.

After the workshop:

- Nothing more will be required of you.
- I will anonymise all the data so no response can be traced back to any individual participant.
- I will use statistical measures to analyse Likert values.
- I will transcribe relevant parts of the audio recording and use it alongside your additional textual comments in a content analysis.
- The outcomes of this study will be used to evaluate the usefulness and applicability of the proposed DCMiTI; and contribute towards the overall PhD research work.

I thank you in advance for your kind cooperation. If you have any further questions, please do not hesitate to contact me.

Best regards,

Zarah Bello

PhD Researcher

Email: z.f.bello@herts.ac.uk

[Second email to participants]

Host Guidance notes for DCMiTI Workshop

April/ May 2022

Schedule: 10am – 12noon

- 10 – 10.15am: (**15 minutes**)
- 10.20 – 10.40: Q1 (**25 minutes**) 25
- 10.45 – 11.05: Q2 (**25 minutes**) 25
- 11.10 – 11.30: Q3 (**10 minutes**) 10
- 11.30 – 12.00: Q4 (**20 minutes**) 20
- A.O.B (10 minutes)

Introduction:

- ✓ Aims of the workshop:
  - Gather feedback on the proposed framework to elicit its perceived usefulness
  - The value lies in the wide range of expertise and experiences
  - Responses will be used to calibrate the framework so that it is more useable in the real world

- ✓ If you consent, this interview will be recorded, although the recording will only be accessible by me. The reason why I would like to record, is so that I may accurately type up our conversation. After which, the audio will be deleted in accordance with ethics guidelines. EC3 should have been collected from all participants prior to the workshop

- ✓ If there's anything that you want to talk about off the record, please feel free to let me know and I can pause/stop the audio or will not transcribe this information. You are also free to stop the interview at any time; be it for a break or to end the interview process. You don't have to answer any questions that you don't want to.

- ✓ Do you have any questions you want to ask me?

- ✓ If you are happy to begin, I will turn the recorder on.

Start Recording

Thank you all for agreeing to participate in this activity. I hope you have all had a chance to go through the framework which I emailed and hopefully noted some opinions.

I will take a little time to talk you through a bit more detail about the framework, how it emerged, and the envisaged mode of use.

Then I will open the floor to your views and opinions on the applicability and usefulness of the proposed framework.

(**15-minute presentation**)

- 15 minutes to present
- I'll politely ask that if you have any questions or concerns about anything in presenting, if you note the questions on a paper and we can address them at the end, if they slot into the topic of our discussion, even better.

Now, the primary purpose of inviting you all here today is eliciting your views and feedback on how applicable and useful this framework will be. Since we have limited time, and need to keep the conversation focused, I will use 4 questions to guide our discussion.

Like I mentioned at the beginning, I have also allocated a set time for each question to make sure we get to cover them all. So, I'll put up queues we are approaching the end of our time.

I have also allocated some time at the end for A.O.B and I will ask you to help me fill out a short questionnaire at the end just to highlight the key points that stand out for at the end of our discussion.

Guiding questions

1. In your opinion, how useful do you think the proposed framework will be towards developing DC in TEIs?

2. How effective do you think applying this framework would be towards supporting digital education programmes?

3. Do you have any suggestions regarding the current wording of the level descriptors (the word used to describe the level of maturity 0-5)?

4. Any other comments and observations that may improve the framework?

Thank Participants

- ✓ Thank you for taking part in the study
- ✓ Moderator will reiterate what will happen to the information you've shared (i.e. how it will be analysed, anonymised, and added to the PhD project as well as how it will appear in presentation/papers).

Turn off recording

Questionnaire for DCMiTI Workshop

Question 1: Reasonability

The Proposed Framework is intended as a basis for assessing the level of maturity of a Tertiary Education Institution. (TEI). In your opinion, how **reasonable** is the proposed framework in that regard?

1	2	3	4	5	6	7
highly unreasonable	unreasonable	somewhat unreasonable	neutral	somewhat reasonable	reasonable	very reasonable

Question 2: Applicability

In your opinion, how **applicable** is the proposed framework for supporting the development of Digital Capabilities in TEIs?

1	2	3	4	5	6	7
highly inapplicable	inapplicable	somewhat inapplicable	neutral	applicable	somewhat applicable	very applicable

Question 3: Usefulness

In your opinion, how **useful** would the proposed framework be in supporting the implementation of digital education programmes?

1	2	3	4	5	6	7
highly un-useful	un-useful	somewhat un-useful	neutral	somewhat useful	useful	very useful

Question 4: Given that Level Descriptors are short labels summarising the definitions in Table 1 and intended to indicate the key achievement at each stage of maturity:

Table 0-1: maturity level definition for the proposed framework

Maturity Level	Description
Level 0	Digital Education is not possible. There are generally insufficient facilities to support the process.
Level 1	Digital Education is possible but inefficient. Practices are ad hoc. Tools and services are unpredictable. The value of digital skills is unrealised.
Level 2	Digital Education Programmes are stable. The value of digital knowledge and skills is recognised. The TI encourages digital skills and practices. Services and maintenance are often reactive.
Level 3	Digital services are standardised with the availability of policies and guidelines that support the smooth running of digital education. The TI actively promotes the use of digital tools and skills (e.g., Through recognition reward schemes). There is a focus on the development of digital services and skills.
Level 4	Digital programmes, services and facilities are quantitively measured and controlled. Stakeholders expect to locate knowledge, policies and guidelines related to digital practices, and the concept of digital Wellbeing is woven into policies. Usability becomes a consideration in resource acquisition. Tools and equipment are easy to use, with user manuals and instructions. Management stakeholders demonstrate commitment to digital practices, and digital policies have detailed implementation plans.
Level 5	Digital Maturity is continually optimised through data analytics and visualisation. An established assessment feedback loop informs decision making. Tools, resources, and processes are continuously and regularly updated.

In your opinion, which *one* of these **level descriptors** best describes LEVEL 0 of maturity?

- Not possible
- Not available
- Not considered
- If other, please specify: _____

1) In your opinion, which *one* of these **level descriptors** best describes LEVEL 1 of maturity?
   - Possible
   - Ad hoc
   - Unpredictable
   - Reactive
   - Poorly controlled
   - If other, please specify: _____
2) In your opinion, which *one* of these **level descriptors** best describes LEVEL 2 of maturity?
   - Often reactive
   - Encouraged
   - If other, please specify: _____
3) In your opinion, which *one* of these **level descriptors** best describes LEVEL 3 of maturity?
   - Proactive
   - Practised
   - Defined
   - Standardised
   - Procedures in place
   - If other, please specify: _____
4) In your opinion, which *one* of these **level descriptors** best describes LEVEL 4 of maturity?
   - Managed
   - Measured and controlled
   - Quantitively surveyed
   - If other, please specify: _____
5) In your opinion, which *one* of these **level descriptors** best describes LEVEL 5 of maturity?
   - Optimizing
   - Stable and flexible
   - Continuous improvement
   - If other, please specify: _____

Question 5: Do you have any other comments or observations that could improve the proposed framework?

Answer:

Question 6: How might you envisage using this DCMiTI Framework in your institution?

Answer:

Appendix AB: Transcripts from Study 5

Transcription of DCMiTI Workshop 1

Date: Monday 30th May 2022

Time: 12noon – 1pm

Note: Prior to the workshop all participants received a documentation pack with the proposed framework, glossary, guidance notes and the polling questions that would be asked.

[Start of recording]

ZB: [Workshop started with a brief presentation to put the proposed DCMiTI Framework into context].

ZB: I'm happy to take any comments or questions at this stage before we go on the evaluation exercise.

P1: I don't have any questions.

P2: May I ask a question?

ZB: yes

P2: So, I believe that this Framework you proposed is something that is kind of related to the literature research. For example, there are this TASDO and other frameworks or technology acceptance models in the literature. Have you considered them? Have you compared them? Or have you used them in some way applied to your research?

ZB: Yes, I have. Not really introduced them into my own work but I considered them at my literature review stage. The closest model to one that I have proposed is the Digital Capabilities Framework, which is not really an academic undertaking. It's more of a… I mean it's used in many universities but when I tried to find empirical studies that support why they are using the domain elements that they are using to measure capabilities, there was really any academic backing to these things. Empirical … Some of the elements that I have identified do overlap with existing models……

P2: I actually have several questions because one of my PhD students is doing similar work. But I think the main purpose of this workshop is not to judge your work but to help you.

ZB: I'm happy to take additional questions but well do the evaluation exercise and then if you have any additional questions, we can do that at the end.

P2: yeah, but I have to leave at 12.55 pm, I'm so sorry I have another 3hours meeting from 1-4, so I have 5 minutes to prepare for that, so I have to leave at 12.55. and I'm so sorry for my late attendance yeah. Ok, carry on.

ZB: ok so I'll go onto the polling exercise, you'll have to bear with me this is the first time I'm using zoom polling.

[Conducted polling exercise. Read Questions out loud:]

P1: some of these groups are very similar and can be merged together, I know we will discuss this later but I'm saying it now.

[still polling]

ZB: great! So that brings us to the end of the polling. I will just switch back to the presentation screen. So, thank you very much for filling out the polls. Now, are there any… or rather what prompted you to answer the way you did? If you indicated the framework was reasonable, what makes it reasonable?

P1: do you want me to start? I thought that the framework is somewhat reasonable which I think I number 5 and the reason for that is, that I think it's a valuable FW and it makes sense in terms of the categories that you used for qualifying variables capabilities. However, I think that it is over complicated and from that perspective, it usually links to… I mean reasonableness and applicability are kind of very similar categories as well, there is some overlap there. I think is why I put for applicability its somewhat unapplicable because its overly complicated. You really need to simplify this framework. If you look at the frameworks that are used in the IT industry like Prince2 Agile even CMMI and ISL Frameworks, they have far less initial categories and descriptors and one of the characteristics of a good framework

is it should be simple enough to be used otherwise people will simply switch off and won't use it. So you have to sell it, first and foremost sell its usability otherwise what's the purpose of the framework if no one is going to accept it.

I think also reasonableness is also about the meaning of all these different categories and there is a certain overlap in various descriptors for example when it comes to wellbeing, you have wellbeing dotted around various places etc. so I think what I would suggest Is that when you look at this top categories, that you try to think of an existing framework such as you can start off with a definition of information systems, people, processes, technologies, organisation ok. And try to kind of push these various sub-themes through that filter, rather than having ten top categories. Then also when it comes to the values if you look at the existing frameworks, such as CMMI, they have 5 values, you included 0 and I'm not seeing any reason for having a zero category to be honest.

Also, you should think about when you look at the sub-category and the sub-themes not also sub-categories need to have all 5 values. Otherwise, you're forcing yourself to come up with some artificial qualifiers, explanations or whatever. Some could have only 2 or 3 values rather than 5 and so on.

My final comment is for the final 2 categories, they are very similar. I don't see a big difference between 4 and 5. And I think there is a top category missing. So you could merge these 2 and add something that is above that and it should have more to do with a kind of leading role and I don't know. It's your job to come up with that but I think there is a place for an additional category there and you could do with merging these two.

Too much I know, but you asked us to read all these documents and think about it, so I did!

ZB: it's not too much at all. Thank you!

If I could just comment on the last 2 categories… distinction between 4 and 5 …..

P1: I see your point, but I would argue that we are beyond that point and organisations understand that the data they are collecting are there to be used. So, they are not just repository of data. For those organisations out there, that are putting them near the top, it's too far. In other words, I think that everybody is collecting the data and many organisations that are collecting the data are actually using them for something.

ZB: just a reminder that the framework is actually targeted for… I mean the first section of my research was quite general and conducted it in the ok, but the larger part of the work was in Nigeria.

P1: yes, I understand.

Actually, I think they are relatively less advanced in terms of their use and collection of data. So, if the framework was targeted at TEIs in Nigeria, then I think the differentiation means a lot more to those institutions that are probably not as advanced in their digital awareness as those institutions here in the UK.

P3: I can say something. I 100% support a simplified framework. A little bit less huge. So, I work with international partners, so I do know a lot of the capabilities of our partners. So I have partners in Trinidad and Tobago, I have partners in Pakistan, Indonesia and also in Singapore and Kenya. I fully agree that the realities in terms of digital capabilities, data analysis, data use is very different to our own in the UK. So I think that there is definitely a niche for this framework but it is extremely complicated for me who doesn't necessarily have a background other than the education background and managed a supported distance learning programme.

I think simplifying the framework would definitely be for me, useful in a sense because I would then be able to use it but also I do understand where you are coming from and where you are putting all those different sections together because one thing is what I do here. One thing is what my international partners do in their institutions and it's very different sometimes.

I think there is definitely a place for the framework but yeah. Also, another thing you may want to consider is whoever is doing it, I really see that as a bit like an audit tool more than anything. Whoever is doing that audit or the group of people who are doing it, there is always going to be a little bit of bias because they will be the ones doing in t on their organisation. Whereas if it's done by somebody outside there is probably a bit less bias on the application of the framework so maybe account for that if you haven't done so. So that's my take.

ZB: thank you!
I think that touched on reasonability, applicability, and usefulness.
Ok great! So P2 do you have any other comments that you would like to make with regards to any of those key questions of how reasonable, applicable or useful the framework may be?

P2: I actually agree with P1 and P3, it's very complicated. I'm just thinking about how to evaluate at the end of your research. Such a framework, so complicated and maybe not that conventional compared to other frameworks or models in the research literature. So, you need to make it comparable to others so that we can actually evaluate the results of your work, and of your framework. That is the only point u want to raise. Thank you.

ZB: ok so that last question I wanted to ask which is even more relevant now because of the general consensus on how complex the proposed framework is. I didn't want to share how I envisage using the framework so I wouldn't influence your perceptions. So, how do you actually envisage using the framework?

P1: ok, so shall we go in the same order then? Or do you want P2 to go first because she needs to go?

ZB: oh that true.

P2: errrmmmm. I don't have much idea about this, to be honest. I'm sorry.

P1: I first want to talk about usefulness, I didn't come to usefulness in the first expose at the start.
I think a framework like this will be very useful and I second P3 in her opinion on this. So I think you're doing very potentially useful and valuable research for the community. But I think you do need to go through a second iteration of refining this framework and making it more usable.
With regards to how this framework could be used, you know as with any other maturity framework you would be using it as a diagnostic tool first. I mean you demonstrated that in a way. And then those descriptors would tell you what the next step is you could achieve in a certain point in time. In the next step of development and you know what are the activities that you or the organisation need to take to get to that level.

P3: that's exactly my thought as well, so I use that tool as a diagnostics or audit tool let's put it that way. As a starting point to then develop something, in particular, to make sure that the organisation then develops their capability, so if they are at a certain level, then they know what to do in order to progress as well because you do provide that guidance within that tool. So it will be a bit that an audit sort of thing but also with a strategic direction as to where they need to go. So that would be my take.

P2: [P2 excited the zoom call @ 12.55pm]

ZB: ok great! I think you are aware that at least one more iteration to this and refining it. I am also sure that you are aware of the danger of creating artificial qualifiers just to fill in spaces because you decided to have 5 or 6 categories and have to put something in each of these although it's not kind of natural if you know what I mean.
Perhaps its better to start with less values and less categories and expand if you need rather than have a lot of spaces your trying to fill in.

ZB: brilliant, thank you. So I think that pretty much everything on my part. Thank very much for taking the time to join me and reading the documentation beforehand.
[Summary and thank you].
Thank you. Bye-bye
Thank you. Bye

[End of call. End of recording.]

Transcription of DCMiTI Workshop 2

Date: Wednesday 1st June 2022

Time: 9am – 10.30am

Note: Prior to the workshop all participants received a documentation pack with the proposed framework, glossary, guidance notes and the polling questions that would be asked.

[Start of recording]

ZB: [Workshop started with a brief presentation to put the proposed DCMiTI Framework into context].

ZB: I'm happy to take any comments or questions at this stage before we go on the evaluation exercise.

P1: I've got quite a lot of comments but I don't want to monopolise so let's go with your structure of what you want us to do next.

ZB: So, I didn't want to talk at you the whole time, so I thought I'd give you a chance to say anything if you wanted to now, but there will be another opportunity later on so do.

P1: Shame there is no chair here because I could talk too much, but we could always talk afterwards anyway.

ZB: So, I am going to share my slides again.
Now the evaluation exercise is really to elicit your views and opinions so we'll conduct the polling and then we will have discussions around why you've selected the answers you have.
[**Conducted polling exercise. Read Questions out loud:]**
P1: can I just ask you; this is about the entire framework. All levels, every description, everything. Do you just as a matter of interest do you have a set of assumptions because I think for me having worked in Ethiopia abit, in Addis, for me, the infrastructure is just so key. And I've noticed even on this call there has been some people dropping out and in and in order to… no university is an island! In order to start even start assessing the assumption, there is some kind of infrastructure there that's fairly reliable. It feels a little bit like a switch, like its on or off in the framework, when its gonna be fragmented, probably unstable and it's gonna be intermittent.
So how does your framework address the issues of the unstable environment that so many universities find themselves in, which is almost like you know in order to be judged you need to be there. And sometime sits totally outside of the control of the university itself.

ZB: yeah, that's an excellent question. I do have a working set of assumptions but aside from that I also have a very tight scope aswell. So there are certain things that sit outside of the scope of the framework, mainly things outside of the scope of the framework….[quite alot].

P1: Yeah like you said if you can scope it and make those assumptions very clear. I just feel its going to so disadvantage some universities. I'm just aware of the ethics of universities that might be struggling already, through no fault of their own.
Because you know the CMMI, I mean obviously its been used in different areas but it tends to be a choice ting where companies can invest or small companies have issues but they can still have a smaller version of that. So, I'm wondering maybe something for the future might be that you have different levels for different budgets, different political situations or whatever because what we don't want to do is make some universities feel even worse. I think its generally a great idea but I suspect the west with lots of budget and good infrastructure before they even start assessing are going to be at a quite high level but yeah anyway.

ZB: One of the things I noticed in my field work was that a bit similar to the example in the tool was that there were some areas of capabilities for an institution might score a 4 lets say, but overall they would only score a 1. So they would have smart board sand really high tech equipment but yet in the same institutions there would be any light and its sort of a case, well perhaps if you were to assess yourself

P1: And training as well. You can have all this equipment and no one to train people. I thin that was part of your framework training, wasn't it.

ZB: yes, it was, exactly.
[ok so back to poll. I've only has 2 responses out of 5. Just to remind you….]

P2: Ok, I have one question Zarah. Have you considered the continuous representation of CMMI? Rather than going through level 1 to level 5, in the continuous representation, the people get more freedom to pick and choose the areas they want to improve.

ZB: I actually didn't. I did not! And that a great question. I didn't consider the continuous representation and I think the reason for that was that at this stage of the framework this is the first draft and I want to believe in the next iterations it could be kind of narrowed down and some of the rules I'm using to assess the maturity could be tweaked depending on my findings from additional field work. But also, I think that's a case of the institution itself based on what their requirements are an institution wishing to use this framework would kind of configure it to their individual needs. So I think at that point that would be a good time to introduce the continuous representation.

P2: Just like you have shown the excel sheet, ok. So like this could be one possibility like they can check their maturity with respect to continuous representation and with respect to maturity level 5. You mentioned that one example they can be in level 1 ok, but at the same time they should be able to check which areas they have already improved, and which areas need to be Improved in the continuous representation.

ZB: ok thank for that comment, it will be really helpful for me to incorporate that in the next iteration of the work because it will be nice for them to be able to see what they have already improved on.

P1: I mean I totally agree with what P2 has just said. I mean having worked on the CMMI and doing this sort of maturity model myself, a major criticism, certainly in software engineering is that, that's not how life is. You don't have all your processes in level 1 and then go to level 2, it's absolutely a pick and mix of various things. Some things are dependent definitely, the overall concept is you can't improve without knowing where you are, so there is an implicit hierarchy going up. But within those steps, you can be very mature within 1 stream. It's interesting actually to make that comparison, so that might be a viva question you get: what is the difference between your standard CMMI type models and your model? There were actually a couple of other questions that I will bring up about that later.

P2: Or even Host you can go with the domain one. You have 10 domains I believe you mentioned yea?

ZB: Yes

P2: So you can also check which domain is the strongest maturity in that domain and which domain needs more work and this kind of thing yea ok.

ZB: Yes, thank you!
[**Launch Polling for the second question**]

P1: So maybe this is the time to ask my other questions which is about scalability. I couldn't spot anything about scalability. Have you got scalability there? Did I miss that?

ZB: No, you didn't miss it. It's not there, I haven't mentioned it.

P1: The reason I say that is you could be, certainly at the very higher levels as well… just working at Hertfordshire for example with very very large classes suddenly you find that the infrastructure is not great. So it can be fantastic and then suddenly you get another 1000 students or you want to create more than 100 groups or you want to have a zoom call be lots of students able to participate and there are limits and limits. Suddenly you find there is lots of limits, so I would absolutely recommend that you have something called scalability there just only that… I'm not talking about Nigeria and Addis Ababa now I'm talking about just generally. This is very generic now. I don't know if anyone on this call has suffered from this lack of scalability with our digital processes but it's not been good for us. But suppose that's just with thinking of a successful university with lots and lots of students but the digital has to keep up.

ZB: Yes the digital has to keep up. And I think that part of level 4 and 5m the distinction between those 2 levels.

P3: What Sarah has said is very valid. In my university, we have large classes. Very very large classes and you find that without looking at the scalability and then looking at competent technicians to resolve

issues when they arise it is a big problem. So I want to believe what she said is valid and you should look into that seriously.

ZB: ok thank you.
So back to polling quickly.
[Continue polling exercise]

P1: When we talk about scalability then balance that with redundancy in other words you don't want to necessarily have all the bells and whistles and all the expense of having the expense of just in case so it's not straightforward as let's have the fantastic Infrastructure. Let's re-invent zoom so it can take more people. And let's make Canvas extended to however many 500 groups, we've got very large classes but that may not be necessary at some other universities and that would be an unnecessary expense. So that was the other thing: budget I wanted to ask you about budget. Anyway ermmmmm. Were onto usefulness.

ZB: yes onto usefulness. We'll come back to budget. Well just get through the polling questions just because I'm conscious of time. And then we can have the remainder of the time to continue discussing.
[continue polling]
[polling the wording of level descriptors]

P4: Can you share those levels on the screen?

ZB: Yes I can if you just bear with me while I bring it up.
Has that come up?

P4: fine
[continue polling]

P1: do our names come up with this I can remember.

ZB: They do! It comes up as a spreadsheet for mem then once I have put all the results together, I will anonymise them.

ZB: so I'll go on to the next question, which is asking for any other comments or observations you might have?
[continue polling for open-ended questions]

P1: Do you have a concept or because I do a lot of work in global communications and remote. So do you, a lot of what you're talking about with the digital is I suppose forms of communication in a way as well as just supporting people who are there but given the experience of covid and everyone going remote did that change your view of what's important or not in terms of the kind of digital infrastructure and equipment that we all need in the universities to keep going.

ZB: I think post covid since covid 19m mostly I think its highlighted the need to have this auditing or self-assessment tool so that you could see the area of strength and weakness because I did my data collection the same year covid started so I had finished collecting my data before the pandemic fully kicked off. With that said I think still part of the key issue is allocating a lot of resources in one area and completely neglecting the other areas.

P1: I suppose what highlights for me and I don't know the research areas of my other colleagues here I know that P3 has done a lot in this area and I just feel it's so critical, the communication and the coordination stuff. So, if you're lecturing how do you know you're conveying the information and how do you know the students are receiving it. And there is something called Media synchronicity theory that I think you might be interested in where it talks about conveyance and convergence of information. And it's about synchronous and asynchronous types of communication. I mean I don't want you veering off into another thesis, but I think it might just be something to look at.

ZB: Yeah I'll definitely have a read of that: media synchronicity theory?

P1: Yeah I think. I certainly felt, well I don't know whether any of you did any remote lecturing but you're not quite sure whether even anyone's there a lot of the time. No one has their cameras on so I just feel there might be a need for that.

ZB: I think, I think a lot of classes that I have attended lately use online feedback during the session to record student feedback because a lot of the time if you give it out ask them to return it they don't. Face to face they are not necessarily that comfortable telling you how they feel about it but I've

noticed lecturers using online or mobile apps to record how well students understood the session and how it was to follow etc, so I thought that was brilliant because it gives the tutor feedback on what they can improve and it gives you a bit more confidence as well just knowing how well the information was received.

P2: one more question Zarah, for the assessment, how did you calculate different scores and all those things?

ZB: So, I used the median values for individual assessment.

P2: Like which score you have given fully achieved or partially achieved. Like that kind of score, you have given?

ZB: no, so it's literally a yes or no. is the condition satisfied, is it not satisfied.

P2: so one of the things here is like, so if somebody says yes are you collecting any evidence for that yes as well? Otherwise, somebody can say yes yes to everything to get the highest maturity for their institution.

ZB: yeah, so this is kind of the next question I mean I do have an envisaged mode of use, so I have a use case of how I imagine an institution might use it but I was a bit cautious of sharing with you all because I didn't want to influence your responses. So that's the next question but I do have an idea on how that might be solved, and it would be in the instructions on how to apply the model.

P1: The other thing that I wondered about was your 'Noman cloture' – how the CMMI describes the hierarchy of goals so we have specific goals, specific practices, we have specific key process areas starting at the top. I had to look these up because I couldn't remember I've got a very bad memory. And then practices, sub practices, recommendations. So, you have this kind of breakdown, so I just wondered if you're going to sort of fit into that frame or whether you have that kind of idea of breaking things down from top to bottom like that kind of branching.

ZB: branching off. Yes! So I've tried to as much as possible kind of break it down even in the model where you can kind of see the main domain elements and then the sub-elements and then the criteria and that's as much as I've decided it into areas.

P1: yeah, I just would caution you that if your going to follow a framework that's very established and a lot of people have used them in different areas that you stick to the standard terms that are used in the CMMI models. Don't create new ones.

ZB: I mean I did look at the eMM. Is that in terms of the descriptors where they've improved etc…

P1: Well, no sorry. Not about the descriptors about repeatability. No, I'm talking literally about the placeholders so seeing it as a model if it were. Which is what this is, this is a model and as a model it's very strict nomenclature. It has its terms for key process areas, whether you see it as a continuous model or not, it has these areas it has specific goals and specific practices so I'm just saying if you start to break it down try and follow that. Because I kept kind of thinking of I don't really like these terms and then you know I was working with other people who had… and they said no stick to it, stick to it.

ZB: yeah, I mean I suppose I've looked at a couple of other maturity frameworks like the eMM and the knowledge management maturity model and they tend of contextualise it to the domain area that is being focused on so because there isn't really a Digital Capabilities framework documented in literature that is specific to education the closest thing I found was the eMM and then there is the digital capabilities framework that in most universities in the UK isn't an academic endeavour I tried to reach out to them to get an understanding of ermmm… because it's quite different from the eMM it's a CMMI based framework. So, I'm looking at the two as my closest references for what my research is based on, but I will be cautious.

P1: I was expecting to see the key process areas, goals

ZB: what you're calling the key process areas are my domain elements because we're not looking at processes.

P1: yeah that's true you're not looking at processes.

ZB: it was difficult to say these are the key process areas when not all of them are processes some of them might just be resources, do you have it or do you not, so it varies from people, process and equipment.

P1: we definitely have an unstable connection here, poor guy.

ZB: definitely.
Ok. just waiting for one more person to submit [continue polling, the last question].

P2: Zarah, in this thing you need to consider a few things for this question, I'll write my ideas as well ok. One thing about this model is whenever you are assessing any institution so it should be done by a team of people not one person ok so that we can control the personal bias in that so the score should be given by a team of 4 or 5 people you can decide. And the important thing which I mentioned before is that, if they are selecting anything yes, they should provide evidence for that.
Ok should have something in your model so you can judge, otherwise, it will be very difficult. Just like in CMMI when you get the accessors come to your organisation, they conduct interviews with you and they do the scoring of partially achieved fully achieved not achieved. But they also ask you to show them the documentation then based on the documentation they decide that this specific practice is partially achieved, fully achieved or not achieved at all ok.
The other things is that is there area in your model that is not applicable as well.

ZB: So there will be and I think the model will need to be configured to the institution and the area in which it's being used and that way you'll be able to kind of remove or skip the areas that are not applicable.

P2: so some flexibility should be also there ok.

ZB: yeah ok. Thank you

P1: Yeah, I totally agree with what you're saying about… to make it usable and useful I think a set of stakeholders should be involved including students, management tutors, new staff, mature staff and allow the option for staff to add additional areas that might be important for them but you might be missing. One of the ideas of the CMMI was that supposing you are looking for a company… it was about predictability right; you can spend millions on a contract, and I don't know whether I'm going to get anything back that's useful. So it was way of measuring the likelihood of you spending a lot of money on getting some software developed that's likely to get something back. So its about predictability and comparison across universities and that goes back to someone else's comment on yeah you can just make it up. So, I think there need s possibly be clever questions where you actually have evidence for your answers. So make it as tangible as possible. So you know how many times has your internet not worked? How long… you know have sort of a mix of questions where you cant really make it up. And you can't really say yeah yeah great fantastic!
I mean it is a normative model, so it's not specific its very general and the idea of that generalisability is so you can compare across multiple institutions. So bare that in mind that… I mean it might become something that the Times Higher education want to put in and say yeah look this a great university they have invested a lot in digital and that's going to be helpful for the students.

ZB: its about finding that balance isn't it, between being general enough but specific enough to get the job done.

P1: Exactly, you know the problem!

ZB: Just waiting on one more response and that will be the end of the polling questions.
[polling ended].

ZB: Just to summarise the polling. All your responses will be anonymised before analysis. So none of your responses will be traceable back to yourselves.

P1: Have you tried doing this poll at your own university. Have you done that?

ZB: yes, I have

P1: Well you don't have to tell me what the results are [laugh out loud].

ZB: oh well, the responses were quite positive, I did have a couple of neutrals but the advantage of being able to discuss people's responses was that I was able to discuss why they were neutral on their opinion to certain things. I didn't have any participants who said its not useful at all. I think its just a case of a few more iterations.

P1: I did wonder like a lot of these things it might be a useful tool in itself for discussion yes.

ZB: yes. You mean management discussion?

P1: No, I mean amongst all stakeholders, and I think a lot of these things have multiple uses and I think that might be one not just to assess but to discuss. Yeah and hopefully act on it but you never know, do you!

ZB: well at least the information there.

P2: yeah

P1: yeah so I think it's got lots of potential so yeah, well done!

P2: what we do Zarah, with our students, like we normally as them to use this model in the real world as an example as well. Most of our students they do case studies basically they choose few institutions. Organisation and they give them a quick training on the model and ask them to use the model independently from your involvement. So they will do their own assessment and they will come up with some maturity level, ok. After that based on their usage of the model, you design a post-case study questionnaire where you can ask them a similar kind of question like you have posted here. That will be very good feedback because they have used your model and based on that they can suggest any improvement. So that will be future work if you want to do.

ZB: I think a proof of concept would definitely be important to see how well it works thank you for that.

P1: I suspect we're the replacement.

ZB: I mean because of the duration o the PhD I had to things other options.

P2: I want to say have you considered the environment? For example, the African setting and probably other parts of the world. To look at how the framework can fit into the two environments, so you are targeting either of the two?

ZB: so, yes I did. I considered environment. In fact the last element number 10 is external factors. Aside from what I presented today, I actually published a diagram of an ideal digital learning environment and the outer body of it is the external environment and everything else sits within that. So there would be a set of rules to say that ok so these are the assumptions that were making and these are the conditions of this particular environment and for that reason, this is what we have to work within this institution…. Like it said there is definitely a need to calibrate the model to each institution before they are able to us it.

Ps: when I said environment, I meant the issue of financial ability, technology, stability, student populations, and funding options.

ZB: all those things are factored in. so funding option is factored in both in terms of internally generated funding, and external funding from both stakeholder local and international. So, I did consider this.

P1: it's kind of entry-level stuff isn't it, in other words, to participate I think at the beginning we mentioned this and I think in order to just participate there are so many assumptions.

As I say working in Adis, I still have a student there and there are so many barriers. Like the infrastructure is so different. Different set of problems, so I just wonder whether there could be a two-tier… I know it sounds awful but a different one for different entry levels in other words not to make some universities feel they are outside of it but they can still participate.

ZB: yeah!

P1: But also it's odd that you've got this environmental key entry-level criteria as number 5 when its almost should be the number 1. Have you got any money to invest in the digital and you can say no and then everything else put a line through it and that would be very demotivating, I think? But I don't know what the answer is.

ZB: it's definitely something worth thinking about yeah. I mean I've got lots to write in my evaluation section of this work and loads of stuff I could potentially put in the future work section.

P1: well I just feel this is our opportunity to give feedback so I've probably given far more than you need!

ZB: not at all. This is what I was looking forward to! You know when you've been doing research yourself for so long and just can't wait to have that opportunity to talk and talk about everything you've been doing. Thank you so much.

I really appreciate all of you having taken the time out to have read the framework beforehand and taking out the hour to participate even though we've gone over 20minutes in. but that you so much. I think we'll end the call now, just because I'm aware you may have other commitments.

If you do have any additional comments or recommendations

P1: could you send us the results? Your paper that you are writing.

ZB: definitely I'll send you the results, and keep you posted on the status of my submissions and so on. I'll generally keep you updated on the progress of the work.
Thank you.

P2: Good luck

P1: thank you. Nice to meet everyone. Best of luck

P3: All the best
[P1 AND P2 AND PS LEFT THE MEETING]

P3: limitations of third world countries, we have enormous limitations that hamper the progress. But the framework you have outlined is very comprehensive and I'm sure it will assist, and it will be very applicable to us.

ZB: I tried to make it as comprehensive as possible, so that even if there is a need to take something out, at least you can see everything that should be there and then take out what's not possible. I think I came out with all these levels, I went to Kano, different types of institutions so that I could get an idea of what digital capabilities look like all around.

P4: we had the step B project, which was the new net where I'm working now, and these are supposed to serve as ISP for the Nigerian universities. Unfortunately, as soon as the stakeholders from world bank left, the funding ended. The model was that the universities are supposed to subscribe but because of these silos that we operate here in Nigeria every university wants to get their funds in their budget and subscribe directly with their own ISP and their own procurement process instead of tapping into the Nigerian. That made the project almost moribund. But we'll still get there.
Your framework is nice; but I'll just add that you still need to make it scalable so that lower universities can see where to come in or fit in. That's the only thing I feel I have to add, it was a good job. Keep it up.

ZB: Thank you very much. Just one last thing. Your call kept dropping so I'm concerned about losing data, if you could kindly complete a manual version of the questionnaire and email me with your responses, that would be great.

Engineer: ok yes, I will do that.

ZB: Great! Thank again for your time.

[End of call. End of recording].

Appendix AC: Additional Comments from analysis of Study 5

	Additional comments and observation		Frequency of occurrences (n)
1	**Overlap in definitions of descriptors** For example, wellbeing is dotted around various places. The suggestion is to push sub-themes through a filter of an existing framework with fewer categories.	Justified	6/14 42.85%
2	**No need for Level 0** CMMI has 5 values, this framework has 6 and Level 0 is not needed	Justified	
3	Some of the groups are very similar and can be merged (e.g., Levels 5 and 6)	Justified	
4	**Scalability** The framework should be scalable and flexible to suit individual TEIs needs	Not addressed	5/14 35.71%
5	**Access and affordability** Access is one critical success factor for devices internet and affordability and must be given requisite consideration in the FW.	Partially addressed	3/14 21.42%
6	**Continuous representation of CMMI** Consider the continuous representation of the model	Not addressed	
7	**Record evidence** Important to keep a record of evidence for satisfying criteria.	Not addressed	
8	**Budget** No budget in the FW	Not addressed	
9	**External systemic factors** How does your framework address the issue of an unstable environment? Which is sometimes out of the control of the university itself. How does the model account for Political unrest?	Partially addressed	Ouch! I honestly have no idea about how to deal with this comment. Could you perhaps state that this aspect hasn't been considered, but that it could form one element of the environment?
10	**Flexibility to select elements** Consider different levels and different versions for different budgets, and different political situations. It could disadvantage some universities that might be struggling already.	Not addressed	
11	**A set of clear baseline assumptions for users** Do you have a set of assumptions? The scope and assumption need to be made very clear. The infrastructure is just so key to setup. In order to even start assessing the assumption is there is some kind of infrastructure that's fairly reliable. A set of assumptions as some universities will not be able to participate if there is no internet connection.	Partially addressed	
12	**Simplifying the Framework** Simplifying the framework would make it easier to use and more likely to be accepted.	Justified	
13	**The danger of creating artificial qualifiers** Not all sub-categories need to have all 5 values otherwise you're forcing yourself to come up with some artificial qualifiers whereas some could have only 2 or 3 values rather than 5.	Justified	
14	**Further refinement** The framework will be very useful and valuable research for the community, but I think you need to go through a second iteration to make it more usable. Needs more iterations to refine it perhaps it is better to start with less values and less categories and expand if you need rather than have a lot of spaces your filling in.	Justified	