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Lessons learned from the digital transformation of physiotherapy education: A phenomenological study

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A B S T R A C T

Objective: The Covid-19 pandemic changed education globally with a rapid reduction of in-person learning and increase in e-learning. This was challenging for students with themes of poorer motivation, reduced engagement, and difficulty translating knowledge into practical skills. Although Covid-19 restrictions have been removed in the UK, increased e-learning is likely to be permanently integrated in healthcare programmes by most UK universities. Therefore, programmes need to evaluate their e-learning to learn lessons for the future. This study aimed to understand physiotherapy students' experiences of e-learning and what, if any, specific topics were more challenging and why they felt this was the case to identify how e-learning can be developed to meet their needs.

Methods: A descriptive phenomenological methodology and purposive sampling of physiotherapy students at a UK university was used. Two semi-structured focus groups were conducted, data was analysed using reflexive thematic analysis.

Results: Four themes were constructed which were: connected but disconnected; collaborative disengagement; practicality for professional identity; and disembodiment with anatomy.

Conclusions: For vocational healthcare courses with substantial practical skill development required to meet regulatory standards, the balance of online and in-person learning will continue to be a challenge. The changes to education delivery which occurred because of the Covid-19 pandemic have provided educators with an opportunity to reflect on the challenges facing both students and the profession itself in this increasingly online world. Recommendations from this study include integrating online communication skills within the curriculum, prioritising digital skills, and embracing emerging immersive technologies to enhance anatomy learning.

Implications for educational practice:

- The balance of online and in-person learning for professional healthcare programmes is challenging
- Curriculums should include development of online communication skills to support students learning experience in the online classroom and to develop the skills required for the future workplace
- Digital skill development should be integrated into programmes to reflect the changing professional climate of healthcare
- MSK programmes using online anatomy learning needs to include embodied experiences with sensory-motor activities to support deep learning of the topic, digital tools such as iVR may be appropriate to support this

1. Introduction

E-learning is described as the use of electronic media and other devices that represent all or part of the learning experience to develop understanding [1]. Over the past decade, healthcare programmes have increasingly integrated e-learning with 'traditional' face-to-face learning known as blended learning [2]. For healthcare students who require a combination of theoretical knowledge, communication skills, and practical skills, essential for safe and effective clinical practice this has been widely accepted [2–4]. Further innovation in the delivery of healthcare education has been slow and fallen behind the transformative change seen in other fields [5]. However, the Sars-Cov-2 (Covid-19) pandemic drove a rapid change in the delivery of education globally; to help control the spread of the virus, social distancing policies resulted in a rapid reduction of face-to-face learning and increased use of online learning, teaching and assessment [6,7].

Given the nature and speed of the transition, students were required to quickly adapt to e-learning. Globally this was challenging with

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concurring reports of heightened negative emotions, students feeling unmotivated to learn, and concerns over reduced opportunities for social interaction with peers and tutors [6–8]. Whilst covid-19 restrictions have been removed in the UK since 2021 allowing students to return to the classroom, increased e-learning has been permanently integrated in multiple pre-registration healthcare programmes including those requiring substantial manual and palpatory skill development such as the physical therapies [9–11]. Therefore, e-learning in response to the pandemic, should be evaluated to understand its impact on students and to learn lessons for how it can be used most effectively in the future. This study aimed to understand physiotherapy students' experiences of e-learning and what, if any, specific topics were more challenging and why they felt this was the case. This will help to identify recommendations for the future to support the effective use of this delivery.

2. Materials & Methods

The consolidated criteria for reporting qualitative research (CORQR) were used to inform the methods of this study [12].

2.1. Study design

Phenomenology places emphasis on how a person experiences the world and has been extensively used in healthcare research to understand human phenomena [13]. This study used a descriptive approach to describe the meanings of how the participants made sense of their lived experiences [14]. A critical-realist ontological approach was taken, suggesting that truth was there to be discovered, however, the experiences and values of the participants and researcher will shape this, resulting in several truths [15]. The epistemological position was interpretive, which attempts to understand multiple meanings and interpretations of the experiences of the participants [14]. Reflexivity, a process of critical self-reflection [16], was undertaken throughout the research process by the primary researcher who was a lecturer on the programme before and during the pandemic. The researcher used a reflexive diary to identify their own preconceptions, personal experiences and beliefs relating to the aim of the study (Table 1), this questioning of pre-understanding has been suggested to aid openness and overall rigor of qualitative research [13,17].

Table 1
Extract Reflexive Diary - Researcher pre-understanding.

Own experiences:
• As a student, I learnt physiotherapy on campus with no online teaching, I enjoyed this approach
• As a lecturer I have struggled with moving learning and teaching online, it's hard to achieve active learning remotely
• I have felt isolated, lonely and bored working from home, I enjoy the campus environment
• I dislike lecturing to a page of blank screens; I have no idea if they understand me or are even there
Beliefs & Values:
• I am a social person; learning is better when we are together
• I believe learning should be fun and challenging
• Physiotherapy is a practical job, it should be taught in this way
Pre-conceptions:
• Students want to come back to what they know (on-campus teaching) as that was their expectation
• Students are less engaged and motivated generally when attending teaching online
• Students will find all topics involving practical application of skills challenging rather than any one area of teaching specifically

2.2. Study setting

Zoom™ cloud-based video conferencing platform was used as the setting of this study.

2.3. Ethics approval and consent to participate

This study was approved by the Health, Science, Engineering and Technology Ethics Committee: HSK/SF/UH/04705.

2.4. Sampling & recruitment

Purposive sampling was used to recruit participants representative of the Physiotherapy cohort's demographic. A definitive sample size of participants was not established a priori, based on the number of eligible students (n = 76) it was estimated that between 8 (10 %) and 19 (25 %) participants would be required to provide data to inform the research question. Data saturation, the point where no new information or codes are derived in the data, is not consistent with reflexive thematic analysis as every new participant will be able to expand the richness and context of the findings [15]. Therefore, the final sample size was determined using the power of the information [18]. This model suggests the sample size is justified using the power of the data relating to five aspects; the aim of the study; the specificity of the sample; the existence of surrounding theory; the quality of the participants data and the analysis strategy.

Recruitment was conducted by advertising on student's module sites and by lecturers not involved in the study providing information in teaching sessions.

Inclusion criteria.

- Students registered and attended the BSc (Hons) physiotherapy programme in the 2019/20 academic year and at least one subsequent year.

Exclusion criteria.

- Students resting for more than one semester of the 2019/20 academic year.

2.5. Data collection

Data was collected in March 2022 using semi-structured online focus groups lasting between 75 and 90 minutes. Focus groups were facilitated and moderated by two senior academics who were unknown to participants and independent from the students' programme of study. It was important that participants felt able to share their experiences openly and honestly and to ensure no power dynamics between facilitator and participants influenced the discussions. Both academics had extensive research backgrounds and experience of supporting students in higher education.

A focus group guide (Table 2) was used, consisting of five question types as proposed by Kruger and Casey [19]; an opening question allowing each participant to speak and become familiar with the group composition; an introductory question to consider their position on the research topic; transition questions to move discussions towards the key questions; finally, asking the participants to reflect on their experience and consider if there was any other aspect that should be raised [14]. An independent qualitative researcher with extensive experience reviewed the guide resulting in amendments to ensure questions were neutral about the topic of discussion.

Table 2
Focus group guide.

Focus Group Guide
Can you introduce yourself to the group?
Covid-19 meant that most learning moved to being online, tell me your experience of this.
How did you feel about learning before and after the changes that took place due to the pandemic?
How did you find learning particular topics?
How did you find applying the skills or knowledge that you learnt online?
How was your experience of learning anatomy online (if it has not already been discussed)?
Looking back on your experience of learning online, what do you think could have supported this further during the pandemic restrictions?
Is there anything else that you would like to tell me?

The audio-visual output was recorded and used to generate a transcript of the discussion. This recording was stored on the universities secure OneDrive, password protected and available to the research team only.

2.6. Data analysis

Data was analysed by the primary researcher using reflexive thematic analysis (TA) incorporating the six stages described by Braun and Clarke [15]. Initial familiarisation and immersion involved watching the focus groups which were transcribed verbatim and anonymised using codes for each participant. These were then compared to the recordings for accuracy. A reflexive diary (Table 3) of the researchers' perspective during analysis was used at this stage, the researcher considered their initial reaction to the data and reflected on their own experiences and pre-conceptions of what the participants may have experienced. This helped the researcher recognise their own understanding and attempt to maintain openness to the participants experiences. By enhancing openness this aims to reduce the risk of describing the authors pre-understanding of the experience rather than understanding and making light of the participants experience [13].

The anonymised transcripts were uploaded to NVivo (version 12) for initial coding. Data which was linked to the research aim were marked and labelled with initial codes which were progressively refined by linking codes with similar meanings to produce patterns [17]. Following generation and refinement of codes, initial themes and sub-themes were developed and cross-checked against the data (see supplementary file 1). This was an iterative process in which the researcher moved back and forth between the patterns and themes using the reflexive diary to critically consider if the researchers' initial assumptions and beliefs were restricting the interpretation of the findings.

The power of information during analysis was determined to be high due to the participant group being specific, the richness of the discussions and the data analysis strategy aiming for an in-depth, reflexive approach. These factors increased the power of information [18], discussion with the research team concurred that the data provided enough high-quality information to answer the research question. Therefore, recruitment was stopped at this point.

Researcher triangulation has been suggested to strengthen the rigor of the study by providing alternative views and critical commentary on the analysis [17]. This strategy was not used within the study methodology as reflexive TA values the subjectivity of the researcher, hence additional perspectives are not consistent with this approach [15]. Therefore, it is accepted that whilst preconceptions of the researcher were accounted for, they were not eliminated or bracketed and put aside [13]. Bracketing was unlikely to be truly possible especially with the substantial impact and resulting experience that the change to e-learning had to both students and staff. Therefore, the effect of the researcher and their own perspectives will shape the interpretation of the data and the resulting discussion which may differ from that of a different researcher [17].

Whilst researcher triangulation was not used, critical commentary within the peer review process led to further evolution of the themes to express greater meaning of the lived experience of the participants. The researcher reflected on the critique, re-engaged with the data and the patterns identified to ensure that the theme names and discussion reflected the lived experience of the participants.

Member checking, where participants review the interpretation of the results was undertaken to enhance credibility [14]. Themes were sent to participants who consented to further involvement (n = 4), one participant responded with no resulting changes. The ability of others to see their experience and recognise this in the themes is an indication of credibility and contributes to trustworthiness [20].

Table 3
Extract from reflexive diary during familiarisation.

Extract from initial reaction during familiarisation 12/03/22	**Extract from initial reaction during familiarisation 12/03/22**
The isolation aspects resonated as this was experienced by me also, but I was surprised this came out so strongly across students who lived in groups and where able to attend teaching in person even at the height of the pandemic. I will need to take care that I do not focus on my own experiences when analysing this.	I found this discussion conflicting; I completely understood the frustrations of students with their cameras off and muted, from my own experience lecturing this was a challenge and it frustrated me to be speaking to a blank wall not knowing if anyone was engaged. I could, therefore, understand the students' frustrations and I need to take care to ensure I look for balance.

3. Results

Twelve students consented, however, two did not respond to the focus group invitation resulting in a sample size of ten final year students (mean age 31.5 years (SD = 12.7)). All participants were UK nationals, none had previous experience of e-learning, 60 % were mature students, 90 % were female, and 33 % had previously studied to degree level. Two students did not have their cameras on, one for personal choice and one due to technical issues. Data analysis led to the construction of the following themes.

1. Connected but disconnected
2. Collaborative disengagement
3. Practicality for professional identity
4. Disembodiment with anatomy

3.1. Connected but disconnected

Digital connections were an established part of most of the students' everyday lives before the pandemic, however, the rapid change of both social and learning activities moving to a predominantly online 'world' affected their balance between real-life connections and digital ones. Students expressed a sense of a loss of peer support opportunities that were highly valued when they were on campus between teaching sessions and within them, which were not replicated online. This imbalance resulted in a sense of disconnection from their peers and feelings of loneliness (Fig. 1).

With the perceived loss of social connection opportunities between taught sessions, the importance of quality peer communication and

"There's quite a lot of people on the course that I probably haven't had a conversation with due to it being online, so I do agree that has been a lot more isolating, and as I'm an older student… I found it harder to connect with certain students anyway. Without being there in person, I found that was exacerbated." [1]

"[When online] you can't talk to your friends, whereas before you would be sat next to them, and you can have little discussions before class and after." [12]

"I did miss … having somebody to sit down with and work with, quiz each other … and have that morale boost of somebody to work with." [11]

Fig. 1. Quotes to illustrate sense of loss of in person social connections.

connection in the online classroom was heightened. However, the student's expressed difficulties with their self-confidence to communicate online and with knowing how to communicate with fewer non-verbal cues. These issues were apparent both with their communication with each other and with lecturers making it more challenging for others to see when support was needed. This resulted in some participants describing negative impacts on their mental health and withdrawing further, exacerbating their disconnection (Fig. 2).

Each participant's experience of being connected online but disconnected from others differed but was experienced by all to varying extents regardless of whether they were school leavers living away from home for the first time, or mature students with families.

3.2. Collaborative disengagement

The second, interconnected theme was developed from the building

"[e-learning] is a very different medium, you don't have that body language to read off other people and also you kind of end up cutting people off and interrupting people and that can just feel really awkward." [11]

"[On-campus] If I don't know something I look confused, the lecturer knows, they pick up on those cues. Where I'm online, I think it is due to being more socially anxious now, I don't like to have my camera on." [8]

"When you are in a room with each other, although you're not talking over each other you can go back and forth more. Whereas when you're online it's a lot harder to have that back-and-forth conversation. Because you have to sit and wait for everyone to have their turn." [2]

Fig. 2. Quotes to illustrate the importance of non-verbal cues for effective communication.

sense of student frustration with each other when required to work together in collaborative tasks. Students with expectations of shared effort and equal contributions found that the actual reality of group work differed with others not seen to be contributing. This misalignment of expectation and reality resulted in growing frustration, over time the students identified that as a result, their own contributions progressively dissolved (Fig. 3).

However, some students experienced this differently. Whilst their peers perceived a reluctance to participate and felt frustrated, others expressed that their personal barrier to engaging actively was linked to fear of judgement, and anxiety of being exposed to the group (Fig. 4).

This theme reveals the complexity of fostering positive collaborative experiences within the online classroom and how if this is not achieved it can negatively impact students' engagement. As teamworking is an essential skill for healthcare professionals this disengagement in collaborative learning not only effects the student's capacity to achieve the learning outcomes but also impacts the unintended benefit of developing teamwork skills.

3.3. Practicality for professional identity

The participants had developed their own concept of what it meant to be a physiotherapist and felt a strong connection between the practical, hands-on experiences that they had been exposed to within learning and teaching before the pandemic and their evolving professional identity. However, even though practical teaching was continued throughout the 2020/21 lockdowns, the changes to the practical, hands-on delivery to a more condensed format did not align and reinforce their concept of professional identity causing a sense of doubt in the effectiveness of the learning (Fig. 5).

The high value that students placed on 'hands-on' practical teaching to enable them to fulfil their understanding of the role was interlinked with their lower confidence levels in clinical settings. Students doubted their ability to apply hands-on skills despite feeling that they had the knowledge and understanding required. Whilst this was apparent for all specialities of clinical practice, musculoskeletal (MSK) settings were highlighted as an area where confidence was particularly low (Fig. 6).

Although students considered that low confidence may be a normal experience for any newly qualified professional, the combination of low confidence, perceived loss of hands-on ability and their understanding of professional identity brought into question their perceived readiness for their first job and whether they could see themselves as competent practitioners (Fig. 7).

This theme reflects the interconnecting relationship between the students' early concept of their own professional identity and how their expectations of teaching are influenced by this. The experience of the changes had a detrimental effect on their confidence to achieve their vision of what being a physiotherapist means and was particularly evident for their understanding of MSK professional practice.

3.4. Disembodiment with anatomy

The final theme interconnects with 'practicality for professional identity', prior to the pandemic, students learnt anatomy with a combined theoretical and practical approach encompassing tactile experiences such as deconstructing and constructing models, participating in prosection laboratory sessions, and palpation of anatomical structures on each other. Following the transition of anatomy learning to the virtual environment tactile experiences were limited, other resources were used to support learning and teaching including three-dimensional (3D) images and dissection videos. However, the student's discussion demonstrated a sense of disembodiment with this approach which made anatomy challenging to understand (Fig. 8).

The recognition of the importance of tactile and sensory experiences when learning anatomy resulted in disparities in learning experiences between students. Some had the ability to fund their own anatomical models to help provide a sense of embodiment, but this was not accessible to all (Fig. 9).

This theme reflects the value of sensory and tactile experiences when learning anatomy. Students expressed specific challenges with understanding how anatomy knowledge, when taught without these experiences, linked to a person. Their discussions demonstrated a sense of disembodiment, as a result, the ability of some students to supplement their learning to create these experiences created inequity across the student group.

"[for online tutorials] I think it is a case of who you are with, sometimes it was really beneficial, but the majority of the time it's not….you just think why am I doing the hard work for everyone else….[you] do it yourself and don't share it because what is the point?" [12]

"Everyone's got their screens off and got their microphones off and you're just sitting there trying to talk to them, there is no interaction it's really, really hard" [2]

"There have been times when we actively have not said anything because we realise we have said a lot. [We are] waiting for somebody else to say anything, for them to contribute…I'm actually waiting for somebody else to say something now." [11]

Fig. 3. Quotes to illustrate building frustration.

"It would be important to understand that maybe those people……they are the people who wouldn't necessarily put their hand up or say something because of who they are…so for them (try) not to be as frustrated when they aren't talking much." [8]

"Because only one person can speak at a time, for people who aren't confident they feel like everyone's listening to them, and if they get it wrong everyone's going to hear." [5]

Fig. 4. Quotes to illustrate barriers to engaging.

"Most physio students, the reason they want to become a physio [is] because they are a more hands-on person. Physio is a hands-on job role…you gain a lot of information from actually feeling and testing and trying things out. So, it's interesting that we've had a lot of online work …naturally we are practical people that probably learn better by doing things." [5]

"We're physios so we have to physically do stuff in order to learn." [2]

"[if I had known about the changes to teaching] I never would have started this course. Because it's hands-on, the amount of time in practical….that is what attracted me to this degree." [11]

Fig. 5. Quotes to illustrate connection between teaching method and professional identity.

"I know that I need that practice, that hands on to feel confident and not feel anxious about things." [11]

"Just because you learn the theory doesn't mean you can do it." [4]

"When it came to my MSK placement, I was thinking I've learned so much, but do I know how to apply it?" [10]

Fig. 6. Quotes to illustrate lower confidence in the clinical setting.

4. Discussion

Multiple countries, including the UK are reflecting on the lessons learned during the Covid-19 pandemic. It is, therefore, prudent that all sectors including higher education do the same; by exploring the experiences of students' lessons can be learnt to evolve and enhance e-learning in the future.

A range of challenges were experienced with increased e-learning which were multifaceted and at times, interlinked. Firstly, e-learning and the subsequent reduced face-to-face contact with the student community evoked feelings of isolation and disconnection. As final year students, they had been attending campus with a particular group of peers and had developed associations between their learning routine and their sense of belonging to this group. This student community provided them with social connection, developed by positive bonds, interactions and relationships with others [21]. By changing the location of learning to a distant, virtual environment, the association between the place learning occurred and the feeling of belonging was impacted. Social connection in adolescents can influence their mental health, with a systematic review reporting higher internet use was linked with higher levels of loneliness [22]. This review was almost a decade ago and access to the internet, social networks and other internet-based activities have

"I don't feel I would be confident to go and work…I don't think I've got enough experience or hands on practice for that, maybe a bit later on once I've gathered more confidence." [12]

"I have had conversations (with employed senior physiotherapists) about when we graduate, what are going to be your expectations from us….are you prepared for us as we have come through the system with a lot less hands-on?" [11]

Fig. 7. Quotes to illustrate perceived readiness for entering the workforce.

"I find it really hard to learn anatomy from the books ….it doesn't translate well onto a body. So, MSK was more of a struggle for me because I can't visualize very well muscles and origins and insertions and the rest of it and I learned by having my hands on. Even just watching it in a video isn't the same because you don't actually have your hands on a personal or hands on a model even." [11]

"I think I found quite a discrepancy…. I knew the theory to an extent, but trying to apply that to an actual person, I found it quite hard, quite a disconnect between it. Once I actually had a person there it's kind of like, well all right, I know I could list it off (anatomy knowledge) but I couldn't necessarily place it on someone. So, then that's were some issues came about." [1]

"[discussing dissection videos] they're great to visually look, but unless you're actually feeling and touching where the muscles were, because it's alright seeing it but when you have actually got a person in front of you, you can't actually see it, if that makes sense?" [2]

Fig. 8. Quotes to illustrate disembodiment with anatomy learning.

"I ended up buying a lot of models. So, yes, it cost me a small fortune in models, just because I need that hands-on to appreciate it." [11]

"I have a mini skeleton that I.. detach and attach together to figure out what I'm doing." [10]

Fig. 9. Quotes to illustrate inequity in experience.

grown exponentially since, becoming part of everyday life [23]. The students in this study found that the change in learning location and reduction of in-person activities negatively affected their balance of online and in-person connections leading to feelings of isolation. This theme concurs with experiences of other healthcare students in international literature [7,24,25] and furthermore, this was also recognised as an issue effecting students by lecturers across multiple countries [26].

The strong sense of disconnection in the current study was interesting as previous literature was conducted in countries with strict

lockdown policies and full e-learning, hence, less in-person social contact was possible. Considering the students in the current study had been able to maintain limited face-to-face teaching on campus even during the peak of the pandemic, the sense of a loss of community is important to recognise. Social connections at university through peer relationships and positive student communities have been reported as a positive influence on mental well-being, furthermore the sense of belonging to a meaningful group has been identified as an important factor for undergraduate students in dealing with difficult events and seeking help [27]. Although, the results from this study were a small group in one professional programme, feelings of detachment were also reported in a large cross-sectional survey of health students in another British university that maintained some face-to-face teaching during the pandemic [28]. Therefore, the results appear to be consistent with this highlighting the importance of integrating activities to develop and maintain student communities in online environments.

Given the students' sense of disconnection from the student community, effective communication and collaboration between peers within online learning and teaching activities was important. However, students struggled to adapt their communication to allow meaningful interaction online which they associated with difficulties using and identifying non-verbal communication. The students described talking over one-another, being uncertain if it was their turn to speak and not being able to identify expressions resulting in interaction being described as "awkward". Facial expressions and voice have been reported to be less effective online [29], hence the students' experience aligns with this. Communication challenges may have been amplified for the students in the current study who were randomly allocated to small groups for collaborative tasks whereas in face-to-face teaching, they would often self-select their working group. This may have impacted on their ability to understand the group dynamics and pick up on non-verbal cues if they were less familiar with the group members. Small, permanent groups have been suggested to aid effective collaborative e-learning to enhance relationships and group cohesion [30]. Therefore, the practice of mixing groups, although creating contact with more students, may have been detrimental to communication and peer support. Therefore, it would be of value to use long-term working groups, especially in the initial stages of the programme to enable effective relationships to be formed.

In addition to ineffective communication between peers, student connections with each other were also hindered by unsatisfactory collaborative learning experiences. Small group working related to patient cases are commonly used within undergraduate healthcare teaching to enable students to use existing theoretical knowledge to exchange thoughts and ideas with their peers, and construct further learning from this interaction. This approach is aligned with social constructivism learning theory, which views social interaction as fundamental to learning [31]. However, when this approach transitioned online, students felt dissatisfied with the learning experience compared to when it was in person due to the lower interaction from their peers. Students expressed growing frustration when their expectation of shared contributions and active engagement were not met, this was further amplified when some students kept their web-cameras and microphones off. Over time, some students actively chose to disengage from collaborative learning as a result. This dissatisfaction with peers was also reported by Australian physiotherapy students who felt that virtual group work was an ineffective substitute for face-to-face collaboration [7]. As peer interaction has been recommended to enhance engagement and a sense of belonging [32], the frustrations and poor-quality interaction experienced by the students may have had a detrimental effect on both engagement and further negative impacts on the sense of student community. An opposing view of low peer engagement was given by a small number of students, who suggested that keeping cameras off and avoiding online interaction was partly due to low confidence in a different learning forum. Confidence has been reported to be an important influence on e-learning with some feeling nervous and exposed [33], and others reporting discussions as intimidating [34]. Furthermore, students can feel uncomfortable when being seen and heard in online platforms as they perceive they are the centre of attention [35]. Therefore, although social learning through collaboration and problem-solving is accepted to encourage participation and engagement [36], it may not meet the learning needs of all students without effective facilitation and support to develop online communication skills.

The students in this study had a clear concept of what it meant to be a physiotherapist. Professional identity begins to develop from an individual's prior experiences, beliefs and values and is continually shaped during their educational programme [37]. The students placed high value on the hands-on practical learning they had previously experienced, particularly for MSK topics. As manual therapy has a long history within various physical therapy professions including physiotherapy, osteopathy and chiropractic, it is unsurprising that teaching of this topic often remains in its traditional format whereby the level of skill and precision of hands-on techniques is linked to a clinician's ability to successfully manage their patients [38]. The students in this study had formed these traditional values which have also been reported as an influence on professional identity for osteopathy students' [39]. MSK physiotherapists and osteopaths have shown similarities in their professional identity perceptions and decision making [40], hence it is unsurprising that likenesses exist at the pre-registration stage also. Somewhat conflictingly the students in this study recognised discrepancies with their expectation of the skills needed for MSK professional practice and what they actually experienced whilst on clinical placement. Most students described undertaking remote consultations, triaging, delivering education sessions, and leading exercise classes in addition to hands-on physical assessment and management of patients. Practice education is considered a large influencing factor on professional identity [41], therefore it is interesting that despite the conflicting experience, the students at this stage of their education still felt low in confidence to work in the MSK field due to their perception of reduced hands-on skills.

However, the wider picture for MSK professional practice and the knowledge and skills required of graduates is changing with future directions being debated. Healthcare is growing increasingly complex at a time of greater financial restrictions, combined with technological advances providing increased access to free health expertise 24-hours a day, on any internet enabled device [42]. In response to these challenges, authors have discussed how the MSK physical therapy professions need to adapt to meet the needs of the population and healthcare funders [5,42,43]. One such example is the early use of artificial intelligence (AI), which authors have proposed could be utilised to automate some of the practical tasks that are at the traditional centre of the physical therapies, such as movement analysis [43]. Furthermore, research has shown that when AI is used in a supervised manner it can enhance diagnostic ability by performing clinical data analysis, classification of pathology and prediction of risk in a more rigorous way than by human decision making [44]. Despite this technological development, currently hands-on practical skills remain part of professional standards for the MSK professions and are integrated into the management guidelines for various conditions. Hence, teaching with a hands-on approach remains relevant. However, authors from multiple MSK professionals have proposed alternate methods of teaching and practicing manual therapy to reflect the modern requirements of person-centred healthcare. This consensus has challenged the traditional focus on specificity of skill and pathological faults of clinician-centred assessments and proposed a new model focussing on communication and context to support a patient's empowerment and reduce reliance on the therapist [38]. Therefore, despite the students aligning the hands-on, traditional aspects of learning with their professional identity, this may not provide them with the knowledge and skills that they require for their future careers. As such, educators of future MSK professionals should take the opportunity to innovate and adapt the curriculum to the changing professional direction and consider how students can be

supported with learning how to use emerging technology within clinical practice.

A further area where emerging technology could enhance online teaching is anatomy, students in this study found, when taught online this topic was particularly challenging and discussions indicated a sense of disembodiment with the subject. Embodiment theory proposes that learning is closely linked with the sensory and motor systems and that learning is enhanced when the sensations and actions experienced are meaningfully related to the topic [45]. Therefore, anatomy e-learning, which combined lectures and small-group working supported by 3D images and dissection videos, was not an effective replacement as they did not enable physical and tactile exploration of anatomy in a meaningful way which left students feeling disconnected with the topic. The reduction of these sensory-motor experiences in digital learning has been linked with unclear and inaccurate understanding [45], which is concerning as anatomy is fundamental knowledge for safe and effective practice in the MSK professions [46,47]. Digital technologies for anatomy education have shown a clear increasing trend [48]. In the last decade there has been the emergence of multiple immersive virtual reality (iVR), and augmented reality (AR) anatomy software programmes which provide sensory-motor opportunities by allowing the user to interact with 3D anatomical models, construct, deconstruct and alter their perspective. Furthermore, learning in 3D with active manipulation of anatomy models helps to develop spatial understanding, whereby the learner can appreciate the shape, position, and relationship of anatomical structures [49]. Better spatial ability has been shown to positively correlate with anatomy exam scores in two systematic reviews and meta-analyses [50,51]. In addition, learning with iVR has shown greater benefits for students with lower visual-spatial abilities [52], therefore, this approach may be of particular benefit to students who need to use greater cognitive effort to understand how anatomical structures are represented in the body. These benefits may be important factors in why significantly greater knowledge acquisition was reported when iVR and AR were compared to traditional anatomy education in a recent systematic review and meta-analysis [53]. Therefore, a clear opportunity exists for universities and educators to innovate their approach to anatomy teaching by exploring how these technologies can be integrated within teaching.

4.1. Methodological considerations

This study reflects experiences of a small group of physiotherapy students at one university. Inclusion of a larger group of students from other universities and MSK professions would likely add to the richness of the data and resulting analysis, enhancing transferability. Recruitment aimed to represent the diversity of the programme, but there was a larger proportion of mature students (60 %) compared to the UK average (51 %) [9]. However, each focus group had representation from both mature students and school leavers. Similarly, no international students participated but reflects 14 % of the average within a cohort [9]. The latter group would have had a unique perspective on e-learning whilst studying away from home and having different cultural backgrounds. Asian students, who make up 39 % of international physiotherapy students in the UK [9], have been suggested to be less inclined to speak out linked to cultural norms [54], therefore, inclusion of this group could have provided alternate insights into discussions relating to peer engagement and student community. Finally, only 10 % of the participants were male despite the UK average on Physiotherapy programmes being 37 % [9]. It is unclear if inclusion of more males would have influenced the data as research exploring gender and its correlation to outcomes of e-learning have shown inconsistent findings [55,56]. However, research investigating satisfaction with anatomy e-learning found no significant difference between genders [57], therefore this may not have influenced the analysis of this theme specifically. Whilst member checking was included, only one response was received. Further responses would have enhanced credibility. Finally, as the focus groups were held on Zoom™, it is possible that students uncomfortable with being seen or heard online would have been less likely to volunteer to participate. Hence these groups experiences may not have been explored and may have provided deeper insight into the themes.

5. Conclusion

Future generations of healthcare students will not face the same challenge of adjusting to e-learning as this is now commonplace with many universities planning to continue its use. However, for vocational healthcare courses with substantial practical skill development required to meet regulatory standards, the balance of online and in-person learning will continue to be a challenge. The changes to education delivery which occurred because of the Covid-19 pandemic have provided educators with an opportunity to reflect on the challenges facing both students and the profession itself in this increasingly online world. From the findings of this research it is suggested that the curriculum should integrate online communication skills, not only would this be of value to enhance students' online participation and ability to connect with their peers but would also develop the necessary skills for them to undertake online patient consultations which they are already experiencing on their clinical placements. Educators need to embrace the changing professional climate to ensure that graduates have the necessary knowledge and skills for their future careers. Prioritising digital skills, such as understanding of why and how they can use AI in an ethical manner will be of value as the integration of these tools is growing in clinical practice and is likely to continue. Finally, as a fundamental topic for MSK programmes, anatomy online learning needs to integrate sensory-motor activities in a meaningful context to support deep learning. iVR is one approach that could enable this, with increasing software options commercially available further research to understand the effectiveness of this approach compared to traditional methods would be warranted.

CRediT authorship contribution statement

Laura Eccott: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Andrea Moulson:** Writing – review & editing, Investigation. **Karen Atkinson:** Writing – review & editing, Supervision. **Salvatore Livatino:** Writing – review & editing, Supervision. **Jeremy Lewis:** Writing – review & editing, Supervision, Conceptualization. **Mindy Cairns:** Writing – review & editing, Supervision, Investigation.

Data statement

The data for this research is available on request in the University Data Repository.

Ethical Approval

This study was approved by the Health, Science, Engineering and Technology Ethics Committee: HSK/SF/UH/04705.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijosm.2025.100759.

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