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Insights in healthcare professions education 2023

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Insights in healthcare professions education: 2023

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Editorial: Insights in healthcare professions education: 2023

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KEYWORDS

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Editorial on the Research Topic
Insights in healthcare professions education: 2023

Introduction

Welcome to our collection of articles in the 2023 edition of the Research Topic "*Insights in healthcare professions education*" where we explore the latest developments in education, research methodologies and evaluation approaches that are shaping the future of medical and healthcare education. In this Research Topic of fifteen articles from across the world, we identify three key themes arising from this contemporary body of research (1) Course and Program Evaluation and development; (2) Innovative Teaching Approaches and Technology Integration; and (3) Promoting Human-Centered Education and Practice. Indeed, as healthcare landscapes continue to evolve for us all, educators across the world face the challenge of equipping students with the skills and knowledge necessary for practice while emphasizing ethical decision-making, diversity, and growth. By exploring the articles within these three identified themes, we believe you will gain a comprehensive view of the transformative impact of educational research on the next generation of healthcare professionals.

Course and program evaluation and development

Five articles in our Research Topic focus on evaluating and improving healthcare education interventions and programs across a range of healthcare professional groups, using different frameworks, tools and methodologies to assess course quality, acceptability of service learning, validity of assessment and guide curriculum design (Choi et al.; Guraya et al.; Li et al.; van de Mortel et al.; Van Winkle et al.).

Li et al., employing the well-established approach of Generalizability theory (G-theory), examined the correlation between items of their core residency entrustable professional activities. In their paper they outline their rationale for G-theory, further embedding their work in the rigor required for our developing field. Carefully following all steps required for G-theory, they concluded that both residents' and trainers' ratings showed good validity and reliability in the pediatric residency training program at the Peking University First Hospital. Using a different approach and focusing on students attitudes to learning specific courses, Van Winkle et al. report on the development of a new measurement instrument designed to assess prospective medical students' attitudes toward team service-learning in

an Immunology course. Analyzing remote and in-person students' data ($n = 73$) from a 10-item survey measuring attitudes toward team-service learning, community service and teammates, they identified a single factor of "attitudes toward required service-learning". Although further testing of their tool's reliability is needed, especially with other healthcare professions students and across different cultural contexts, we warmly welcome this new assessment tool that has the potential to detect differences in attitudes toward service-learning across different groups of students and different contexts, enabling course developers to implement curricula changes when needed.

Two studies in our Research Topic offer very different approaches to understanding and improving curricula quality. Underpinned by Social Cognitive Theory, van de Mortel et al. advocate for the implementation of an holistic, collaborative, and systematic Program Quality Framework. Choi et al., however, using a pragmatic approach, employ the six-step "contribution analysis". Each approach has its merits with the Program Quality Framework fostering the development of staff capability and scholarship throughout the curriculum's duration with educational scholarship underpinning curricula design and teaching. Choi et al.'s contribution analysis moves away from measurements of students' attitudes, toward an appreciation of the deeper complexity around educational offerings and uptake. Indeed, rather than offering a single measurement of value, contribution analysis provides an holistic understanding of the multifaceted trajectories experienced by students as they progress through their learning journey.

Interestingly, the research perspective of pragmatism features heavily across two articles (Choi et al.; Guraya et al.). While taking us carefully through the 6-step contribution analysis process, Choi et al., explain how they examined the factors involved in students' development of their graduate outcomes. They also report on their evidence-based model illustrating the relationships between external factors, graduate outcomes, results, assumptions and risks. Similarly, Guraya et al. carefully outline their philosophical approach of pragmatism, alongside the materials, methods and data analysis they adopted whilst developing, validating and evaluating their e-professionalism framework in the context of medical education. Interestingly, unlike Choi et al., who examine the complexity of both content and processes within education, and Van Winkle et al. who focus on students' attitudes, Guraya et al. employ the theory of planned behavior and Kirkpatrick's model of evaluation to focus on outcomes at the behavioral level and how their framework has impacted on how learners engage in the digital world. Furthermore, they describe in impressive detail the great lengths they have taken to conceive of, implement and evaluate their e-professionalism framework; a level of detail that is often missing or unspoken.

Innovative teaching approaches and technology integration

Four articles in our Research Topic focus on the use of the technologies within healthcare education. These include: simulation, virtual/augmented reality, telehealth, interactive online experiences, and social media with the studies exploring when and how to integrate them effectively into curriculum (Attar et al.; Bacon et al.; Lembo et al.; Stoehr et al.). For example, although Bacon et al., found face-to-face consultations to be significantly more acceptable, affording more opportunities for students than telehealth, telehealth has its place in the curriculum, providing valuable learning experiences for students and supporting their competency development. Notably, in this study, students reported improvements in clinical reasoning, problem-solving skills, resourcefulness, flexibility, and communication skills in ways that are quite different to their face-to-face experience. Furthermore, students' skills development (e.g., in areas such as craniotomies, dural openings and suturing) has shown to be enhanced by learning with devices such as Google Glass for Augmented Reality and a cadaver-free high-fidelity simulator (Lembo et al.). In this pilot study of neurosurgery residents' and students' learning during a 6-week course, all participants significantly improved across technical indicators, with more junior participants showing greater improvement.

Stoehr et al., report on their blended approach to medical students' thoracic radiology learning using both online and onsite learning. Interactive online learning included on-demand video loops, image magnification and clickable color highlighting whereas the in-person teaching comprised small-group (8–10) 90-min seminars. Significant improvements in knowledge were found, with the online aspect of the course motivating students to become more involved with thoracic radiology in the future. Finally, focusing on phlebotomists ($n = 435$) from across 14 public hospitals in the Eastern region of Saudi Arabia, Attar et al. examined their use of social media to improve their knowledge and awareness of safety procedures and practices. They concluded that social media is a valid form of knowledge exchange and development with over 70% of participants reporting that that they frequently shared phlebotomy-related information with other phlebotomists. With this in mind, Attar et al. highlight that the need to now focus on improving skills, knowledge and awareness regarding identifying misinformation to prevent inadvertently sharing incorrect knowledge among colleagues.

Promoting human-centered education and practice

Four articles in our Research Topic focus on the importance of placing human values and dignity at the forefront of healthcare education and practice (Fu et al.; González-Blázquez et al.; Klinner et al.; Schramlová et al.). They encompass the ethical considerations of providing educational opportunities that respect the dignity of all individuals, ensuring equality in healthcare, prioritizing student wellbeing and enhancing their quality of life throughout their educational journey. We would further argue that ethics training in healthcare plays a vital role in promoting dignity, student wellbeing and quality of life, healthcare equality (including LGBTQ+) by embedding ethical principles into education and practice, thereby fostering a culture of respect, justice, and moral integrity. However, González-Blázquez et al., in their systematic review of healthcare students' bioethical knowledge and training found that healthcare students, generally, lack sufficient knowledge and/or skills to resolve the ethical dilemmas they may encounter

during clinical practice, although the extent of this differed among healthcare discipline and country of study.

Dilemmas around dignity during workplace learning is the focus of another study. Klinner et al. examined a range of stakeholders' understanding of what comprises dignity in workplace learning in healthcare. Interviewing students, placement educators and university staff across seven allied health professions groups ($n = 51$), they identified eight distinct dimensions of what comprises dignity in a service-learning environment, including: feeling safe, respected, equal, having a sense of belonging as well as the relationship we have with ourselves (e.g., self-worth, self-respect, self-compassion, and self-understanding). Related to the issue of dignity in the workplace, Fu et al. examined the knowledge and attitudes of medical students from Singapore and United Kingdom (UK) toward lesbian, gay, bisexual, transgender, queer, and other sexual and gender minority (LGBTQ+) individuals. Amongst their findings is that, despite espousing positive attitudes, participants lacked a general understanding of commonly used vocabulary and topics, and this was more pronounced for Singaporean participants. Furthermore, 84% of students had no LGBTQ+ specific training in their university education emphasizing the need for inclusive curricula to achieve a dignified experience for all.

The final article we highlight in this Research Topic theme links with Klinner et al.'s finding around dignity being related to the relationship we have with ourselves, specifically to self-care, as it focuses on the wellbeing and quality of life of students in bachelor's physiotherapy programs ($n = 1{,}075$) across 23 European faculties, in eight countries (Schramlová et al.). Issues such as mental wellbeing, stress levels, sleep quality, and adherence to physical activity and nutritional guidelines were examined within the broader framework of *quality of life*. Schramlová et al. found (amongst other things) that academic factors (e.g., amount of material to learn, exam frequency) were strongly related to higher stress levels, with women being more vulnerable than men. Furthermore, problems with sleep, nutrition and physical activity were also reported.

Further studies

Notably, two further studies included in this Research Topic sit outside these themes (Alhamami; Jain et al.). Reporting a systematic review of the evolution and impact of English as a Medium of Instruction (EMI) in healthcare education over the past decade, Alhamami presents a distinctive opportunity for us to examine how EMI has affected students, educational institutions, and the broader landscape of healthcare education. Further, Jain et al. reports on Latvia's medical education system and its challenges, including institutional capacity constraints and investments in adapting to changing landscapes. In doing so, this interesting report and provides us with a unique insight into medical education in Latvia and an opportunity to identify differences and similarities between this and that within our own country.

Conclusion

In conclusion, the diverse array of articles presented in our latest Research Topic underscores the multifaceted nature of healthcare education. By evaluating and enhancing educational interventions across various professional groups, exploring the integration of cutting-edge technologies, and prioritizing humanistic values essential to healthcare, these studies collectively advance our understanding of effective healthcare education. The insights gained from this compilation not only highlight the importance of rigorous assessment and innovative teaching methods but also emphasize the ethical imperative of fostering environments that uphold dignity, equality, and wellbeing. As we move forward, these contributions will be instrumental in shaping healthcare curricula that produce competent, compassionate, and well-rounded healthcare professionals across the world.

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While allied health students prefer face-to-face clinical placement, telehealth can support competency development: results from a mixed-methods study

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Introduction: Student clinical placements are a mandatory requirement within most accredited health programs. During the COVID-19 pandemic, many health settings that had traditionally provided placements cancelled their offerings. Telehealth services however, increased and emerged as an alternative placement setting.

Aim: To compare the learning experiences for allied health students provided by telehealth and face-to-face accredited health placements.

Methods: Health students, from a university clinic between March to December 2020, delivering both face-to-face and telehealth consultations, were invited to complete a telephone survey with 3 demographic questions; and 10-items comparing their telehealth and face-to-face learning experiences. Pearson's chi-squared/Fisher's exact test was used to examine the association between each item and consultation setting. Qualitative survey data was thematically analysed using a descriptive approach.

Results: 49 students from 2 universities and 5 disciplines completed the survey. Students rated their face-to-face experiences significantly higher than their telehealth experiences across all items (all p-values <0.01). Across 9 items students reported positive learning experiences in both settings. Students had greater opportunities to work in a multidisciplinary team in a face-to-face setting. Four themes were generated: (1) placements can vary in quality regardless of setting; (2) telehealth can provide valuable learning experiences and support competency development; (3) enablers for telehealth placements and (4) barriers for telehealth placements.

Conclusion: While telehealth can support student learning and competency development, in this study students preferred face-to-face experiences. To optimise telehealth placements consideration needs to be given to barriers and enablers such as technological issues and university curricula preparation.

KEYWORDS

health, telehealth, clinical education, student placement, COVID-19

1. Introduction

Most professionally accredited university health and medical courses mandate the inclusion of clinical placement hours within the curricula (1). Clinical placements enable students to translate theoretical knowledge into practice (2). They also provide the complex learning experiences necessary to develop and demonstrate competence as described by competency standards approved by professional accrediting authorities (3, 4). The demand for clinical placements has led to innovative models of clinical education such as university clinics (5, 6) which have been shown to support competency development and clinical placement capacity (7, 8).

Government restrictions in response to the COVID-19 pandemic caused many health services to transition towards a telehealth model for the safety of service users (9–12). Telehealth also allowed university clinics to continue operating, preventing the cancellation of student placements during the pandemic (13, 14). The widespread adoption of telehealth for student clinical placements has been described (15–18) but evidence of its learning benefits is only beginning to emerge.

Exploratory qualitative research on student perceptions of telehealth clinical placements in aged care nursing (19); rural medicine (20); and community allied health services (21–23); report increased clinical and communication knowledge, skills, and confidence; a greater appreciation of telehealth services; and improved employability.

Early quantitative findings suggest educational outcomes in telehealth clinical placements may be equivalent to traditional settings. Simulation research, using a randomised cross-over design ($n = 41$), found no significant difference between the diagnostic reasoning assessment scores ($t = 0.54$, $p = 0.588$) and ability to make a correct diagnosis ($t = 0.22$, $p = 0.823$) for nurse practitioners in telehealth and face-to-face standardised patient encounters (24). Similarly, Patterson et al. (25) found senior medical students perceived no significant difference ($H = 0.0242$, $n = 26$, $p = 0.87627$) in the degree of usefulness for learning from face-to-face consultations verses teleconsultations.

In allied health, however, there is less convincing evidence comparing telehealth and face-to-face placement experiences. In a recent rapid review, only 3 studies were identified (26). These had inconsistent methodologies and presented pilot data ($n \leq 6$) or a single telehealth encounter (27–29). Positive preliminary comparisons by students ($n = 13$) on their learning experiences from an interprofessional diabetes clinic post their transition to telehealth have also recently been published (30). Their focus, however, was on interprofessional education competencies, rather than discipline specific professional accreditations requirements. This study aims to determine the difference, if any, in learning experiences for allied health students who participated in telehealth compared to face-to-face consultations within accredited health placements.

2. Materials and methods

2.1. Research setting

This research was conducted in an urban university clinic that has ten different allied health services including: a cancer wellness centre, counselling, exercise physiology, nutrition and dietetics, occupational therapy, optometry, physiotherapy, psychology, and speech pathology. The students involved in the clinics are at varying stages in their degree and placement program, ranging from first year undergraduate students to final year masters students. Telehealth was introduced in March 2020 in select clinics in response to government restrictions during the COVID-19 pandemic. This was intended to provide continuing services to the community that were safe for clinical education staff, students, and clients. As restrictions eased from July 2020, face-to-face services were gradually reintroduced, with most disciplines offering a mixture of telehealth and face-to-face services depending on best practice evidence, risk management, and client preference. Telehealth experiences within the clinic included telephone calls for screening and/or treatment of clients and video conferencing using Coviu© (31) and Physitrack® (32) for assessment, intervention, and discharge. Student preparation for telehealth varied across disciplines and due to stage of telehealth implementation within the health clinics.

2.2. Research design

This research has a pragmatist ontology, where knowledge and ideas are acquired for the purpose of solving practice-based problems (33). As such, it is the research question that has determined the method used (34). This study asks, "Is there a difference in how allied health students rate and describe their clinical learning experiences provided by telehealth and face-to-face service delivery models within accredited health placements?" A convergent mixed-methods approach was adopted to allow a more complete understanding of the phenomenon allowing the student's voice to be heard (35). The quantitative and qualitative data are presented separately in the results and interpreted together in the discussion.

2.3. Procedure

Students were eligible to participate in the study if they had completed a clinical placement at the university clinic between March and December 2020. Eligible students had conducted both face-to-face and telehealth consultations whilst at the clinic. Five disciplines (exercise physiology, nutrition and dietetics, occupational therapy, physiotherapy, and speech pathology) were chosen for inclusion in the study as they provided telehealth services. All eligible students were invited to participate in the study via email with an attached participant information sheet. A member of the research team provided a follow up telephone call to give participants an opportunity to seek further clarification about the study. If consent was provided, researchers (RB, SH, IN, AF, CH, and NB) then read a script outlining the purpose and ethical considerations of the research and proceeded with the telephone survey. Researchers met prior to conducting the telephone survey to discuss the data collection process. Due to pragmatic limitations, responses could not be voice-recorded, however, researchers were instructed to document a straightforward description of the participant's responses capturing their words as closely as possible.

A retrospective telephone survey was used to optimise the response rate (36). The survey instrument was informed by a validated student satisfaction questionnaire (37). Ten statements about student learning experiences were included to align with the research question (see Table 1). For each statement two responses were requested, one

TABLE 1 Student learning experiences of telehealth and face-to-face consultations rated using a five-point Likert scale.

Statement	Strongly agree/agree		Strongly disagree/disagree		Difference	Significance
	Telehealth	Face-to-face	Telehealth	Face-to-face		
I received adequate information about my responsibilities/expectations.	44 (89.8)	48 (98.0)	0 (0.0)	1 (2.0)	1 (2.0)	0.002
I was provided with experiences that were appropriate for a student of my background and experience.	43 (87.8)	47 (96.0)	1 (2.0)	0 (0.0)	−1 (−2.0)	0.000
I was provided with adequate opportunity to develop my competencies.	40 (83.4)	46 (95.9)	3 (6.3)	2 (4.2)	−1 (−2.1)	0.003
I was provided with a quality placement that provided a range of tasks and experiences.	40 (83.3)	45 (93.8)	1 (2.1)	0 (0.0)	−1 (−2.1)	0.000
I had appropriate learning experiences to assist me to meet my assessment requirements.	40 (87.0)	44 (95.6)	1 (2.2)	0 (0.0)	−1 (−2.2)	0.000
I felt prepared for the tasks expected of me.	37 (77.1)	44 (91.7)	5 (10.4)	1 (2.1)	−4 (−8.3)	0.000
My experiences assisted me to develop clinical problem-solving skills.	45 (93.8)	47 (97.9)	2 (4.2)	0 (0.0)	−2 (−4.2)	0.002
My experiences inspired me to develop my communication and counselling skills.	42 (85.7)	48 (97.9)	3 (6.1)	1 (2.0)	−2 (−4.1)	0.003
My understanding of the clinical practice area has improved.	44 (89.8)	49 (100)	2 (4.1)	0 (0.0)	−2 (−4.1)	0.003
I had opportunities to work in a multidisciplinary team.	13 (26.5)	36 (73.5)	24 (49.0)	6 (12.2)	−18 (−36.8)	0.010

for telehealth and one for face-to-face: quantitative data was collected using a five-point Likert scale (1 = strongly agree; 5 = strongly disagree) and qualitative data by open-ended questions asking for further comment. Additionally, a final, open-ended question asking students to comment specifically on their telehealth clinical learning experiences concluded the survey. Open-ended comments were optional, and participants were not excluded from the study when open-ended responses were not provided. The questionnaire was scripted into a telephone survey to ensure consistency in the data collection. A filter question about telehealth exposure was added to ensure participants met the inclusion criteria. The final questionnaire was pilot tested by researchers with students on placement at the clinic who did not meet the inclusion criteria and modification made to improve readability.

2.4. Data analysis

The quantitative survey data was analysed in SPSS Version 26 using descriptive statistics. Questions that received quantitative responses to both telehealth and face-to-face components of the question were included in the data analysis. The ratings of agree/strongly agree and disagree/strongly disagree were combined to provide an overall picture of positive or negative ratings of telehealth and face-to-face experiences. Categorical data were summarised using frequencies and relative frequencies. Chi-square test (or Fisher's exact test when necessary) was used to examine the association between responses to each statement and placement type (38). Qualitative data from the survey was collectively analysed by reflexive thematic analysis (RTA) (39) using a qualitative descriptive approach (40). SH, a novice qualitative researcher, and RB, who had experience in qualitative research, clinical education, and telehealth, both independently analysed the data through a process of data emersion, code generation and pattern recognition to construct preliminary themes. To support a process of reflexivity and increase confirmability, these researchers then met to discuss and critique each other's interpretations, articulating their perspectives, identifying their assumptions, and learning from each other's observations. CM also conducted an inquiry audit, increasing the dependability of the research process. SH then generated her final central organising themes.

3. Results

A flow diagram of the participant recruitment process and summary of the number of students from each discipline is shown in Figure 1. A total of $n = 151$ eligible students were identified, 67 consented to participate (44% response rate), and $n = 49$ students were included in the final data analysis. The number of students from each discipline is as follows: Exercise Physiology ($n = 11$), Master of Nutrition and Dietetics ($n = 6$), Master of Speech Pathology ($n = 2$), Occupational Therapy ($n = 12$), and Physiotherapy ($n = 17$). Students from two Universities participated in placements at the university clinic and were included in the study: University one ($n = 42$) and University two ($n = 5$). Students completed either an even mix of face-to-face and telehealth

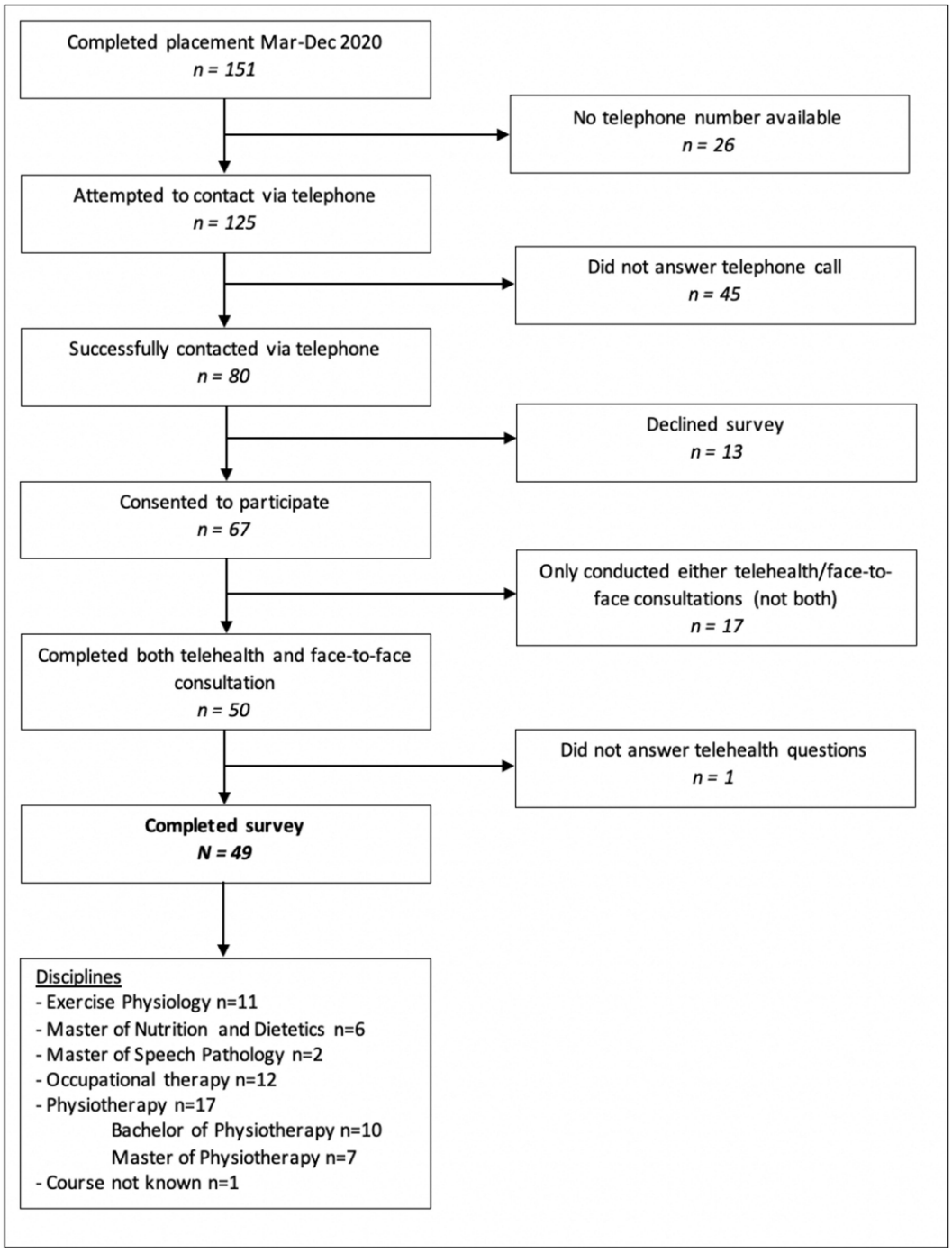

FIGURE 1
Flow diagram of student eligibility and participation in telephone surveys.

consultations ($n = 14$), predominantly face-to-face with some telehealth ($n = 26$), or predominantly telehealth with some face-to-face ($n = 9$).

3.1. Quantitative results

Most students agreed or strongly agreed with nine statements for both telehealth (>77.1% agree/strongly agree) and face-to-face (>91.7% agree/strongly agree), however, face-to-face was rated significantly higher on all ten statements (all p-values <0.01). On the final statement "I had opportunities to work in a multidisciplinary team," students stated that they had significantly more opportunities when conducting face-to-face consultations (73.5% agree/strongly agree, 12.2% disagree/strongly disagree) compared to telehealth (26.5% agree/strongly agree, 49.0% disagree/strongly disagree; $p = 0.003$). A summary of the quantitative results for all ten statements is shown in Table 1.

3.2. Qualitative results

Approximately half the participants provided responses to the open-ended questions [$\sum = 293$, $x = 27$ (54%)], with the majority (73%) responding to the final open-ended question. Four themes were generated by the researcher SH from the participants responses to the open-ended questions. These are: (1) placements can vary in quality regardless of setting; (2) telehealth can provide valuable learning experiences and support competency development; (3) enablers for telehealth placements; and (4) barriers for telehealth placements.

3.2.1. Placements can vary in quality regardless of setting

Participants reported that their experience of a telehealth placement can be influenced by a variety of factors, many of which are not unique to telehealth such as client numbers and case-mix,

> "*I feel like on the placement I had, we saw a huge range of different clients, who all had varying backgrounds, conditions etc. This allowed myself, and other students a huge amount of growth and exposure to different clients which was great." (Q4, Exercise physiology student).*

> "*The range of clients was not much. We got people coming in for the same thing which got quite boring." (Q4, Occupational therapy student).*

learning opportunities available during the placement,

> "*Even in my first week, my supervisor was open to us taking learning opportunities. We had the opportunity to observe but we could also have a go ourselves. We were always offered the challenge to extend our learning. Yes—we always had a say." (Q3, Nutrition and dietetics student).*

> "*I had opportunity to work closely with speech pathology and once or twice during my placement time was had a case study where our supervisors gave us the information about a client and as a multidisciplinary team came together to discuss this client. We had different perspectives and I had opportunities to learn about how the team takes the client from their perspectives. It was helpful and was an interesting experience." (Q3, Occupational therapy student).*

and the student's stage of placement.

> "*I found telehealth difficult, interacting with the client being a first placement. I could see that students who had more experience were more confident and were more comfortable in that setting. If it was the last placement, it would be a better experience but as it was my first placement it was harder." (Q11, Occupational therapy student).*

> "*The only difference was the complexity of the clients. For me, my face-to-face consultations were more complex. Telehealth was a nice opportunity to gather information in a different way—to look in the pantry and make the patient feel more comfortable using their home environment." (Q7, Nutrition and dietetics student).*

Participants highlighted how the educational approach of their clinical educators impacted the quality of their placement,

> "*I had two supervisors. One of them I don't think helped me very much at all, was very critical of everyone. We were scared to ask her questions. My other supervisor was really good, we could ask her anything and get her to check our work." (Q5, Exercise physiology student).*

Participants valued a supportive environment, and regular and constructive feedback following telehealth consultations.

> "*Our educator was always there for us. After each session we were provided with feedback and comments to improve our next consultation. It was really great." (Q2 Nutrition and dietetics student).*

3.2.2. Telehealth can provide valuable learning experiences and support competency development

Participants talked about how when using telehealth, they developed their clinical reasoning and problem-solving skills, improved their resourcefulness and flexibility, and learned to communicate effectively in ways that are different to face-to-face experiences.

> "*Telehealth placed a larger emphasis on clinical problem solving and working in different situation and consolidated some of that learning." (Q7, Physiotherapy student).*

> "*Both options gave different opportunities to meet my assessments. Telehealth required flexibility, adaptability, and skills with using technology." (Q5, Exercise physiology student).*

Participants reported increased work-readiness as they gained an additional skill set and appreciation for the benefits of telehealth to their practice. Development of communication skills stood out as a particular strength of telehealth under this theme.

> "*The telehealth session, it was working well for the client's family. The client didn't have to come to the session, and they could do it at home so there was no travelling time. The parents were more involved in the session with the child, so the parents have more opportunity to practice at home whereas in the (face-to-face) session the parents have to prepare in advance. …I saw lots of benefits of telehealth sessions after that." (Q11, Occupational therapy student).*

> "*I think having the opportunity to use telehealth in the context of placement did provide me with an understanding of the merit of using telehealth as a practitioner in the future and I think that by using telehealth I was able to focus on my communication skills in a way that I probably would not have provided so much attention to if I had all my consultation face-to-face. I was more aware of my tone of voice, the way I phrased things, such as my diet disease relationships. I paid more attention to listening to verbal cures from clients. I feel fortunate that I got to experience this. My future career may involve using telehealth platforms and I felt fortunate that I got to experience that on my placement." (Q11, Nutrition and dietetics student).*

Participants reported that they found the hands-off nature of telehealth encouraged them to develop their verbal communications skills. This was particularly noted for participants from physiotherapy and exercise physiology, whose disciplines are usually considered "hands-on".

> "*Telehealth really helped my clinical reasoning skills as I could not do any hands-on skills, so I needed to develop more questioning skills to describe what I needed to know and what I needed to tell them.*" *(Q11, Physiotherapy student).*

> "*Telehealth required you to be clear and precise with your descriptors/measurements and analysis tools and you needed to work harder to make the client feel comfortable more quickly.*" *(Q8, Nutrition and dietetics student).*

Some participants however, felt that a telehealth placement did not support their development in all areas of practice.

> *The face-to-face was more applicable to our university workload. We had practical assessments—we had more opportunity to develop the 'hands-on' tasks (Q5, Exercise physiology student).*

Telehealth provided an opportunity for safe delivery of placements during the COVID-19 pandemic and for innovation and engagement in the clinic during placements. For example, participants studying physiotherapy had opportunities to complete projects related to telehealth that increased their learning opportunities.

> "*Impressed during the telehealth placement how the supervisors got us involved in the projects. Even when we had time off there were tutorials that gave us opportunities to learn.*" *(Q4, Physiotherapy student).*

3.2.3. Enablers for telehealth placements

Participants described how positive telehealth experiences are enabled by factors such as the provision of learning scaffolds, and induction and site training that familiarises students with telehealth delivery.

> "*I didn't know anything about telehealth before placement. Everything was detailed for me about what I needed to get from the client and how to use telehealth services.*" *(Q1, Exercise physiology student).*

> "*With the telehealth one, as I'm a first-year student, we were provided with a script which really helped me.*" *(Q2, Occupational therapy student).*

Adequate opportunity to prepare for consultations, client screening, and regular feedback from supervisors using competency-based assessment tools also enabled participants to have positive telehealth experiences.

> "*Our supervisors had us create a pre-telehealth questionnaire to give to the clients. After making that I felt more prepared.*" *(Q6, Nutrition and dietetics student).*

> "*Our supervisors gave us feedback which helped us improve. There was adequate feedback given after telehealth as well.*" *(Q3, Occupational therapy student).*

3.2.4. Barriers for telehealth placements

Participants shared how their experiences of telehealth can be negatively impacted. This can be due to issues with the telehealth itself, such as sophistication of the platform or technical issues,

> "*What came out of telehealth was about the quality of the platform we were using, especially for the needs of the clinician and the client. For speech pathology we play games and have children relax, with the platform we used we couldn't give control to the client to support their engagement in sessions.*" *(Q11, Speech pathology student).*

> "*Telehealth delivery was quite new. At times, we lost connection and lost momentum with the client.*" *(Q2, Exercise physiology student).*

or due to uncontrollable factors such the challenges associated with rapid implementation of telehealth within the clinic in the context of the COVID-19 pandemic.

> "*I was happy that we were able to transition to telehealth rather than cancelling the placement. We were able to work in areas that we wouldn't in a face-to-face placement. Instructors did a good job of helping us transition and to help us through technical and other difficulties that we had during the process.*" *(Q11, Physiology student).*

Learning related barriers were identified by the participants. This included limited inclusion of telehealth in the curricula prior to placement and the rapid adaption of face-to-face administered assessments to telehealth practice.

> "*Given that we weren't given any training in telehealth during our university studies, it was a stretch to start doing telehealth consultations only, but we were given enough training to make that transition successfully.*" *(Q2 Physiotherapy student).*

> "*I just think with telehealth my assessments weren't really written for telehealth, so it wasn't fully meeting my expectations.*" *(Q5, Occupational therapy student).*

> "*Sometimes the system can be easy to follow. We needed more set-up assistance for telehealth. We needed more practice. My hours were lower than some others, but I need to know more about how to be professional and to do things better over telehealth.*" *(Q3, Exercise physiology student).*

4. Discussion

This mixed methods study contributes to the body of evidence on the educational contribution of telehealth to allied health student clinical placements. Unlike Posey et al. (41) and Patterson et al. (25) our quantitative results showed a statistically significant difference between telehealth and face-to-face placement learning experiences across all

items. Yet, like Patterson et al. (25) while our students preferred face-to-face consultations, they found both settings provided useful learning experiences. Most participants in our study agreed or strongly agreed that telehealth experiences provided high quality learning experiences (Statement 4), were aligned with the assessment requirements (Statement 5), assisted them to develop their competencies (Statement 3); enabled the development of clinical problem-solving skills (Statement 7), and improve their clinical practice (Statement 9).

Our qualitative results help us to understand these results. Qualitative comments from participants in our study suggested that the stage of placement influenced their perception of telehealth learning experiences. Posey et al. (41), found a statistically significant difference related to the sequence of encounter type, with students more likely to make a correct diagnosis when the first encountered patients were face-to-face rather than telehealth ($x^2 = 9.7$, $p < 0.01$). They suggest that it may in part be due to the lack of familiarity with the technology. In line with previous research (19–21, 42), our study identified technical issues related to telehealth as a barrier to positive learning experiences during telehealth consultations. For example, Shortridge et al. (43) found that complaints about technical issues in student reflections coincided with lower scores on a Telehealth Acceptance Survey following telehealth clinical activities. Offering skills training to clinical educators and students on the telehealth technology prior to conducting telehealth consultations may mitigate this concern. A 2021 review on telemedicine in the medical curricula identified that students would benefit from additional time to become familiar with and practice using telehealth technologies (44). Given the rapid rollout of telehealth during COVID-19, like other students, students and the clinical educators implemented telehealth on the run and learned how to prepare students on subsequent placements (17, 19, 22, 45).

The quality of a clinical placement is dependent on many factors (46–48), independent of whether the placement is completed via telehealth or face-to-face. For example, this can be due to the students' interactions with their clinical educators including the educators' telehealth skills, teaching styles, progress of telehealth implementation in the clinic, and student preparation for placement (49). Other factors that influence student experiences may also be individual, such as the student's prior skills and abilities, physical and emotional state, attitude, learning styles or personality traits (50). In this study, the same students in the same placement settings rated both their face-to-face and telehealth experiences, minimising these variables. The rapid rollout of telehealth in the context of a pandemic, however, must be considered in interpreting these results. This influenced client numbers and case-mix, the learning environments, and the student's interactions with their supervisors.

As found by other researchers (16, 22–24), some of our participants expressed concern that telehealth did not support their development in all areas of practice, particularly for 'hands-on' tasks. Yet, telehealth also offered some unique advantages. Participants reported increased resourcefulness and flexibility, greater appreciation and capability with telehealth, and improved communication and professional skills. Pelly et al. (51) found similar results, arguing that such capabilities are well aligned with future workforce needs. The Australian Government's recent decision to continue subsidising telehealth (52) reinforces that telehealth is now a mainstream health service and its delivery is an essential capability for health graduates. Some disciplines have introduced new competency standards in telehealth (53) while others advocate for more generic competency standards aligned with its delivery (54). Certainly, consistent with our findings, there is a call to embed telehealth into the health curricula (10, 19–22, 26, 44, 55–57).

In our study participants reported fewer opportunities to work in a multidisciplinary team (Statement 10), although it is not clear if this is a limitation of the university clinic rather than telehealth itself. The rapid shift from face-to-face to telehealth in response to the COVID-19 pandemic may have resulted in a move away from the structures that were in place at the clinic for multidisciplinary learning experiences. Previous research on interprofessional education and telehealth has focused on programs structured specifically for interprofessional telehealth activities (43, 58, 59). It may be that a specific focus on providing multidisciplinary or interprofessional learning experiences is needed to enable this to take place within university clinics. Telehealth offers unique capabilities ideally suited to interprofessional care delivery (60), with recent preliminary ($n = 13$) evidence from Pittman et al. (30) which showed that Total Team Skills Scale scores (a self-assessment measure of interprofessional team skills) improved significantly after participating in the telehealth service ($Z = 2.9$, $df = 12$, $p = 0.004$).

4.1. Limitations

Despite its novelty and currency, this study has some limitations. The number of placements that each student had undertaken prior to their placement at the university clinic was not recorded, nor was their level of experience in using telehealth. It should be noted, however, that 87% of students reported to have been provided with experiences that were appropriate given their prior learning (Statement 2). Some of the disciplines had only recently established their clinics within the university clinic and had a small number of students completing placements during the study period. This meant that it was not possible to make a statistical comparison of quantitative responses to determine whether results varied by student experience or between disciplines. We did not measure the time taken for students to complete tasks or compare this time from face-to-face to telehealth. However, these limitations were strengthened by qualitative comments that provided some context to students' responses, and an understanding of how and why student experiences differ. This study is based on retrospective participant reported data. It is recommended that further research be undertaken that measure changes in students' learning development and outcomes after attending telehealth clinical placement experiences.

4.2. Conclusions and future directions

The findings of this study have important implications for allied health education and professional accreditation. Our study provides evidence for allied health courses across a range of disciplines (exercise physiology, nutrition and dietetics, occupational therapy, physiotherapy, and speech pathology) for the use of telehealth to develop and assess students' professional competence as part of an overall placement program. As concluded by other researchers (22, 24), telehealth is an '*important tool in the toolkit*' [Ross et al. (22), p. 14] in student clinical placement education. This research calls for the integration of telehealth into the health curricula including the

development of communication skills and interprofessional experiences specifically for telehealth, and onsite support and training with telehealth technologies. There is a need for more robust research on allied health telehealth clinical placement experiences and competency development, particularly without the added complexities of the COVID-19 pandemic.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the University of Canberra Committee for Ethics in Human Research (CEHR 4431). The participants provided their written informed consent to participate in this study.

Author contributions

RB, EG, SH, AF, IN, CM, CH, NB, LS, and SC contributed to the research design, funding application, and data collection. RB completed the ethics application. SH, EG, and RB completed the initial data analysis. SH and RB drafted the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that this research was conducted in the absence of any commercial relationships that could be constructed as a potential conflict of interest.

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Use of social media for the improvement of safety knowledge and awareness among Saudi Arabian phlebotomists

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Purpose: The purpose of this study is to investigate the use of social media for the improvement of safety knowledge and awareness among phlebotomists.

Methods: As this study was intended to arrive at specific conclusions using empirical evidence, a deductive quantitative cross-sectional online survey design was adopted. A total of 521 phlebotomists participated in the survey, and 86 incomplete responders were removed, resulting in a final sample of 435 considered in this study. *T*-tests and ANOVA were used to analyze the data.

Results: A total of 41.6% stated that social media was very effective, and 31.5% stated that it was somewhat effective in improving safety knowledge and awareness. in addition, this study revealed no major differences between male and female participants ($p > 0.05$) with respect to the effectiveness of social media. However, statistically significant differences ($p < 0.05$) among the age groups were identified in relation to the effectiveness of social media and the intention to use it in the future.

Conclusion: Social media applications are effective for knowledge dissemination among healthcare professionals.

KEYWORDS

social media, phlebotomists, knowledge, awareness, information, sharing

Introduction

With the increase in access to the Internet, the number of social media users has been rapidly increasing across the world. According to a study conducted by Kepios (1), 4.76 billion people across the globe are using social media, which represents 59.4% of the global population. According to a recent study (2), the number of social media users globally has increased from 1,720 million in January 2013 to 4,760 million in January 2023, reflecting a 177% increase in a decade. Currently, for every 10 users on the Internet, 9 users are using social media (3). As social media platforms allow only those who are aged above 13 years, it can be understood that 78% of the eligible global population uses social media, indicating

high adoption rates of social media among people. Moreover, on average, more than 2.5 h per day is spent on social media by users, reflecting 15% of the waking time spent on social media platforms by the users (1). With 2.9 billion active users, Facebook is the top social media platform, followed by YouTube (2.5 billion), WhatsApp (2 billion), Instagram (2 billion), and Twitter (556 million). It is also identified that most of the social media users use four to seven different social media applications (4). According to GWI (5) report, WhatsApp is the most popular social media platform globally, followed by Instagram, Facebook, WeChat, and TikTok. According to a study conducted by GWI in 2022, the main reasons for using social media included keeping in touch with family and friends, filling spare time, reading new stories, finding content (such as articles and videos), and seeing what is being talked about.

Social media apps have swiftly grown in the professional field as a result of social media's popularity in private usage contexts. These applications are helpful as a gauge for strategic information management in an organization's internal environment. Social media in this regard promises to provide sufficient tools to assist both methodical knowledge storage and sharing of knowledge and communication in businesses. However, because social media is only effective when used, employees' motivation to use it is a crucial factor for increasing knowledge and awareness and supporting their professional growth (6). Several studies (7) on the use of social media in the workplace for work-related use could enhance the employees' knowledge exchange process and also their performance. A study on small- and medium-scale enterprises (SMEs) in Germany (8) has found that internal social media, such as blogs and wikis, are used by companies to enhance collaboration among employees and to improve knowledge management. Similarly, another study in China (9) identified that both work-oriented social media and socialization-oriented social media applications can generate synergies to improve employee performance. Not only performance but also social media was identified to be having positive effects on improving work engagement, satisfaction, and organizational commitment (10). A few studies (11–14) have also highlighted the negative effects of using social media in the workplace. For instance, the issue of privacy and security was highlighted in (11) for influencing information-sharing decisions within organizations. In addition, its effects, such as getting distracted and addicted to the use, can negatively affect employee performance and strain organizational resources (12). Considering the similar effects, a study in Hungary (13) suggested that companies should train their employees and motivate them to use social media for knowledge sharing at workplaces. The need for social media in the workplace is realized in many organizational sectors such as news and media (11), insurance (14), and healthcare (15). A recent study of social media usage by doctors (15) in healthcare organizations identified three themes including, extended communication and relationships among doctors, beneficial for acquiring existing and new knowledge, and knowledge sharing and transfer for promoting knowledge exchange.

The healthcare system in Saudi Arabia is complex compared to other countries as the nation largely depends on expatriate healthcare workers in different streams of healthcare (16). Furthermore, it is observed that the percentage of demand supply of personnel in allied health services is projected to increase from 82.4% in 2020 to 99% in 2030 (17), indicating a severe shortage of allied health workers such as phlebotomists. Furthermore, Saudi Arabia is facing issues in healthcare management with frequent epidemics, such as Ebola, MERS, SARS, and the recent COVID-19 pandemic (18–20), creating a huge burden on the healthcare system. Moreover, the prevalence of chronic diseases, such as diabetes, cancer, and hypertension, is increasing at a high rate in the country. In this context, phlebotomists play an important role in managing public health as they are critical resources in disease diagnosis and management. In addition, issues are observed in Saudi Arabia with phlebotomist staffing ratios, readiness, compliance with guidelines, and awareness (21, 22). Therefore, it is important to develop or utilize technology interventions in increasing the safety knowledge and awareness of phlebotomists in Saudi Arabia.

This widespread social media usage has impacted how information is shared, how people communicate, how knowledge is disseminated, and how users—like patients and doctors—interact with one another (23). The usage of social media has also helped healthcare workers perform better by enhancing their knowledge, skills, competencies, and learning environments (23–25). These tools are also helpful in increasing awareness and assisting with the physical and psychological care of patients suffering from a variety of illnesses, including cancer, cardiovascular disease, diabetes, HIV, derma-pathologies, urological illnesses, surgical interventions, mental disorders, and pulmonary diseases (26–30). It should be emphasized that, in addition to the advantages it offers, social media use also carries ethical and legal dangers, including the potential to violate patient confidentiality, harm healthcare professionals' reputations, and handle incomplete or inaccurate information. In addition, during the recent pandemic, social media was very effective in quickly disseminating knowledge among healthcare workers (31) and also for health promotion (32). The use of social media for improving knowledge and awareness of various healthcare workers including physicians, nurses, and other workers was investigated in various studies (23, 27, 33, 34); however, there were no studies identified in relation to the social media use by phlebotomists for knowledge exchange and increasing awareness. It is important to investigate this particular area so that it can help decision-makers in enabling the ethical, efficient, and effective use of social media in the workplace of phlebotomists for improving safety knowledge, which can result in improved patients' safety, improved quality of care, increased efficiency, better compliance with regulations, and also support the professional growth of phlebotomists. Therefore, this study aims to investigate the use of social media for the improvement of safety knowledge and awareness among phlebotomists.

Methods

As this study was intended to arrive at specific conclusions using empirical evidence, a deductive quantitative cross-sectional design was adopted (35).

Study setting and participants

This study explicitly focused on phlebotomists; therefore, 14 public hospitals from the Eastern region of Saudi Arabia were included. The data were collected using online survey platforms.

Questionnaire design

The survey questionnaire in this study was partly developed by the authors. The questionnaire contains two sections. The first section focuses on collecting demographic information. The second section has 13 questions focusing on the use of social media. Among the 13 questions, 6 questions (7–12) were adopted from a similar study (36), while the rest were developed by authors. The survey questionnaire was designed in the English language as it can be easily understood by both Saudi and non-Saudi phlebotomists. The quality of the questions was reviewed by a panel of five academic professors from the health information management department at Imam Abdulrahman Bin Faisal University, Saudi Arabia. Furthermore, a pilot study was conducted with six phlebotomists at the university hospital. The results were analyzed, and the Cronbach alpha was identified to be >0.85 for all items, indicating good reliability and internal consistency (37). The survey questionnaire was then uploaded online using Google Forms, and the survey link was generated.

Recruitment and sampling

After getting ethics approval from the university and permission from the hospital administration, the survey link was emailed to phlebotomists at the respective hospitals and also through social media applications. As the authors have accessed these hospitals considering the mobility and accessibility, focusing specifically on the eastern region, the approach reflects the adoption of convenience and purposive sampling techniques (38) in this study. The total number of phlebotomists at the selected hospitals ($n = 724$) was used in Cochran's formula to calculate the ideal sample required for the study (39), and it was calculated to be 252 at a 95% confidence interval.

Data collection

As stated earlier, the survey link was forwarded to 724 phlebotomists. At the end of 4 weeks after forwarding the link, a total of 521 responses were collected. However, 86 responses were not fully completed. After the removal of incomplete responses, a total of 435 responses were considered for the data analysis.

Ethics

Before commencing the survey, informed consent was obtained from each participant after they had been fully apprised of the study's objectives. The anonymity of the participants and their rights to the data were protected. All the ethical procedures prescribed at Imam Abdulrahman Bin Faisal University were followed. Ethics approval for the study was obtained from the Research Ethics Committee at the university.

TABLE 1 Participant demographics.

	Variables	*N*
Sex	Male	214
	Female	221
Age group	20–29 years	161
	30–39 years	162
	40–49 years	88
	50–59 years	22
	>59 years	2
Education	Diploma	159
	Bachelor's degree	115
	Master's degree	78
	Ph.D.	24
	Others	59
Work experience	<3 years	121
	3–6 years	40
	6–9 years	116
	>9 years	158

Data analysis

To analyze the overall data, statistical techniques including means, relative frequencies, and standard deviations were used as the majority of the data were numerical. Additionally, one-way ANOVA and *t*-tests were performed using Microsoft SPSS to compare the significant statistical differences between the participant groups.

Results

As shown in Table 1, the participants were appropriately distributed across both sexes, including 49.2% male and 50.8% female phlebotomists. Considering the age group, 37.2% of the total participants belonged to the 30–39 years age group; 37% belonged to the 20–29 years age group; 20.2% to the 40–49 years age group; and 5.5% were aged 50 or more than 50 years. Focusing on education, the majority of the participants had a diploma degree (36.5%), followed by a bachelor's degree (26.4%), a master's degree (17.9%), other degrees (13.5%), and Ph.D. holders (5.5%). Given the work experience, the majority of the participants had more than 6 years of work experience, with 36.3% having more than 9 years of experience and 26.6% having 6 to 9 years of work experience.

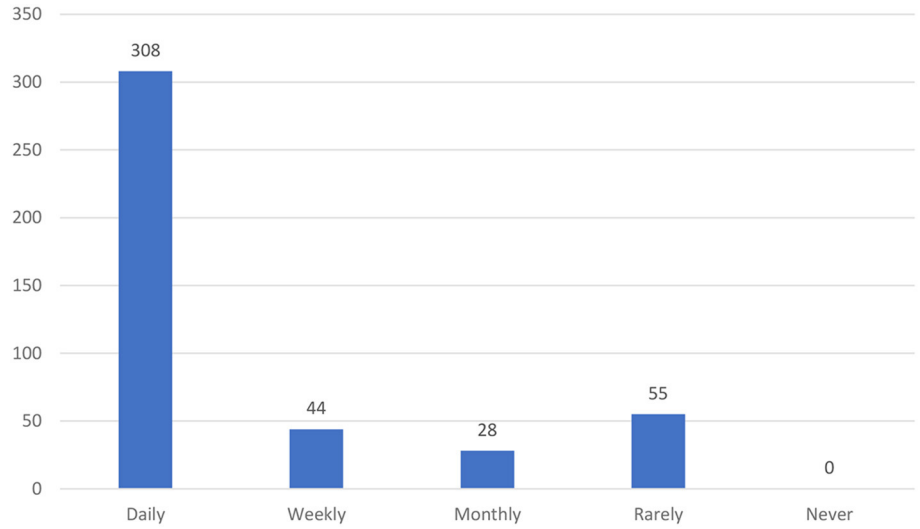

FIGURE 1
Frequency of social media usage.

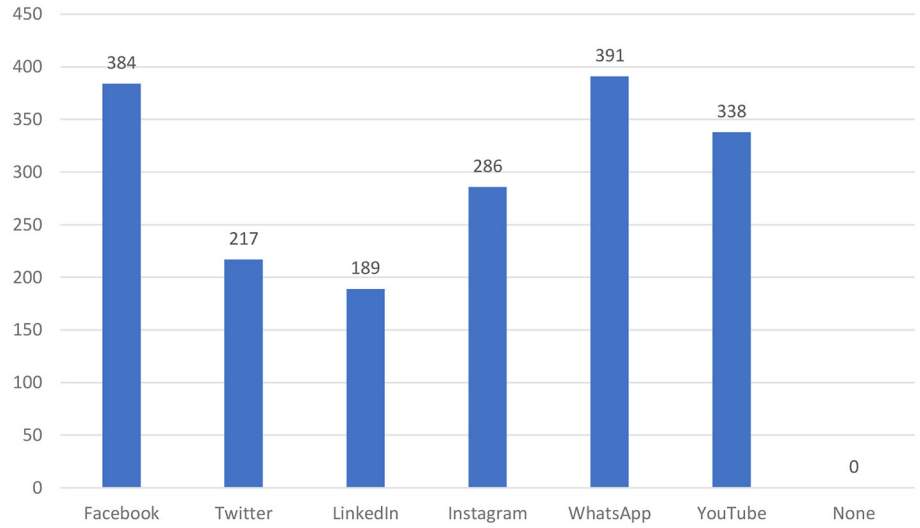

FIGURE 2
Social media applications used by the participants.

Approximately 27.8% had work experience of <3 years, and only 9.1% had 3 to 6 years of work experience.

Analyzing the frequency of social media usage, it was identified that 70.8% of participants used daily, 10.1% used weekly, 6.4% used monthly, and 12.6% used rarely (see Figure 1). Among the social media applications used, most of them used more than two applications (see Figure 2). It is observed that WhatsApp was used by 89.9%; Facebook was used by 88.2%; YouTube was used by 89.1%; Instagram was used by 65.7%; Twitter was used by 49.8%; and LinkedIn was used by 43.4%.

Approximately 60% of the total participants stated that they use social media applications for more than 3 h a day, while 28% use them for 1 to 2 h a day. In addition, 84.9% stated that they use social media for entertainment, 72.4% stated that they use social media for education, and 81.2% stated that they use social media for other purposes. Considering the effectiveness of social media in improving safety knowledge and awareness, 41.6% stated that it is very effective, and 31.5% stated that it was somewhat effective. However, only 14.7% stated that it is not very effective and not at all effective (see Figure 3).

It is identified that 79.5% of the total participants stated that they learned new information about phlebotomy using social media applications. In addition, 76.3% of the participants stated that they share some information about phlebotomy with their colleagues using social media applications. Moreover, 72.8% of the participants (combined numbers of very likely and somewhat likely) stated that they are likely to refer social media applications to their

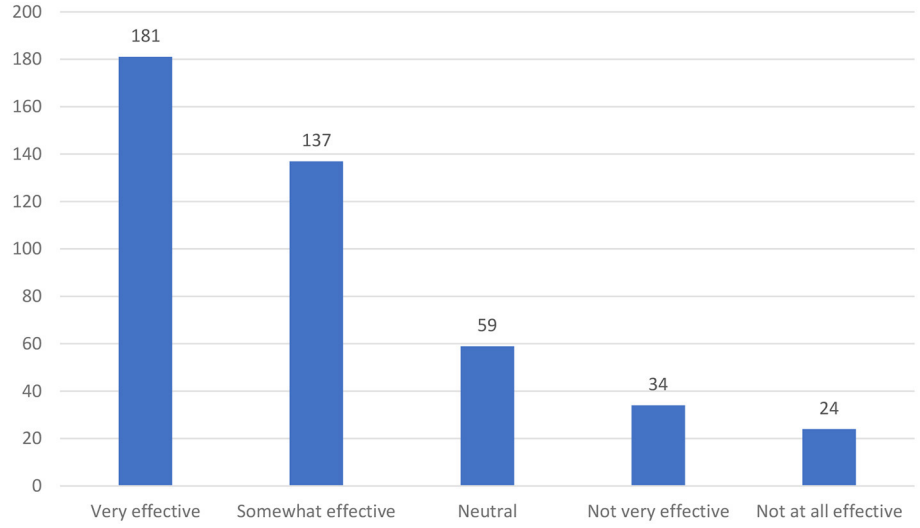

FIGURE 3
The effectiveness of social media applications in improving safety knowledge and awareness.

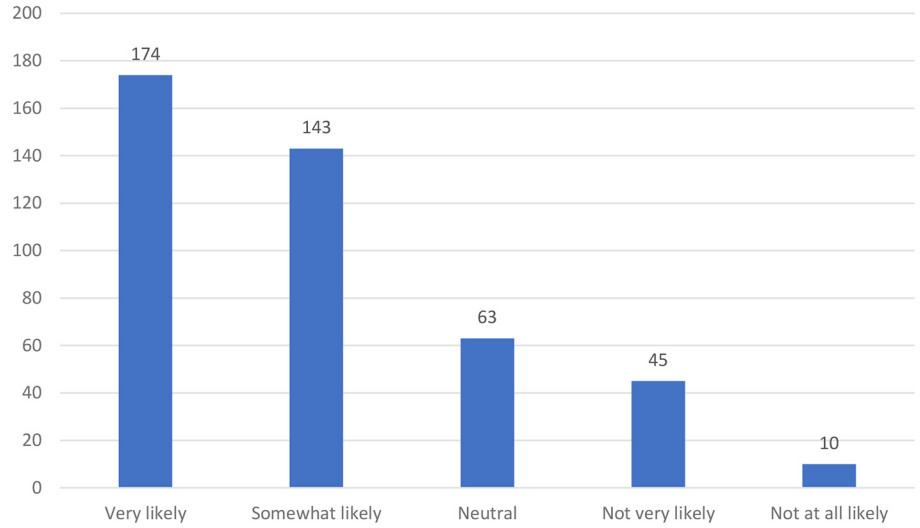

FIGURE 4
Likelihood of referring social media applications to colleagues for improving safety knowledge and awareness.

colleagues for improving safety knowledge and awareness (see Figure 4).

For the preferences on media formats of accessing and viewing information, video and picture formats were preferred by more than 85% of participants, while only 51.1% preferred audio formats. Text formats and articles/journals were also preferred by more than 65% of the participants (see Figure 5).

Approximately 89.4% of the total participants stated that they would use social media if they need any information during working hours; in relation to the sources they preferred, 91.2% preferred the Internet and 88.7% preferred social media, followed by books (52.5%), journals (43.1%), short notes (26.2%), and others (19.8%).

Approximately 65.7% of the total participants stated that they are willing to increase social media use in professional practice about learning phlebotomy safety procedures and practices, while 12.6% stated that they may increase the usage in the future.

In addition, in relation to the drawbacks or challenges that the participants have experienced when using social media applications for learning about phlebotomy safety, some of the major factors identified (grouped similar opinions under a theme) are presented in Figure 6. Interactions with opposite sexes and time management were the most related comments observed.

Furthermore, to identify whether differences existed among the participants' groups based on sex, *t*-tests were conducted, and the results as shown in Table 2 revealed no major differences between the male and female participants with respect to the effectiveness of

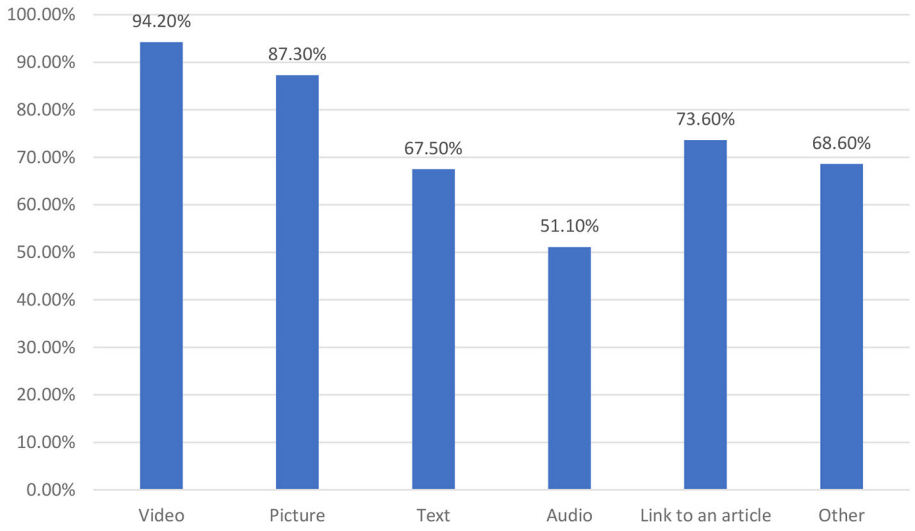

FIGURE 5
Preference of media formats for safety-related information.

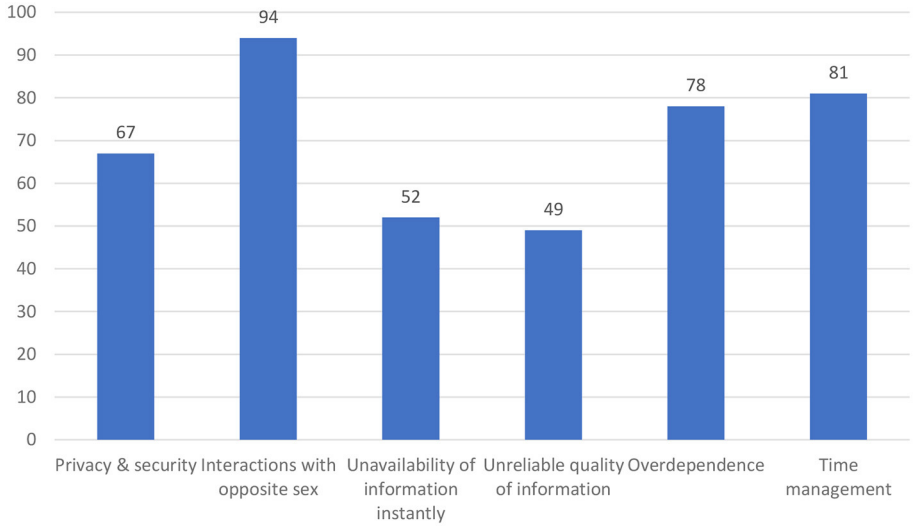

FIGURE 6
Challenges of using social media for sharing safety knowledge.

social media for improving safety knowledge and the intention to use them in the future.

Similarly, Table 3 presents one-way ANOVA results to identify the differences among the age groups in relation to the effectiveness and intention to use in the future (see Table 3). Significant differences among the age groups were identified in relation to the effectiveness of social media ($p < 0.05$) and intention to use it in the future ($p < 0.05$).

Discussion

This study has achieved its objective of analyzing the use of social media for the improvement of safety knowledge and awareness among phlebotomists. It is evident from the results that the majority of the participants used social media daily, and nearly 60% were using it for more than 3 h a day. Similar results were reported globally on the use of social media (1–5). These results indicate that phlebotomists use social media in the workplace more frequently, indicating that most phlebotomists are active social media users, and this identity can be used for enhancing safety knowledge and information-sharing behavior among themselves. Focusing on the social media platforms, WhatsApp, Facebook, and YouTube were the most used channels by the majority of the participants. As per 2022 statistics, in Saudi Arabia, 82.3% of the population uses social media, the country has 11.4 million Facebook users, and its ad can reach 40.7% of the eligible population, 29.3 million YouTube users with a reach of 84.1%

TABLE 2 Differences between the sexes on the effectiveness of social media and intention to use it in the future.

Factor	Groups	*N*	Mean	Std. Dev.	*df*	*t-value*	*p-value*
Effectiveness	Male	214	3.92	1.64	410	0.5847	0.2759
	Female	221	3.99	1.09			
Intention to use it in the future	Male	214	2.52	0.65	428	1.5269	0.0637
	Female	221	2.64	0.56			

TABLE 3 Differences between the age groups on the effectiveness of social media and intention to use it in the future.

		20–29 years	30–39 years	40–49 years	≥50 years
Effectiveness	N	161	162	88	24
	$\sum X$	760	602	336	24
	Mean	4.7205	3.716	3.8182	1
	$\sum X^2$	3620	2350	1414	24
	Std.Dev.	0.4502	0.8375	1.2275	0
	F = 163.59753				
	p-value < 0.00001*				
Intention to use it in the future	N	161	162	88	24
	$\sum X$	456	467	173	29
	Mean	2.8323	2.8827	1.9659	1.2083
	$\sum X2$	1336	1379	421	39
	Std.Dev.	0.5272	0.4512	0.9643	0.4149
	F = 91.65748				
	p-value < 0.00001*				

*Statistically significant.

population, and 15.45 million Instagram users in Saudi Arabia with a reach of 55.2% population (40), supporting the results identified in this study. Furthermore, a similar study conducted on radiologists in Saudi Arabia (36) has identified that WhatsApp was the most used social media application followed by YouTube, Snapchat, Twitter, Instagram, and Facebook. Focusing on the main factor, i.e., the effectiveness of social media for improving safety knowledge, more than 70% stated that it is effective, indicating the positive perceptions of phlebotomists in relation to social media for knowledge enhancement and information sharing. Recent studies (41–44) have suggested that social media can be effective in improving knowledge, information sharing, and communication among various healthcare workers, similar to the findings achieved for phlebotomists in this study. The effectiveness can also be understood from the high extent of learning new information by the participants using social media, with more than 70% agreeing that they frequently share information about phlebotomy or relevant updates.

As observed from the results, the preference for information formats mostly reflected videos, pictures, and journals/articles. Social media applications can support all types of information formats, and similar results were identified in (36). During work hours, it was evident that 89% of participants were using social media for accessing new information, but when asked about sources, 91.2% preferred the Internet (browser application or other applications) and 88.7% preferred social media. Therefore, it is clear that other applications are used in the workplace apart from social media. Considering this factor, it is essential that phlebotomists are made aware of the effectiveness of social media for knowledge sharing. Moreover, it is interesting to observe that more than 65% of participants were currently willing to increase their social media usage. This has to be considered as an opportunity to integrate social media channels into healthcare for increasing safety knowledge among healthcare workers. One of the interesting findings is the challenges associated with opposite-sex interaction on social media, followed by time management. Although the issue seems to be a normal issue, in a conservative country such as Saudi Arabia, the laws are strict, and family norms do not encourage opposite-sex interaction with unknowns (45, 46), which could create hurdles in information exchange and communication via social media among phlebotomists.

Furthermore, the results of the *t*-test did not identify any difference between the male and female participants, indicating that both sexes perceived the high effectiveness of social media for improving safety knowledge and awareness, and also in their intention to use social media for information in the future. However, in relation to effectiveness, younger participants stated that social media is more highly effective compared to

older participants. Similarly, younger participants were more interested in using social media in the future, suggesting that young phlebotomists more actively support and use social media compared to older phlebotomists. Therefore, there is a need to provide training for older phlebotomists to create awareness about the benefits of social media for improving knowledge. Overall, the findings have indicated the positive effect of the use of social media on improving safety knowledge among phlebotomists.

Although the results revealed the effectiveness of social media in contributing to the knowledge and awareness of phlebotomists, it is important to consider the issue of health misinformation on social media platforms, which can lead to equally negative outcomes. It was observed that people with all personality traits shared misinformation about COVID-19 during the pandemic. However, it was observed that users with high cognitive levels shared misinformation to a lesser extent than users with low cognitive levels (47, 48). It is also possible that healthcare professionals may access health misinformation on social media and spread it unintentionally if they lack awareness and analytical skills. A recent study (48) observed that healthcare professionals were similar to healthcare students in correctly distinguishing between true and false news stories. However, skills including analytical and open-minded thinking were positively correlated with the ability to distinguish true and false information. In addition, healthcare professionals have a tendency to believe that news articles are true if they are consistent with the narratives that have already been established (49). Therefore, it is important for all the stakeholders including healthcare professionals, institutions, government, and the public to be vigilant and take responsibility in addressing the issue of misinformation by establishing transparency and trust through reliable communication channels, either through their own platforms or through personalized social media pages (50). The responsibility of healthcare professionals is largely recognized in a recent study as they can help patients and fellow citizens obtain reliable, evidence-based health information (51). Focusing on the government, the policies adopted may be complex to analyze. For instance, in Saudi Arabia, individuals who intentionally share misinformation are fined up to SAR 3 million (approximately US $800,000) and can be jailed for up to 5 years (52). While it is important to adopt strict laws and regulations, the essential focus should be on improving the skills, knowledge, and awareness of identifying misinformation among all stakeholders as there are high chances of arising legal complexities in proving the unintentional action in sharing the misinformation. Therefore, it is essential to adopt various strategies for managing misinformation, some of which are included below:

- Media Literacy Programs: Support media literacy initiatives that educate individuals about evaluating information credibility, identifying biases, and understanding the scientific process. Encourage schools, universities, and community organizations to integrate media literacy programs into their curriculum or public outreach efforts.
- Support from Regulatory Bodies: Advocate for the development and enforcement of regulations related to health misinformation on social media. Work with regulatory bodies and policymakers to create guidelines and policies that hold individuals and organizations accountable for spreading false health information.
- Continuous Monitoring and Adaptation: Regularly monitor social media platforms for emerging health misinformation trends and adapt strategies accordingly. Stay up to date with the latest research, developments, and best practices in combating health misinformation to ensure the effectiveness of one's efforts.
- Collaboration with Social Media Platforms: Collaborate with social media platforms to develop policies and mechanisms that address health misinformation effectively. Advocate for algorithms that prioritize accurate and reliable information while downplaying or flagging misleading content. Engage in dialogue with platform representatives to highlight the impact of health misinformation on public health.
- Educate the Public: Conduct awareness campaigns on the risks of health misinformation and the importance of relying on trusted sources. Educate the public about the potential consequences of acting on inaccurate health information. Promote critical thinking skills and empower individuals to become discerning consumers of health-related content.
- Reporting and Flagging: Encourage users to report and flag health misinformation on social media platforms. Many platforms have mechanisms for reporting false or misleading content. By reporting such content, users can contribute to the removal of misinformation and raise awareness among platform moderators.
- Fact-Checking: Promote the importance of fact-checking and critical thinking among social media users. Share resources and tools that help individuals verify the accuracy of health information. Encourage users to check the credibility of sources, look for supporting evidence, and consult reputable health organizations or professionals.
- Collaborate with Experts: Partner with healthcare professionals, medical organizations, and reputable sources to amplify credible voices. Collaborations can include hosting live Q&A sessions, interviews, or panel discussions with experts to address common health concerns and debunk misinformation. Their authoritative expertise adds credibility to the information being shared.

Implications

Although no study was found to evaluate the use of social media to increase phlebotomists' knowledge, numerous studies have found the substantial usefulness of social media in spreading information to various other healthcare professionals in hospitals. Based on the aforementioned findings, the study's most important conclusion was that the majority of participants thought social media may assist in spreading knowledge to advance phlebotomists' skills, understanding, and awareness of safety. These findings can help policymakers create social media adoption strategies that will promote knowledge and information sharing at work, which will lead to better professional growth and healthcare quality. Additionally, the issues brought up—such as privacy and security,

relationships between people of different sexes, inaccurate or low-quality information, and time management—give decision-makers an overview of the issues that can be solved through the development of policies. This study also adds to the body of knowledge by illuminating the advantages and difficulties of using social media for patient care and professional growth.

Limitations

The significant drawback of this study was that the majority of participants came from a small sample of the eastern region of Saudi Arabia, indicating that more effort needs to be put in future research to include participants from all parts of the Kingdom of Saudi Arabia. It could be interesting to investigate any statistical relationships between demographic variables and the use of social media for knowledge dissemination. Additionally, it is advised to establish and assess the performance of a WhatsApp group and other popular applications in the region for the purpose of disseminating information on phlebology safety and raising awareness among phlebotomists in Saudi Arabia.

Conclusion

The findings indicate that the majority of respondents thought social media may assist in spreading knowledge about safety among phlebotomists in Saudi Arabia. As a result, they are eager to expand the amount of time they spend on social media for this reason in their future professional endeavors. Furthermore, the assessment of the literature revealed that there have only been a few international studies on the use of social media to improve healthcare workers' awareness of safety knowledge and no studies associated with phlebotomists.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Before commencing the survey, an informed consent was obtained from each participant after they had been fully apprised of the study's objectives. Ethical approval for the study was obtained from the Research Ethics Committee at the Imam Abdulrahman Bin Faisal university.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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A program quality framework: a collaborative teaching team approach to quality assurance, quality enhancement and staff capacity building

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A global shortage of registered nurses provides a further impetus to retain nursing students and graduate safe nurses. While various frameworks support curriculum design and describe the need for ongoing curriculum evaluation and monitoring, there is little in the literature to support the enactment and ongoing quality enhancement of curricula. Translation of the curriculum plan into the delivered curriculum relies on academics who may or may not be adequately prepared for course writing and teaching in higher education settings, despite their discipline expertise. Additionally, there are well recognized issues of curriculum drift where curriculum innovations and changes are whittled away over time by incremental changes to courses that interfere with the integrity of the accredited curriculum. We propose an evidence-based Program Quality (ProQual) Framework that takes a holistic, collaborative, and systematic approach to monitoring and enhancing curriculum quality and program delivery over the life of the curriculum while developing staff capability and scholarship.

KEYWORDS

curriculum enactment, quality assurance, quality enhancement, framework, faculty professional development

1. Introduction

Baccalaureate-prepared registered nurses (RNs) decrease patient mortality (1). However, the current global shortage of RNs is projected to worsen (2). Thus, there is an ongoing impetus to provide high-quality nursing curricula to ensure safe graduates and a positive student experience to retain nursing students until graduation. While definitions differ, quality can be defined as a level of excellence that can be assured–through reaching benchmarks–and enhanced over time (3).

Whilst referring to higher education at the institutional level, Land and Gordon (4) indicate that higher education institutions are entrusted with public money to develop human capital and suggest that frameworks that strengthen core academic processes are the best way to protect these interests. In this paper we propose an evidence-based framework to protect and enhance

curriculum quality and program delivery through a capacity-building and collaborative team approach. Throughout this paper, 'program' refers to a degree program, and 'course' to subject level units within the program.

Nursing programs undergo accreditation as one means of ensuring they provide high-quality education (5). Australian accreditation standards mandate:

1. stakeholder consultation to inform curriculum development,
2. an underpinning curriculum framework,
3. mapping that demonstrates constructive alignment between course and program learning outcomes, the syllabus and assessment,
4. the minimum clinical hours to be completed,
5. that national RN and health standards are addressed,
6. that there are student support mechanisms and a documented process to ensure appropriate teacher qualifications, and
7. that governance mechanisms include quality assurance processes that seek and respond to stakeholder feedback and inform the accrediting body of curriculum changes (6).

Once the proposed curriculum (in what is effectively an outline form) is accredited, it is handed to the teaching staff to enact. The enactment of a quality curriculum is predicated on various assumptions. The first is that having postgraduate qualifications and clinical expertise translates to skill in course development and teaching. However, these do not automatically qualify someone as either a competent course writer or teacher (7); clinicians moving into academia often lack formal teaching and course convening preparation and feel unprepared for the role (8).

Another assumption is that teaching staff are eager to adopt innovations. Historically, modifications to courses have often been made using a 'course' rather than 'program'-based focus, and staff tend to return their courses via incremental tweaks to what they are comfortable teaching, with ensuing curriculum drift (9). Decisions about andragogy can be made based on prior experience rather than on solid evidence (5). The enacted curriculum is then not the planned curriculum described in the accreditation documents (10), and 'eventually resembles its pre-innovative ancestor' [(11), p. 2]. Additionally, in large multi-campus programs, maintaining consistency in course delivery across multiple staff and campuses remains a challenge.

Ralph and colleagues' (5) curriculum design framework recommends an evidence-based best practice approach is taken to curricula and that processes are put in place to review and monitor quality. Little is written about mechanisms to do this through the life of a curriculum. Quality in curriculum translation, implementation, and evaluation, as well as nursing faculty development is frequently addressed piecemeal. The literature on quality initiatives is often focused on improving the teaching of particular content, e.g., health policy (12).

2. Discussion

To address these issues, we propose an overarching evidence-based Program Quality (ProQual) Framework that takes a holistic, collaborative and systematic approach to monitor and enhance the quality of the curriculum and program delivery while developing staff learning and teaching capability and scholarship (Figure 1).

The ProQual Framework's planning, implementation, data gathering, and evaluation phases incorporate elements of existing quality assurance approaches such as the Plan-Do-Study-Act cycle, which was developed for quality assurance in business (13). The ProQual Framework focuses on the translation, delivery, and evaluation phases of the curriculum, and:

1. involves the whole teaching team plus a curriculum lead, educational designers, Program Director, and Deputy Head of School (Learning & Teaching),
2. is conducted on a trimester-by-trimester basis throughout the life of the curriculum (continuously and iteratively),
3. incorporates both quality assurance and quality enhancement mechanisms,
4. is underpinned by the scholarship of learning and teaching,
5. is informed by regular stakeholder feedback,
6. capacity-builds staff and students, and
7. takes a 'whole of program' approach to curriculum modifications to minimize curriculum drift and ensure that constructive alignment and scaffolding - and thus curriculum integrity-is maintained throughout the life of the curriculum.

2.1. ProQual panels

Kelder et al. (14) indicate the importance of engaging teachers in collaborative ongoing curriculum evaluation. The continuous curriculum review process developed and evaluated by van de Mortel and Bird (9), van de Mortel et al. (15), and Bird et al. (16) provides an effective mechanism to do this. While departments ordinarily have a committee to review planned changes to courses/programs, these often operate at the department rather than program level, have limited attendance, and due to the volume of business to be debated and approved, do not generally enable deep consideration of how proposed changes might impact program scaffolding, program leaning outcomes and constructive alignment.

A trimester-by-trimester ProQual panel addresses these challenges, focusing on collaborative social learning in the manner of a community of practice (17) to:

1. facilitate peer-to-peer learning that enhances members' capabilities,
2. minimize curriculum drift, and
3. enhance course/program decision-making through a whole of program/whole of team approach.

Prior to the start of trimester, the ProQual panel meets to plan upcoming program delivery. Planned changes from previous course iterations are discussed to ensure they will be completed prior to delivery to close the loop. A program level assessment matrix ensures that assessments are spaced to reduce pressure on students (9). The panel also meets after course delivery to discuss course and program challenges and successes, facilitating whole team deliberations on any proposed changes. The ProQual panel is underpinned by Bandura's (18) Social Cognitive Theory; the collaborative discussion of proposed course changes against concepts of constructive alignment and scaffolding, facilitates both direct learning about aspects of quality curricula, and vicarious learning-through discussion of other

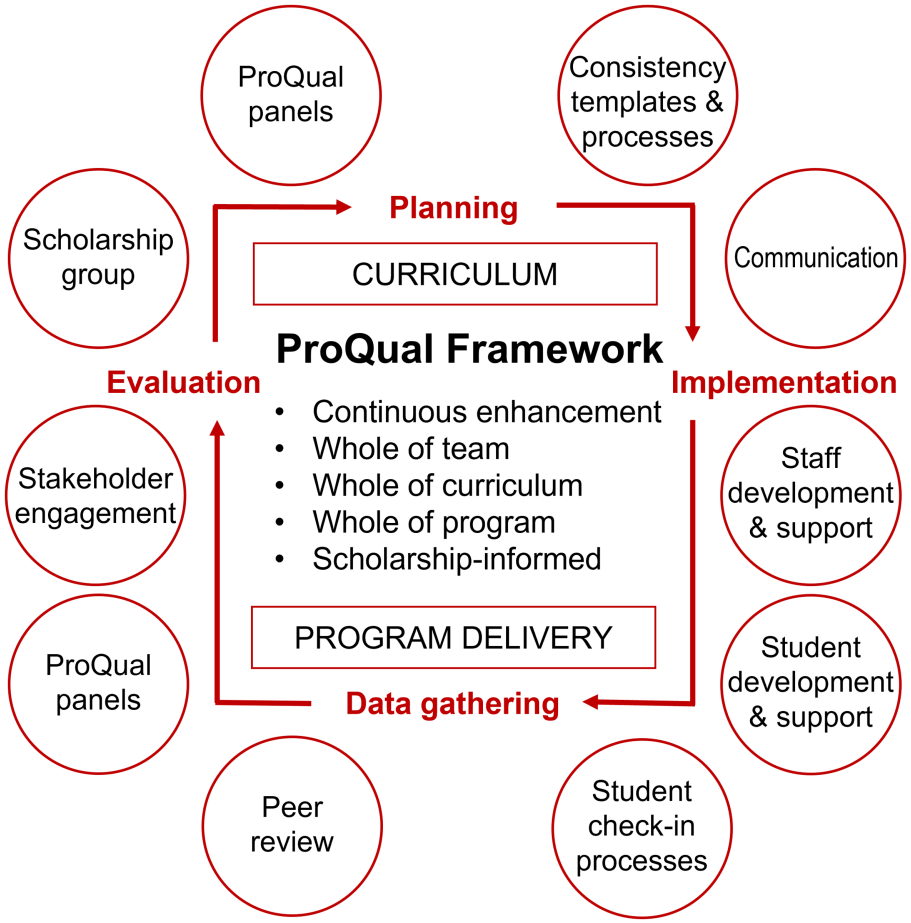

FIGURE 1
ProQual framework. Adapted from Tague (13).

academics' experiences and ideas. It further establishes staff ownership and understanding of the curriculum.

2.2. Consistency templates and peer review

As well-organized learning materials positively impact student engagement and higher-order learning (19), consistency templates, and peer review – a fundamental component of the dissemination of knowledge (20) and academic development (21) – are used to assure the quality of course resources. Course content and sites are developed using a template that assures a professional, consistent, easy-to-navigate structure, and embeds sound andragogical approaches to encourage active learning, which improves students' learning outcomes (22). Peer, curriculum lead and educational designer reviews are conducted prior to the release of course sites to ensure quality. Secondly, a consistency template is used for assessment task descriptions to ensure that assessments contain key information in a logical standardized format. Peer and educational designers also review assessment task descriptions and rubrics prior to approval by the Program Director for release to students. This ensures the task description is clear, learning outcomes are addressed, and the rubric and task description are aligned as part of pre-marking moderation. Peri-and post-marking moderation are also conducted.

2.3. Communication

With large, multi-campus programs it is critical to provide clear communication and consistent decision-making across campuses to ensure equity for students. Our program leadership team meets weekly to discuss implementation issues and problem solve. Teaching staff are kept informed through a weekly electronic newsletter and quarterly ProQual panels. To ensure consistent decision-making in courses with work-integrated learning (WIL), a Clinical Reference Group meets bi-annually, providing a mechanism to obtain feedback from clinical teams on issues related to students' WIL placements, and to communicate updates in processes. Teaching staff and students are also supported with WIL placement guidelines that explain placement processes. Each course has a primary convenor responsible for overall communication with students and a communication plan that details key messages to guide student learning and encourage engagement, while minimizing *ad hoc* messaging.

2.4. Staff support, development and scholarship

Sidhu (7) indicates higher education institutions have a responsibility to ensure educators are competent. ProQual panels

provide professional development through workshops on topical issues. The iterative discussion of proposed curriculum changes and issues related to program delivery provide opportunities for staff to view examples of best practice or solutions to issues. The peer review process also provides formative learning opportunities (23).

Learning and teaching scholarship should underpin course design and teaching practice (5, 15). Teaching faculty are encouraged to join a Scholarship of Effective Learning and Teaching (SELT) community of practice dedicated to:

1. improving student learning, the student experience, program retention and graduate success,
2. driving innovation, and
3. supporting excellence in teaching, recognition of exemplary practice, and building leadership.

Mentoring is provided through peer review of draft manuscripts, abstracts and grant applications and brainstorming research ideas during SELT meetings. Staff recognition for educational practice is supported through advice on, and peer review of, teaching award and Higher Education Academy Fellowship applications. Group meetings provide opportunities for networking and for staff to join scholarship teams in an area of interest, creating a culture of evidence-based teaching practice. Staff are encouraged to plan evaluations of innovations to inform their teaching and provide evidence of outcomes for teaching award applications. Academics are supported to complete postgraduate studies in learning and teaching and funding can be sought for professional development.

2.5. Student development and support

Lizzio (24) describes the Five Senses of Success that positively impact retention and student success: students' sense of purpose, connection, capability, resourcefulness, and academic culture. These underpin our student lifecycle program. Commencing students are offered a two-day orientation (25) that incorporates connectedness activities and builds sense of purpose. A weekly Nurses Connect electronic student newsletter provides just in time information for students, advertises development opportunities and reduces *ad hoc* email traffic. Regular interaction promotes connectedness, and, as a result, retention (24). We also conduct extra-curricular weekly academic skills development workshops for commencing students and Peer Assisted Study Sessions for our bioscience courses to build capability and resourcefulness. We have a Student Lifecycle team dedicated to student support throughout the student lifecycle. Year level coordinators coordinate the academic skills programs, implement employability initiatives, and provide pastoral care (26). A peer mentoring program provides further support and connectedness opportunities. Students are thus supported with both transition in (to university), through, and out (to graduate positions) (25).

2.6. Student check-in and stakeholder engagement

An early in-house anonymous survey with students in each course is used to get a sense of the student experience of the course to detect and address any issues (26). This complements university level surveys of commencing students to determine their experiences of orientation and the early teaching weeks, which are based on Lizzio's (24) Five Senses of Success. The Lifecycle team develops an annual student lifecycle plan, assesses student feedback, and implements strategies to improve the student experience. We also respond to end of course and WIL feedback. Regular industry stakeholder feedback on our programs and graduates is sought through external advisory committee meetings.

2.7. Outcomes

We implemented the ProQual framework in 2016 to drive quality enhancement of our new curriculum. While aspects of this have been previously positively evaluated (9, 15, 16, 27, 28), we have not formally evaluated the full framework, however, over the life of the 2016–2021 curriculum, courses with satisfactory student ratings increased by 15%, program retention by 7% and admissions rank cut-offs (an indicator of student demand/program reputation) by 17–21 points. Three years after implementing the SELT group, scholarly publications and conference presentations had doubled.

2.8. Limitations

This framework was developed for a nursing program and thus may not be fully generalisable to other discipline areas, for example, those that do not include WIL. It may also be more difficult to implement in programs where many courses are shared between different degree programs due to the level of consultation required. However, the underlying principles - which focus on consistency, peer review, communication, as well as staff and student development and support - can be used by any degree program to ensure curriculum integrity, develop staff and enhance student satisfaction and retention. While the proactive processes that form the framework have a definite time cost, we have found this is offset to some extent by a reduction in foreseeable problems, a reduced need for reactive management of issues, and a substantial reduction in student appeals of grades (Box 1), and the other benefits noted above make it worth the effort.

3. Conclusion

We suggest the ProQual Framework shifts the focus from sub-optimal individual course-based practices to a collaborative programmatic scholarship-based approach to maintain curriculum integrity, assure and enhance curriculum quality and program delivery, and develop academic staff into the future.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

BOX 1 Practice example.

In response to multiple Review of Decision of Grade requests from students in 2015, the ProQual panel examined the issues in relation to student appeals of grades. One of the issues identified was that some task descriptions lacked clarity or marking criteria did not fully align with the task description – confusing students (and at times markers) and providing grounds for appeal.

Consequently, an assessment template was created by the Program Director – with feedback from the team – to improve the clarity of assessment tasks and marking criteria. The template was coupled with robust peer review of assessments by a curriculum consultant and the Program Director, which complemented existing marking moderation processes. Requests for Reviews of Decision of Grade declined by 75% following implementation of these processes.

Author contributions

TM led framework conceptualization with critical input from BP, CM, M-AS, JN, GS, and VK. TM drafted the manuscript. All authors made revisions, approved the final version for publication and agreed to be accountable for all aspects of the work.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Medical education in Latvia: an overview of current practices and systems

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Located in northern Europe, Latvia is one of the three Baltic States with a population of 1.9 million. The country has a rich history of medical education spanning a century and is becoming an emerging global hub for medical education. Although the surge in international students has been beneficial for the development of educational and research infrastructure, increasing demands from local students, along with institutional capacity constraints, have overburdened the available resources. Substantial investments are being made to adapt to the rapidly changing geopolitical and techno-biomedical landscape. This perspective paper presents an overview of the country's medical education system, its challenges, and prospects from pre-university to doctoral level.

KEYWORDS

education, Latvia, curriculum development, medicine, university

1. Introduction

The Republic of Latvia, with a population of approximately 1.9 million, is located on the eastern coast of the Baltic Sea in northern Europe. The country shares borders with Estonia, Lithuania, Belarus, and the Russian Federation and is one of the three Baltic States. There are 43 administrative regions in Latvia, and around one-third of the population lives in or around the capital city of Riga. According to the 2022 demographic data, the median age of the population was 42.9 years, with median ages for men and women being 39.6 and 45.7 years, respectively. The life expectancy at birth was 73.1 years (1). The difference in life expectancy between men and women is about ten years, one of the highest among all EU (European Union) countries.

2. Overview of Latvian healthcare system

Like many other European countries, Latvia confronts a multitude of health challenges due to a healthcare system that is highly strained and underfunded. Local experts have repeatedly stressed that the country's performance has been poorer than the EU average in terms of access to healthcare, according to the European Commission's European Social Policy Network (ESPN) (2). Notable health challenges for Latvia include an aging population, obesity, high tobacco and alcohol consumption, and an growing incidence of chronic diseases. The country's demographics are strained by a shrinking population caused by high emigration rates among young people (3).

The five leading reported causes of death are circulatory disorders, malignancies, COVID-19, external causes, and diseases of the digestive tract. Besides, the country has a high prevalence of traffic accidents, suicides, and communicable diseases like HIV (1, 3). Despite a reasonably comprehensive universal coverage, patients in the country still incur the second-highest out-of-pocket spending amongst EU countries. Publicly funded health services are limited by annual quotas, which often leaves patients paying for their expenses privately (4).

2.1. Structural Organization of the Healthcare System

The country has a publicly funded, single-purchaser healthcare system similar to the United Kingdom's National Health Service (NHS). It offers universal health coverage to the citizens and permanent residents. The healthcare system includes both public and private players and can be broadly categorized into primary care, community and outpatient, and secondary hospital and specialist care (4). The Ministry of Health (MoH) regulates policies and regulations, while municipalities have limited responsibilities that include ensuring access, health promotion and education, and providing long-term care services. The Health Inspectorate (HI) oversees the quality of care and compliance with national regulations. There are three authorities that operate under the supervision of the MoH – the Centre for Disease Prevention and Control (CDPC; responsible for public health monitoring), the State Emergency Medical Service (SEMS; provides emergency care throughout the country), and the State Agency of Medicines (monitors safety and quality of pharmaceutical products and medical equipment).

2.2. Capacity and distribution of the healthcare system

The country is currently undergoing reform measures to transition from an in-patient to an out-patient care and care-at-home system (5). Consequently, the number of hospitals in the country has reduced from 65 hospitals with 11,920 beds in 2010 to 56 hospitals with a combined capacity of 9,729 beds in 2021 (1). Over the past decade, the number of healthcare institutions providing out-patient services has decreased from 4,756 in 2010 to 3,922 in 2021 (1). The country currently has 1,194 registered general medical practices, 963 specialty practices, and 457 dental practices. Also, there are 132 medical assistants (obstetrician) aid posts and 82 medical aid rooms in educational institutions across the country (1).

The healthcare system faces challenges similar to those of other countries, with a mismatch between the distribution of healthcare personnel in urban and rural areas. This imbalance sometimes leads to rural residents experiencing delays in accessing timely and necessary medical assistance (6, 7). The low wages offered in the public sector have resulted in healthcare professionals migrating to the private sector. The demographic composition of the healthcare providers (Table 1) clearly reflects the impact of an aging workforce (1, 8). Latvia has a rolling ceiling on the retirement age, which increases by 3 months every year. As of 2023, the retirement age is 64 years and 6 months.

3. Higher education system

In Latvia, there are 29 higher education institutions, 16 of which are state established with remaining 13 being private. After joining the EU in 2004, the Latvian higher education underwent significant modernization to align with the principles of the Bologna process. The Latvian education system follows a three-cycle system – the first cycle leading to a bachelor's degree, the second cycle leading to a master's degree, and the third cycle leading to a doctoral degree. Up until October 2022, Latvia employed a credit point system, where the credit point represented an accounting unit corresponding to a student's workload of 40 academic hours (one-week of full-time studies) (9). However, as of October 2022, the credit point system in Latvia is fully comparable to the European Credit Transfer and Accumulation System (ECTS), where 1 credit point corresponds to a workload of 25 to 30 academic hours.

4. Qualification regulation and accreditation

All qualifications awarded in Latvia are referenced to the Latvian Qualification Framework (LQF). The framework, developed in two phases from 2009 to 2015, is based on the European Qualification Framework (EQF), adapted to the local context and traditions. Since 2008, the Academic Information Centre (AIC) has been the nodal state government authority for the recognition of professional qualifications in regulated professions (10). The AIC is also the national coordinating body and the national EUROPASS center. AIC has also played a key role in the development of the Latvian Qualifications Database (LQD), which provides data on qualifications issued in the country since 2016. The database is updated regularly and is available in both English and Latvian (11).

The Quality Agency for Higher Education (QAHE) is a department established within the AIC that accredits higher education institutions and study programs and implements quality assurance standards. AIC is a full member of the European Association for Quality Assurance in Higher Education (ENQA), the International Network for Quality Assurance Agencies in Higher Education (INQAAHE), the Council for Higher Education Accreditation in the United States (CHEA) and is also part of the European Quality Assurance Register for Higher Education (EQAR). AIC's extensive participation ensures the recognition and interoperability of all diplomas and qualifications issued in the country by other EU member countries. Starting in 2019, an agreement on automatic academic recognition in the Baltic States (Estonia and Lithuania) has been in effect which allows for automatic recognition of certain qualifications.

In addition to the QAHE, the Higher Education Quality Assurance Council, the Ministry of Education and Science, the Council of Higher Education (CHE), and the Latvian Council of Science are involved in the internal accreditation, licensure, framework regulation, and quality control processes. Furthermore, the Students' Union of Latvia, Latvian Rectors' Council, and the Employers' Confederation of Latvia (LDDK) participate as external stakeholders in the deliberations of the internal accreditation and licensure processes (9).

TABLE 1 Summary data for practicing medical staff in Latvia (2015 vs. 2021).

Medical staff	Total number in 2015	Number per 10,000 inhabitants	% aged ≥ 60 years in 2015	Total number in 2021	Number per 10,000 inhabitants	% aged ≥ 60 years in 2021
Medical doctors [1,2]	6,491	33.0	29.0%	6,328	33.7	34.0%
Dentists	1,419	7.2	21.9%	1,331	7.1	30.2%
Family doctors [3]	1,327	6.7	30.4%	1,448	7.7	40.2%
Nurses [4]	8,781	44.6	18.5%	7,880	42.0	23.0%

[1]There are differences in the calculation methodology. Prior to 2019, the number of medical doctors included general practitioners, physicians in-service training and residents, but excluding dentists. After 2019, the number now includes the number of residents. A resident is a physician who undergoes postgraduate training in the chosen specialty under the guidance of a physician who is licensed for training according to the programme of the respective specialty provided for in the regulation for this specialty.
[2]A medical doctor (or "*physician*") is medical personnel who after a full-term study have acquired physician's qualification and through a scientifically based medical activity directly or indirectly exerts influence upon a human being and within the framework of own professional activity examines patients to diagnose, deny, or treat a physical or mental illness. They do not include dentists, oral and maxillofacial surgeons, doctors working abroad, non-working or unemployed retired doctors, and doctors working in other sectors of the economy (administrative; research) outside the field of healthcare.
[3]A family doctor (or "*general practitioner*") is a medical doctor with additional postgraduate training in family medicine. Family medicine is the specialty in which the physician provides state-paid primary healthcare services to every individual who seeks medical care, regardless of age, gender, diagnosis, social status, etc. This includes assessing the patient's health condition, diagnosing diseases and, within the scope of their competence, determining the necessary preventive and curative measures, as well as, if necessary, determining special examinations and the participation of other healthcare specialists in primary healthcare. The primary duty of a family doctor is to provide comprehensive and continuous healthcare.
[4]There are differences in the calculation methodology. Prior to 2019, the number of nurses included roentgenology and radiology nurses (radiologist assistants). After 2019, the number now excludes dental nurses and radiologist assistants.

5. Medical education in Latvia: an historical perspective

Latvia has two public universities providing medical education to both local and international candidates – the Riga Stradiņš University (RSU) and the University of Latvia (LU). Located in Riga, both universities share a centennial past. Before the 1900s, Latvians seeking medical education would travel to Estonia's University of Tartu. However, due to a growing population and improving healthcare infrastructure, the Faculty of Medicine was established at the University of Latvia in 1919. In 1920, the first lectures were held at a former Orthodox seminary named the Theatrum Anatomicum (since it housed the Department of Anatomy).

The main faculty was selected from the midst of Latvian specialists, supplemented by international faculty from Sweden, Austria, USA, and Russian Federation in disciplines where there were no Latvian specialists available (12). Coinciding with this, in 1920, the Dentistry Department of the Faculty of Medicine was established. Later, other preclinical departments were set up at the Theatrum. At first, the curriculum mainly drew upon the Russian education system, featuring rigid departmental structures and lifelong appointment of professors. In 1922, however, a 6-year study model for medicine was implemented, followed by the establishment of the clinical base at the Pauls Stradiņš Clinical University Hospital in 1928.

In the late 1930s, the first generation of Latvia-trained doctors and professors were elected to lead the clinics and departments. After the 1940s, during the occupation of the Soviet Union, a widespread faculty replacement exercise was forced upon the staff that led to the sacrifice, repression, and emigration of many professionals. Due to suspicions regarding the university staff, including their political agendas, qualifications, and teaching models, the Stalin government officially ordered a separation of the Faculty of Medicine from the University of Latvia.

However, this plan could never be executed due to a lack of time (12). The war in the 1940s also saw the closure of the faculty for a short period followed by its restoration under the leadership of the Dean, Professor Pauls Stradiņš. The number of graduates from the medical faculty at LU was affected during the Soviet occupation period due to the re-implementation of the Soviet-style 5-year program in 1945 and its subsequent roll-back and switch to a 6-year program in 1947. Since, previous diplomas issued under German rule were not recognized by the Soviet government, many physicians were forced to retake qualification examinations in order to continue practicing medicine (12).

Finally, after several unsuccessful attempts at liquidation, the Riga Medical Institute was established in June 1950. In 1990, the Riga Medical Institute was renamed the Latvian Medical Academy. Growing contradictions inside the academy, however, led to the re-establishment of the Faculty of Medicine at LU in 1998. In 2002, the Latvian Medical Academy was re-renamed to Riga Stradiņš University, in the memory of Professor Pauls Stradiņš (1896–1958).

6. Pre-medical preparatory courses

Both universities provide preparatory courses to high school graduates and soon-to-be graduates as they begin planning for future medical education. Studies show that taking these courses can improve the retention of worthy candidates and create a more equal and fair selection process (13–15). Furthermore, these courses provide prospective students with an opportunity to experience the challenges and the requirements of the medical field, which can help them make informed career decisions (14) and ease their transition into medical work life. This also has been correlated with better academic performance during the early years of medical training (13, 14).

Participation in pre-medical courses in Latvia does not influence admission prospects to the same institution. The courses offer comprehensive preparation for state-administered exams in biology, chemistry, and Latvian language. RSU organizes the "*The Academy of Young Doctors*" program, which introduces high school students to a range of medical disciplines like surgery, gynecology, physiology, and gastroenterology. The program covers theoretical knowledge and practical experience through hands-on medical manipulations. Participants have the chance to participate in activities such as cardiopulmonary resuscitation, intravenous catheterization, and simulated childbirth. Similar offering by LU is titled "*The School of Young Doctors*."

7. Admission to medical schools

The undergraduate medical education program in Latvia is 6 years long and leads to the award of the Medical Doctor (MD) degree (EQF Level 7). The degree corresponds to a second level professional higher education programme (360 ECTS). Local students are instructed in Latvian, although they have the option to participate in mixed groups where English is the main language. The study process for international students is conducted in English with an introductory course in Latvian language. Admission for state-funded positions is based on the overall high school grades in chemistry or biology, foreign language, mathematics, and Latvian language. Applicants can earn additional points by participating in extracurricular activities. The system is highly competitive with approximately six applicants per position. International students on the other hand must have completed their secondary education from recognized boards in biology, chemistry, English, and mathematics (Table 2). For international students, there are two intakes every year - in summer (August) and in winter (February), while for Latvian students, there is only single intake in the summer.

8. Undergraduate medical education

Although there may be variations among university programs, for the most part they do not differ significantly. Medical education commences with an introduction to basic medical sciences (e.g., anatomy, histology, microbiology, physiology, pathology) in the first 2 years, followed by gradual introduction to clinical and research subjects (e.g., pharmacology, biostatistics, epidemiology, general surgery, cardiology) in the third year. Particular emphasis is placed on the development of communication skills relevant to the doctor-patient relationship. Training of this kind has been reported to be well received by the students as it helps them to apply their classroom knowledge more effectively in clinical settings (16, 17). Therefore, the curriculum is designed to provide early student-patient contact, including simulated and bedside interactions, from as early as the second year.

During the 4th and 5th year, the education transitions to block-based education with rotations in various clinical disciplines such as internal medicine, infectious diseases, gynecology, and surgery. Starting in 2022, the final 6th year at RSU has been restructured to solely concentrate on clinical placements -17-week rotations in three departments of student's choice. After clinical placements, the students are required to defend their research work (thesis) in a department of their preference and appear for the state examinations.

Students may select between preclinical laboratory-based research or clinical patient data-based research. Research can be completed in the form of a literature review or original data collection and analyses. As a component of the research work, students are required to independently develop their research protocol (with the guidance from their supervisor) and request the appropriate ethical approvals. The block-based system during the clinical years provides enough time for self-study and developing research directions, making it an ideal time for most students to complete their thesis. Studies indicate that incorporating a research component in medical education fosters scientific thinking and result dissemination skills among students (18–20).

8.1. Teaching methodologies

The students are organized into small groups of 10–12 students to ensure an interactive and personalized learning experience. Employment of such small-group teaching approaches have been reported to have positive learning benefits and outcomes (21–23). The programme places significant emphasis on fostering practical skills. During the training program, students have opportunities to improve and perfect their practical skills through hands-on training at specialized facilities. The Medical Education Technology Center (METC) at RSU has an array of diverse practical simulators, such as a laparoscopic simulator and a fully equipped simulated operating room. These resources help the students acquire and refine hands-on skills, thus enhancing their preparedness for the clinical setting. Smartboard-equipped classrooms heavily utilize visual learning aids like models, posters, and augmented reality tools.

8.2. Assessment methodologies

Several approaches are used to assess the acquired knowledge of medical students. Although some departments may prefer verbal evaluations, most of them favor written exams. The evaluation process generally involves the use of multiple choice questions (MCQ) along with clinical cases and open-ended questions. The education system has been swift in adapting the OSCE structure (Objective Structured Clinical Examination), particularly due to its relatively recent integration into the European national medical curricula (24, 25). Apart from theoretical knowledge, clinical skills, including the ability to gather patient data, write medical histories, formulate diagnoses, present and rationalize diagnostic hypotheses, and propose appropriate treatment plans, are also assessed to evaluate the student's clinical proficiency.

8.3. Open University

Students can attend courses as non-enrolled listeners through the Open University program. The program allows individuals to choose

TABLE 2 Intake capacity for medical programme in Latvian universities.

University	Latvian students		International students
	State subsidized	Privately funded	Privately funded
University of Latvia (LU)	30 places	100 places	30 places
Riga Stradiņš University (RSU)	205 places	45 places	590 places
Total	235 places	145 places	620 places

subjects that interest them. Applicants can choose between two options – to participate as an un-enrolled listener without taking any tests or exams, or to study under the same conditions as other students and obtain a certificate. Even though admission exams are not required for participating in the Open University program, an applicant must certify that they meet the level previous education required for the chosen course.

8.4. Scientific interest groups and conferences

Students are encouraged to participate in different scientific focus groups, providing them with opportunities to explore and cultivate their areas of interest and deepening their knowledge (26, 27). Moreover, students receive active support for their efforts in writing and publishing scientific papers, with readily available guidance and resources to facilitate the scientific process. In addition, students have the opportunity to work in hospitals and medical institutions, such as the emergency medical service. These opportunities not only provides financial assistance but also helps students gain valuable real-world experience that can enhance their understanding of the complex and dynamic nature of the healthcare system.

LU hosts the annual "*The International Scientific Conference on Medicine*" that comprehensively explores various disciplines within clinical and research medicine, pharmacy, nursing, and public health (28). Both students and specialists are welcome to participate in this conference and share their knowledge and ideas. On the other hand, RSU, holds the biannual "*Research Week*" event, gathering various international research conferences in medicine, social sciences, public health, and university teaching and learning (29). Since 2015, as part of the Research Week, RSU has been organizing the *International Student Conference* (RSU ISC) annually. RSU ISC provides a platform for students to present their research findings and exchange ideas with fellow students as well as experts in the field. RSU ISC is the largest student-organized conference in the Baltic region, attracting a significant number of participants, with approximately 1,500 to 2000 attendees from over 30 countries.

8.5. International mobility and exchanges

The ERASMUS+ program provides a chance for local and international students to pursue studying abroad or complete internships with partner universities worldwide (30). The duration of the exchange can vary from a minimum of 2 months to a maximum of 12 months. To be eligible for the Erasmus program, 4th and 5th year students are expected to demonstrate proficiency in the foreign language that is required by the destination country or host institution, in addition to satisfying other prerequisites. A scholarship under the Erasmus+ grant is provided to students during the exchange, which varies in amount depending on the host country (ranging from 540 to 600 euros per month). International exchange programs under bilateral, national, and international agreements are also open to the teaching faculty. Both universities also welcome incoming students and staff members from the partner universities.

8.6. State examinations

The centralized examination consists of three separate components – a theoretical component, a practical component that evaluates knowledge-based practical skills, and an interpretation component that requires interaction with patients. The written theoretical component provides students with ten open questions to be answered in two blocks of 1 hour 40 minutes each. Both blocks are separated by a one hour break for the students. The exam questions cover topics from all years of medical education including basic sciences. To assess practical proficiency, students are presented with a set of five standardized tasks (manipulations) that must be completed without prior preparation. Points are individually allocated for each task, and the scores are subsequently aggregated to produce an overall score. During the interpretation component, students receive an electronic ticket which details the patient's case subject and the medical institution where they must take the exam. The student is granted access to the patient's data and instructed to gather the patient's medical history within a specified timeframe using appropriate communication and patient examination skills. Afterward, the student attends a meeting with the examination committee, where they are expected to present a detailed account of their interaction with the patient.

9. Postgraduate medical education

Upon the successful completion of the state examinations, students have the opportunity to continue their medical education through a residency programme in more than 70 specialties, subspecialties and additional specialties.

9.1. Admissions to residency programme

The universities are responsible for governing the residency admission process and the implementation of training. The university is responsible for developing and maintaining the curriculum, monitoring the training process in hospitals and other medical institutions, and partially delivering theoretical education, including simulation training, administering of state exam, and granting diploma. Hospitals and other medical institutions provide practical training and partially deliver theoretical training (seminars). The duration of a residency program is regulated by the Professional Qualifications Directive 2005/36/EC and varies according to the chosen specialty, ranging from a minimum of 3 years to a maximum of 6 years. For instance, a residency in Dermatology and Venerology lasts for 3 years, whereas a residency in Neurosurgery requires 6 years. Admissions are based on a points-based system which factors various accomplishments and grades obtained during undergraduate studies. Factors such as weighted average grade and grades on the state examination, scientific work, presentations at scientific events, written scientific publications and results of an interview prior to the enrolment to the residency program in basic specialty are considered.

9.2. Residency programme intake capacity

The Ministry of Health determines the availability of government subsidized positions for each specialty annually, considering the demand for the specialties from hospitals, the health needs of the society, and the

existing and projected supply of doctors in each specialty (31). While this planning model appears to be based on reliable indicators, realistically, the challenge to ensure a proper balance between the supply and demand remains a highly topical issue in most specialties. Consider the following example – Anesthesiologists and Reanimatologists (18 places), and Internists (20 places) have had a higher number of government subsidized study places in the last 5 years. However, the data reflects an ongoing demand for 62 Anesthesiologists and Reanimatologists and 35 Internists (32). This mismatch issue can be explained partly by the fact that for a long time the number of government subsidized residency positions were lower than the number of annual undergraduates in medicine (33).

Nonetheless, there has been an increase in the number of government subsidized positions. For the academic year 2021/2022, there were 232 available subsidized positions, which are projected to increase to 297 by the academic year 2023/2024. This increase in subsidized positions raises concerns regarding the abilities of the universities to maintain high residency training standards. This is due to the limited capacity for full cycle training process in university (tertiary level) hospitals. To accommodate the planned increase in residents intake, universities should decentralize residency training, and promote acquisition of practical knowledge in university clinics and excellence centers. This process should also focus on enhancing the skills and competences of trainees across various levels of medical institutions throughout the country.

9.3. Residency curriculum

The residency program provides students with the chance to gain theoretical knowledge, practical training, and hands-on experience in patient care. Furthermore, it establishes a foundation of theoretical knowledge for the state examination at the end of the residency. The curriculum and requirements of each specialty vary, for example, specialties within internal medicine such as gastroenterology, cardiology, pulmonology, and other therapeutic specialties follow a common two-year training and practice cycle module. Generally, each training and practice cycle lasts a few weeks, after which the student advances to the next cycle. Apart from the practical cycles, residents engage in theoretical seminars held by hospitals or other medical institutions, as well as other educational activities outlined in the curriculum, such as theoretical education provided by a university, pedagogical skills, and simulation training.

The curriculum is not only designed to train residents as medical experts, but also to develop interdisciplinary skills including communication, management, and research. An examination is held at the end of each educational activity. The university organizes the state examination at the end of the residency training. Besides the state examination, national legislation administers a certification examination to obtain a specialty certificate. Although legally considered separate processes, both examinations are commonly held together in most specialties. Upon completion of the residency, students become licensed specialists and commence their professional careers in their respective specialty.

10. Doctoral studies

The PhD programme in medicine aims to prepare highly qualified scientists and academicians. In 2022, RSU offered 36 government subsidized places and 24 paid tuition places, while LU offered 7 government subsidized places and 10 paid tuition places. Interested applicants must follow a similar admission process to that of the residency and be evaluated based on a point system. Applicants receive points for their previous scientific work and the assessment of their research plan for the intended doctoral thesis. This includes an evaluation of the written abstract and its oral defense. To complete the doctoral program, candidates must defend their dissertation before the Doctoral Committee, publicly presenting and defending their scientific paper. Successful completion of the defense leads to the conferral of the doctoral degree.

11. Continuing medical education

After finishing the residency programme and obtaining the specialist certificate, doctors must maintain their status as specialists by earning continuing professional development points, also known as TIP (Latvian - *tālākizglītības punktu;* English - *further education point*). The TIP system is a point-based system, that assigns points for activities such as attendance at scientific conferences, completion of educational courses, and participation in lectures. One TIP is equivalent to one academic hour or 45 min. The certificates are valid for 5 years, after which the specialists must apply for recertification.

Recertification can be obtained by accumulating 250 TIPs over 5 years, of which 150 TIPs must be obtained through professional and scientific activities related to the obtained specialty. In addition to accumulating TIPs, specialists must also provide a comprehensive account of their professional and scientific activities during the past 5 years. This account should consist of an assessment of the volume, intensity, and quality of their work, along with a detailed description of the procedures and knowledge gained during this period. This information is crucial for the recertification process, as it serves as a means to evaluate the ongoing professional development of specialists.

12. Challenges and future prospects

The medical education system in Latvia is being constantly evaluated, adjusted, and updated based on recent technological and biomedical advancements. For example, the current undergraduate medical education faces a number of curricular challenges as more time and attention needs to be devoted to the development of digital skills, including the use of e-medicine and telemedicine (34). The COVID-19 pandemic and lockdown have only fueled the adoption of telemedicine applications (35). Furthermore, telemedicine has been shown to be beneficial in reaching out to the patients in remote and rural areas, reducing the number of physical visits, saving time, and traveling costs, especially in patients with chronic conditions requiring frequent and multiple visits (36, 37). E-medicine is also supported by the need for reducing medical carbon footprints and adoption of green environmental practices (38). Given these advantages of telemedicine and industry-wide shifts to its adoption, it is important to train medical professionals in appropriate on-camera etiquette, background display, and body language (39, 40). Students also need to be able to understand non-verbal and verbal clues from the patient's body language since physical examination is not possible. Finally, the ability to manage the patient examination in cases of technical glitches

(patient's or doctor's) like camera not working are other skills that students will need training (39).

Issues of patient safety, biomedical safety, and incident reporting have also been indicated as of increasing importance in undergraduate, residency and professional development programs (41). The international political situation has also accelerated the need for extensive training in disaster and military medicine for civilian medical professionals (42–44). To improve the continuity of skill acquisition in both basic medical sciences and in clinical and research subjects, RSU has developed Skills Monitoring System that strengthens the planning, teaching, and learning, as well as the assessment phases of skill acquisition. One of the future developments will be the extension of this system beyond the undergraduate and residency study programme to the continuing education programs. Further development of simulation-based learning is another focus area as the simulation-based educational approach should be strengthened state-wide as an integral part of medical studies, supporting the transition from theory to practice, thus strengthening the quality of medical education, health care, and patient safety (45, 46). Another challenge to mention is the need to revise legislation to increase more intense implementation of simulation training and technical skills (medical methods) in the curriculum.

Given the fact that residency training is being implemented in various hospitals, post graduate medical education faces the challenge to maintain coherent training processes, including adoption of steps to prevent assigning of non-study duties to the residents due to a shortage of medical staff in the hospitals. Furthermore, more effective decentralization of practical training whilst centralization of the implementation of theoretical education, including seminars needs to be done. Research-integrated medical course leading to MD/PhD qualifications is another area for future consideration (47). Also, legislation should be reconsidered regarding the need for an officially determined joint exam at the end of residency and for the certification. Finally, the distribution model of government subsidized positions in specialties should be reviewed to ensure better matching the needs of hospitals, other medical institutions, and society as well as to the extent possible, to also provide for the wishes of the students. The implementation of medical education, which concludes with the right specialist being in the right place, should be one of the main goals for the whole system.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

NJ conceptualized the present study and was responsible for methodology, and software. NJ, KJ, TS, MP, IG, and NJ-R were responsible for data collection, formal analysis, investigations, visualization, and validation. NJ, KJ, TS, and NJ-R were responsible for writing the first draft of the paper. AP, MP, IG, and NJ-R were involved in revising the manuscript. MP, NJ-R, IG, and AP were responsible for supervision. All authors have read and agreed to the final version of the manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Using contribution analysis to evaluate health professions and health sciences programs

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Introduction/background: Course evaluation in health education is a common practice yet few comprehensive evaluations of health education exist that measure the impact and outcomes these programs have on developing health graduate capabilities.

Aim/objectives: To explore how curricula contribute to health graduate capabilities and what factors contribute to the development of these capabilities.

Methods: Using contribution analysis evaluation, a six-step iterative process, key stakeholders in the six selected courses were engaged in an iterative theory-driven evaluation. The researchers collectively developed a postulated theory-of-change. Then evidence from existing relevant documents were extracted using documentary analysis. Collated findings were presented to academic staff, industry representatives and graduates, where additional data was sought through focus group discussions - one for each discipline. The focus group data were used to validate the theory-of-change. Data analysis was conducted iteratively, refining the theory of change from one course to the next.

Results: The complexity in teaching and learning, contributed by human, organizational and curriculum factors was highlighted. Advances in knowledge, skills, attitudes and graduate capabilities are non-linear and integrated into curriculum. Work integrated learning significantly contributes to knowledge consolidation and forming professional identities for health professional courses. Workplace culture and educators' passion impact on the quality of teaching and learning yet are rarely considered as evidence of impact.

Discussion: Capturing the episodic and contextual learning moments is important to describe success and for reflection for improvement. Evidence of impact of elements of courses on future graduate capabilities was limited with the focus of evaluation data on satisfaction.

Conclusion: Contribution analysis has been a useful evaluation method to explore the complexity of the factors in learning and teaching that influence graduate capabilities in health-related courses.

KEYWORDS

contribution analysis, curriculum evaluation, learning and teaching, practice ready, health professions, health science

Introduction

Evaluation plays an important role in education ensuring the quality and impact of teaching and learning. More specifically, in health professions and health sciences education, evaluation contributes to ensuring that desired graduate outcomes fulfil community health needs and assure health regulatory authorities, educational regulators, employers and patients/clients that programs of study produce safe, professional, effective and work-ready and fit-for-purpose practitioners (1). Additionally, evaluation can be a tool for assessing curricular relevance, satisfying learner needs, assessing the constructive alignment with institutional standards (2), and maximizing instructional resources (3). Despite the recognized need for rigorous evaluation of health profession's education curricula (3), there are few published examples evaluating health curricula in the literature (4–6).

Current approaches focus on the evaluation of individual concepts, disciplines or content, such as evidence-based medicine (5) or preparation for practice (4, 6). These approaches provide evidence for student satisfaction and acquisition of knowledge and skills, with many using the Kirkpatrick's (7) model of program evaluation (8). However, the Kirkpatrick's model has been recently criticized for not capturing the full impact of learning and development (8). This criticism is, in part, because of a focus on process evaluation measures, such as appropriateness, satisfaction, numbers enrolled, demography, and the assessment of knowledge and skills (8). Such evaluation models might not sufficiently explore the complexity of the factors (e.g., learning, teaching, assessment, research, healthcare delivery, community engagement and settings of health care programs) that lead to different outcomes in preparing health professionals for practice (9, 10). Due to the complexity of health professions education programs, few evaluation strategies have the capacity to holistically consider student behavior change (both personal and professional development) or graduate outcomes (11). Such factors are often considered beyond the scope of a single health professions course.

Traditionally, attribution analysis (AA) has been used to determine whether the curricular outcomes being studied are attributable to the program, i.e., did the program cause the observed outcomes. AA is a positivist-orientated approach assuming a unidirectional causal relationship and focusing on short-term outcomes (10). In the complex system of teaching and learning where learning is caught not taught (12), the linearity of this evaluation approach has been widely criticized (13). It would be beneficial for educators to consider alternative approaches.

Contribution analysis has been proposed as an alternative approach to evaluate health professions education. Contribution analysis (CA) aims to explore how and why various elements of a program contribute to the outcomes of interest (10), e.g., how the professional accreditation standards contribute to the observed outcomes. By collecting information from multiple sources (e.g., documents and interviews), CA uses an expert-derived theory of change (14, 15) to explore the interactions between program and curricular activities and connect their relationship to proximal (program-related outcomes) and distal outcomes (system-level outcomes), and the assumptions informing these connections (10). CA aligns with contemporary recommendations of health professions education program evaluation to comprehensively capture contributing factors and the emergent processes toward development of the outcomes of interest (1). While CA has been used extensively to evaluate complex public health and health promotion interventions (16), there is a paucity of research using CA as an approach for the evaluation of health professions education curricula (10, 17). To the authors' knowledge there have not been any published examples of the use of CA as an evaluation approach in health professions education.

Our study aimed to evaluate health professions and health sciences programs using Contribution Analysis. Specifically, we are exploring what factors support and hinder teaching and learning and what teaching and learning factors contribute to the development of fit-for-purpose health profession graduates. The identification of these factors and their relationships will inform a more holistic evaluation approach of health professions and health sciences programs and enhance outcome-directed teaching.

Methods

Design

This study applied Mayne's six-step contribution analysis (15, 18) to evaluate the outcomes of a convenience sample of six health professions/health science programs offered at a large Australian university (name removed for peer review). In our study, we applied CA to identify relevant health professions graduate outcomes and develop a theory of how and why factors that have contributed to this outcome (10, 14, 15). Utilizing CA approach allowed us to describe the complex pathways learners experience as they move toward these outcomes and explore the relationships between the different contributing factors to the outcomes (10). An important aspect of our study was to clearly define the terminology including 'outcomes', or the attributes of learners who are competent to practice. We also explicitly identified the assumptions regarding cause and effect and the theory behind these assumptions. We then used existing data to build a model that illustrated the relationships between external influences, outcomes, results (or processes that

have led to impact), assumptions and risks. We took a pragmatic approach and we did what was possible and potentially feasible to allow replication.

Sampling

The study was conducted across four health professions and two health sciences education programs at two faculties - Faculty of Medicine, Nursing and Health Sciences and Faculty of Pharmacy and Pharmaceutical Sciences at a large metropolitan university in Australia. Collectively these faculties offer five different undergraduate health sciences and 12 health professions entry-to-practice programs (post- and undergraduate level). The programs chosen for evaluation conveniently elected to participate in this evaluation and included four health professional (medicine, nursing, dietetics and pharmacy) and two health science (nutrition science and health science) programs with a total number of graduating students approximately 1,400 per year across the programs.

Our research team comprised 16 members, many of whom had a large stake in the project as program coordinators of the above programs. The team was diverse in terms of demographics (e.g., age, gender), disciplinary background, geographical location, teaching, research, as well as different levels of orientation and expertise with qualitative and quantitative research. At the beginning of the project, we undertook a team reflexivity exercise (19) with all authors, where discussion was facilitated by CP to acknowledge, reflect on and understand our own power and positioning at both an individual and system level as educators. It provided us with a valuable opportunity to understand each other's perspectives, as well as cultivating a collaborative and rigorous approach to the analysis and interpretation of cross-disciplinary data. The reflexivity exercise identified that the team was motivated by outcomes and learnings about the impact of curricula on graduate outcomes. This exercise also provided a platform to share teaching experiences and curricular resources.

Data collection and analysis

The six-step iterative process involved a series of data collection and analysis processes.

Steps 1 (Develop the results chain) and 2 (Assess the existing evidence on results): CA's first step is to set out the attribution problem to be addressed. In our study, this happened in two stages. The first was identification of the health professions and health science education programs that would allow us to understand the processes of graduate outcome development in different teaching and learning contexts within health-related disciplines, and the second was identifying the nested theories of change in these education programs. The latter was done after partial implementation of CA Step 2 where the initial theory of change was established by building on a previously developed program evaluation framework (Figure 1). This program evaluation framework was developed prior to the commencement of the study by the Faculty Evaluation Strategy Working Group, which included a subset of the research team. The framework postulated that: if students are satisfied with the program and educators, and educators are supported to deliver quality tailored teaching (i.e., proximal shorter-term outcomes), students will develop the knowledge, skills and capabilities required to work as health professionals in practice (i.e., distal longer-term outcomes). We hereafter refer to these distal longer-term outcomes as graduate outcomes.

The framework included six common graduate outcomes as identified through a content analysis approach across the competency standards of 12 vocational health professional courses, including medicine (20), nursing (21), dietetics (22) and pharmacy (23). These common graduate outcomes were: (1) collaborate and work effectively in teams, (2) commit to lifelong learning, (3) demonstrate effective communication skills, (4) use and generate evidence; (5) improve health and (6) display professionalism in their practice. The assumption underpinning the evaluation was that graduates of the included courses achieve these graduate outcomes as evidenced by their current accreditation status. Thus, the evaluation did not set out

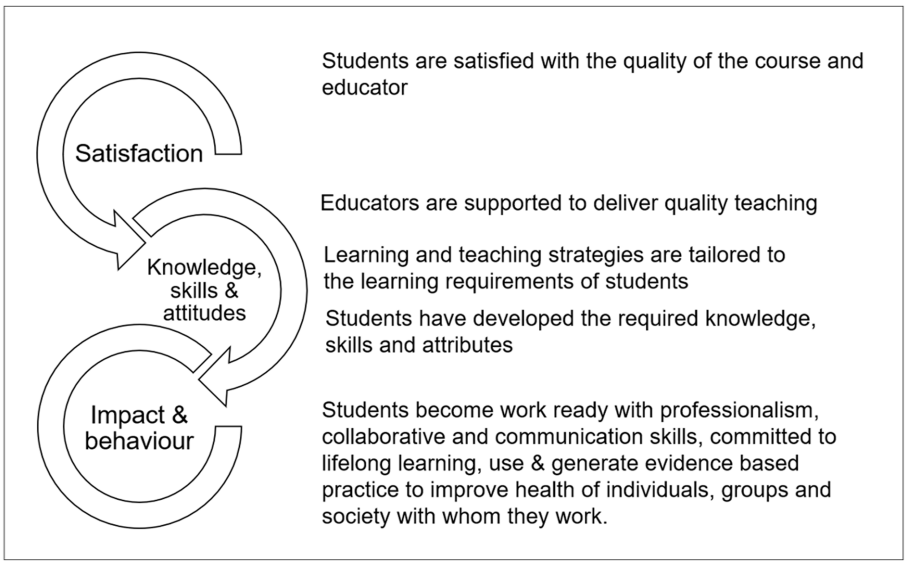

FIGURE 1
Program evaluation framework.

to determine if these outcomes were achieved, but rather focused on the contributing factors that led to these outcomes.

During step 2, senior academic educators (authors of this paper) from each education program were invited to contribute to the postulated theory of change (TOC), i.e., what contributes toward the graduate outcomes of interest within their program. The TOC represents hypothesized cause and effect relationships and related assumptions within an overall pathway of change, contributing to proximal and distal outcomes indicated in the program evaluation framework (Figure 1). Broad factors affecting graduate outcomes were identified as 'human', 'organizational' and 'curricula'. Human factors were defined as the skills, qualities and personal education philosophy of the academics, work-based learning educators/clinical teachers, students and patients/communities. Organizational factors were acknowledged as the university and policy-related issues that impact on curriculum and outcomes. Examples of organizational factors include assessment policy, student discipline procedures, human resources policy and processes, resources provided for teaching and learning and work-based learning organizational cultures. Curricular factors included content, pedagogical design and quality of delivery. In addition, the role of accreditation in influencing curriculum was identified. In developing the initial TOC, the research team explicitly acknowledged related assumptions influencing the learning and teaching process, including previous learning and teaching experiences shaping individual student or teacher education expectations, individual educators' pedagogical methods, educator-student relationships, health and mental health wellbeing of students and teachers, impact of disciplinary hearing on learning behaviors, and measurement of teaching quality. From the discussion, the initial logic model (Figure 2) was developed.

Step 3 (Assess the alternative explanations): All authors identified and gathered all potential sources of existing evaluation data to test the TOC and provide contextual insights. Relevance was the core criterion for all sources of evidence. These sources of data were grouped under four main areas: (i) relevant accreditation documentation; (ii) program materials; (iii) teaching evaluations and

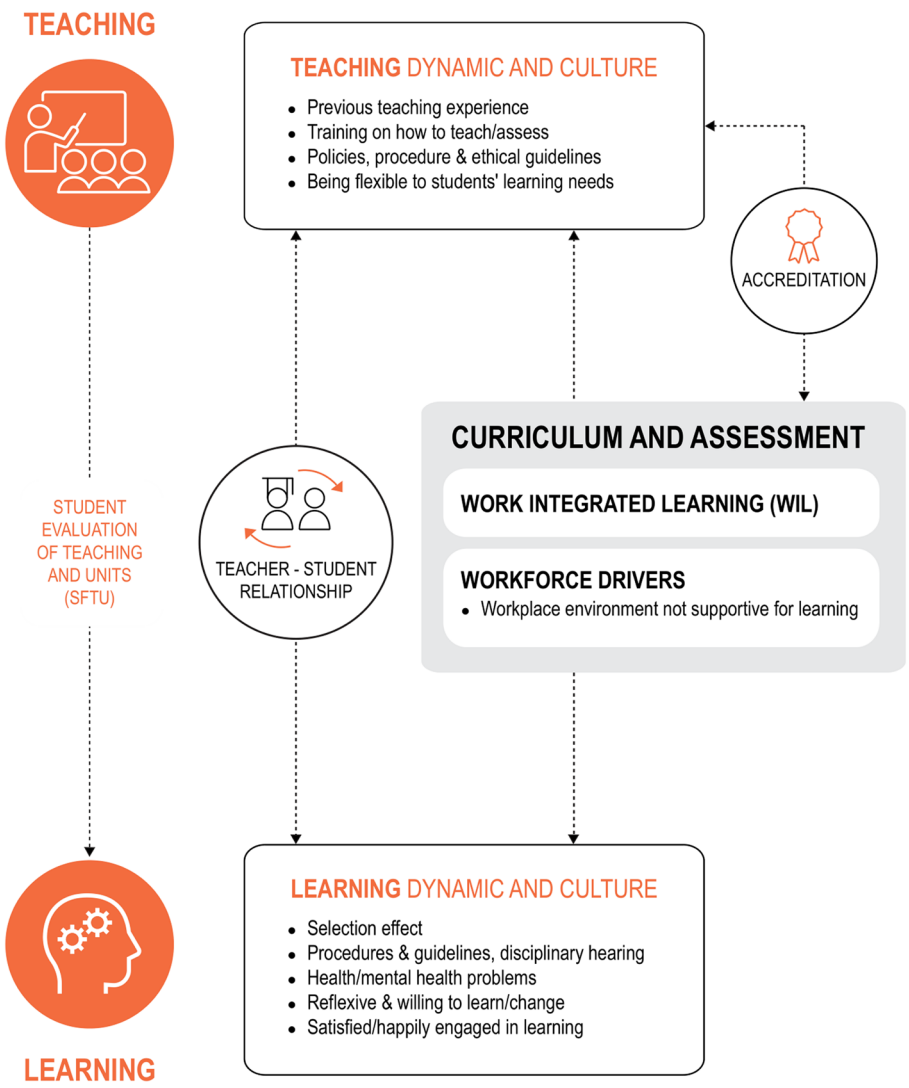

FIGURE 2
Initial logic model of factors influencing the achievement of graduate outcomes.

TABLE 1 Description of sources of existing evaluation data.

Type of information source	Description of information source
Accreditation documentation	The most recent accreditation reports with appendices were obtained from each program, ranging from an 84-page report with 68 appendix items to a 537-page report. At the time of study, the Pharmacy, Nursing and Health Sciences programs were undergoing a revision and did not have accreditation documents. Internal and external program review reports were included for analysis instead.
Program materials	Unit guides (subject outlines) of all units in the included programs were obtained from the university unit guide portal. Specifically, the unit objectives and relevant assessment tasks were extracted and mapped against the six graduate outcomes.
Teaching evaluation	Anonymous Student Evaluation of Teaching and Units (SETU) responses of individual units were collated to provide a broad indicator of students' satisfaction with teaching and the students' learning journeys.
Student demographic and completion data	Class size, completion rate and student data including gender, age, Australian citizenship status, country of birth, socioeconomic status and geographical classification (metropolitan and regional) were extracted and added to the contribution story.

(iv) student demographics and completion data (Table 1). Seeking diverse sources of evidence respected the inherent complexity of learning and teaching. Additional opportunistic interviews with student discipline officers were conducted to gather insights about student discipline procedures which were the same across the two faculties.

Step 4 (Assemble the performance story): The existing data were assembled and assessed by TC for its strengths and limitations. Document analysis was employed to extract relevant data for building the initial contribution story. Specifically, the process involved collating student demographic information, academic staff qualifications, student evaluations of each unit, mapping learning objectives of individual unit of each course against the six graduate outcomes, and extracting information from the accreditation reports and assessment policies to explain the contribution of human, organizational and curricular factors to the development of the graduate outcomes.

Steps 5 (Seek out additional evidence) and 6 (Revise and strengthen the performance story): The gathered evidence of each course was used to iteratively refine the initial Contribution Story. The refined Contribution were presented for assessment by stakeholders *via* a focus group at respective stage of data collection. These stakeholders were identified as academic staff, clinicians involved in work-based placements/learning, employers of graduates and graduates of the programs themselves. Invitations to all current academic staff were sent *via* program coordinators and a convenience sample of participants of work-based placement educators, employers and graduates volunteered to participate in the focus groups. A total of 44 participants took part in six focus groups (Table 2) which lasted between 65 and 124 min. Altogether we collected 512 min of audio data.

These focus groups were designed to assess the existing evidence and strengthen the contribution story. See questions in Table 3. As such, the focus groups involved a program-specific presentation on summarized existing data followed by a set of structured questions. The questions explored whether participants perceived the data to be reflective of teaching and learning in their relevant program, if any key data sources were missing from the summaries, whether the program was effective in facilitating student development of the six graduate outcomes and if the program developed any other competencies. This stage of evidence assessment was done iteratively where the Contribution Story was strengthened and revised after each focus group. The iterations helped to uncover a small number of additional data sources, including evaluation reports of teaching activities and notes from curricular design planning. The iterations also helped the research team experiment with different data displays to examine the strengths and limitations of the contribution stories.

Focus groups were audio-recorded and recordings transcribed verbatim and checked for accuracy by respective focus group facilitator (TC, CP, or MS). In order to develop a deeper understanding of the qualitative data, the transcripts were read several times by the first author (TC) (24). Focus group transcripts were analyzed thematically using an iterative coding process, whereby all transcripts were coded line by line inductively before grouping codes into similar concepts or themes selected to answer the evaluation questions for the study (25). To ensure robustness of data analysis, analysis of all transcripts was first undertaken by TC followed by a second author (CP or MS). Both authors came together to discuss their independent findings and, in most cases, came to consensus. A third author (CP or MS) was involved in the discussion where the two authors who completed the analysis could not come to a consensus in the first instance.

Results from the thematic analysis of focus group transcripts were triangulated with document analysis. The themes were then utilized to build the Contribution Story iteratively (10). In this approach, steps three to six were an ongoing cycle from program to program, allowing us to keep refining and strengthening our final Contribution Story patterns common across all programs. As such, each subsequent focus group was presented with an adapted version of the contribution story. The focus group discussion helped to enhance our contextual understanding of the relationship between learning and teaching activities and proximal outcomes of learner satisfaction and distal outcomes of development of graduate outcomes. The themes identified from the focus group data described below were used to inform the Contribution Story. To ensure anonymity of participants, we intentionally avoided naming the discipline and role of the person who expressed the quotes.

Results

The six focus groups with academic staff, clinicians, employers and graduates provided in-depth contextual information to the collated input from the variety of evidence. They shared experience and expert opinion on factors supporting and hindering teaching and learning, and what teaching and learning factors contribute to the

TABLE 2 Included documents and focus group participants from each program.

	Nutrition science	Dietetics	Nursing*	Pharmacy*	Medicine	Health sciences*
Documents reviewed						
Student demographics	√	√	√	√	√	√
Accreditation report	√	√			√	
Unit guides	√	√	√	√	√	√
SETU	√	√	√	√	√	√
Placement supervisor & student survey	-	√	-	-	-	-
Faculty program review with unit map	-	-	√	√	-	-
Class activity evaluation	-	-	-	-	√	-
Program documents	-	-	-	-	-	√
Focus group participants (n)						
Academics	3	7	4	6	4	4
Work based learning educators	2	-	2	3	4	2
Graduates	2	-	-	-	1	-
Total	**7**	**7**	**6**	**9**	**9**	**6**

SETU, Student Evaluation of Teaching and Units. *New curriculum, no graduates yet.

TABLE 3 Guided focus group questions.

	Question
1	Drawing on your experience as an educator or past student, do you think the presented analysis captures what's happening in your course in terms of teaching & learning? • In area of student satisfaction, knowledge skills & attitude development, and impact & behavior
2	Do you think we have missed any key data / document that could tell us more about your course?
3	Specifically, do you think your course is effective in facilitating student development in the core capability areas (teamwork, lifelong learning, effective communication, evidence-based practice, improving health & professionalism)?
4	Do you think there is desirable quality or capability required as a health professional not captured in our analysis?
5	If you can provide improvement suggestion to any part of training health professionals, what would that be & why?

development of competent health profession graduates. The shared narratives provided contextual information and insight of teaching and learning that helped to refine and strengthen the logic model toward development of the final Contribution Story. Four themes were identified from the focus groups. They described learning and teaching strategies to enhance development of the graduate outcomes of interest. Only quotes from the focus groups were used in presentation of the findings as it was the final step of contribution analysis and the focus group participants added contexts to the gathered evidence in earlier steps.

Theme 1: the need for explicitly described learning objectives in curricula

Focus group participants reported incorporation of the development of the six competencies of interest (working collaboratively in a team, effective communication, lifelong learning, evidence-based practice, professionalism, improving health) in respective curricula. However these competencies were often implied in the wordings of unit guides and hidden within accreditation-body-approved curriculum. It was highlighted during our document analysis that teaching and facilitation of development of these student behavioral competencies were often implicit, rather than explicit. During focus groups, participants described teaching, role-modeling, designing authentic assessment tasks (e.g., group presentations, critical essays) and Work Integrated Learning (WIL) as vehicles to promote development of the behavioral competencies. However, such vehicles were not explicitly communicated in unit guides and assessment instructions. One educator commented on the ambiguities between competencies required and learning outcomes:

> "…[w]e teach them critical thinking and reflective [thinking] but it's not actually mentioned [in the unit objectives]. I don't know if

> you can always teach critical thinking. I think it's almost a common sense." (Focus group 1, participant A)

The lack of explicitly described learning goals for teaching and assessments was reported to contribute to inconsistency in teaching delivery. The high percentage of sessional staff (i.e., part-time instructors) and/or turnover of teaching staff across all programs, and their varied educational qualifications and teaching experience, were reported to be a key concern regarding achievement of learning outcomes:

> "…[d]ifferent people interpret things [in the unit guide] differently." (Focus group 2, participant A)

Theme 2: recognizing learning priorities and challenges in work integrated learning

Work Integrated Learning (WIL) provides a unique training environment and a platform for teachable moments, consolidating knowledge learnt in the classroom to application into practice. Teaching and learning was explained as a fluid process and highly influenced by qualities of teachers and students, and contextual circumstances during the process. Captured in student feedback within accreditation reports, the WIL setting was reported to be an unstructured environment for learning, which could further challenge consistency in the education experience for students. This variability made teachable moments unplanned, opportunistic and episodic, involving field-educators and, sometimes, patients:

> "…[m]y unit is set up so theoretically all this stuff would happen. But I'm not sure if it does in real life, and does consistently across all the placement sites." (Focus group 3, Participant A)

In the fast and complex clinical environment, errors and complaints are unavoidable. Educators and teachers reported capitalizing on such critical incidents in healthcare and made these teachable moments. Incidental teaching moments may mean that students learn serendipitously with difficulty in ensuring a standardized learning experience. In an accreditation report, one anonymous student noted professional misconduct of her field educator who was behaving in a way that conflicted with what the student had learnt in class. The university teaching team was reported to have addressed the professional misconduct and related negative emotions with the student and turned these incidents into teachable moments. While education experience during WIL remained unstructured, it allowed students to gain insights into labor market expectations.

Theme 3: prior experience, education interests, and team dynamics among students and teachers shaped learning and teaching experience

Human factors were found to contribute both positively and negatively to the learning and teaching experience. Human factors included the individual teacher's passion and intrinsic interest in teaching, perceived commitment to education, resilience in dealing with complex student problems and heavy workload, teaching experience and peer support in the teaching team. Similarly, students were found to enter the learning process with different levels of education capacity and social skills, along with varied learning preferences and expectations. The learning culture within student cohorts and in-class peer interactions also varied from year to year. One teacher commented:

> "…[t]he student-student relationship is so important. When they are in a group cohort within a class, with great dynamic, they learn well when they're with their friends." (Focus group 3, participant B)

A cohesive supportive culture within the student body was found to reduce anxiety in learning, however, this was often challenged by the diversity of the student cohort. The diversity in age, gender, culture, ethnicity, educational background, capacity and commitment could also result in a heavy workload experienced by teachers:

> "…what we're doing is herding cats! The huge diversity; where they [the students] come from in terms of countries and also whether [they have] previous training and also for them whether or not they are receiving and they are willing to learn and all that is really a big thing." (Focus group 1, participant B)

Individual interpersonal relationships among staff in the teaching team and with WIL educators were reported to affect the quality of teaching. Some teachers purported to have reservations with specific WIL sites or a specific educator, but most teaching teams in the six programs described strategies to support novice WIL educators and offered to share workload within the teaching team when needed. Participants commented on important support strategies including strategies to identify struggling students, having clearly defined and detailed teaching materials, offering novice educators regular coaching by program coordinators, and site visits to WIL sites to support onsite educators and ensure clear communication of expectations. One participant noted:

> "…[c]urrently we have our third years doing their placement [WIL] and we have lots of new preceptors [WIL educators]. We have been doing [a] lot of education for the preceptors so they understand how to assess and grade the students appropriately. Some also found us helping to bridge understanding between them and students, like highlighting they [students] don't understand the scale [a clinical tool] because they haven't learned it in class." (Focus group 1, participant C)

During education interactions, teachers reported habitual collection of unstructured teaching feedback and informal evaluation of student assessment performance to inform modifications in teaching. Quality assurance feedback was mostly gathered in situations where the teachers were reflexive and had good relationships with students.

Theme 4: professional identity provides structure for teachers and students

Professional identity and perceived professional obligations were reported to be significant drivers of behaviors among teachers, particularly the commitment to 'pass down' the knowledge and skills:

> "…[i]t's that complex arrangement for medicine where that's the culture, and it comes down from consultants expected to facilitate learning for registrars, are expected to facilitate learning for interns, are expected to facilitate learning for, I don't know, whoever else… a lot of it's to do with the history of how it developed and the roles of various levels of expertise in medicine and what they were supposed to do for the people following behind." (Focus group 4, participant A)

Construction of a professional identity was embedded in the curriculum across the four vocational programs, with non-vocational health sciences programs the exception. The actions that a professional would take in practice were found to be used in teaching to anchor students' understanding of what they need to be able to do at the end of the program while providing some contextual explanations of how the behavioral competencies are relevant in the profession. One participant noted:

> "…[w]hen you're looking at students who are coming through Medicine, Physio[therapy], Pharmacy, Nursing, Dietetics, they have a career that is at the end of that, which very much colours their process of learning, but also the process of teaching." (Focus group 5, participant A)

Participants in the non-vocational degrees described the challenges in structuring the program and sparking inspiration among students when there is a lack of a clear job role at the end of the degree. One participant reported:

> "I remember not knowing why I needed to do chemistry and biochemistry and everything and finding it so hard. And I still find it hard… because I'm just not going to engage with it because I don't connect with it." (Focus group 2, participant B)

Multifactorial contribution to quality learning and teaching

Based on the data, a Contribution Story was built to showcase the complex multifactorial influence on learning and teaching (Figure 3) between the six graduate outcomes and their causal properties. The existing data collected from document analysis and the narratives from the focus groups helped to unpack the three areas contributing to graduate outcomes identified as: (i) human factors (teacher related and student related), (ii) curricular factors (accreditation requirements, classroom and WIL, formal and informal feedback pathways), and (iii) organizational factors (teaching logistics, policies and procedures in place to guide and monitor teachers and students' behaviors). A complex interplay between the above factors was identified alongside the constantly changing degree of influence on the quality and experience of learning and teaching. Moreover, the Contribution Story (Figure 3) showed that teacher dynamic and culture, student dynamic and culture and WIL context, all contributed to the development of graduates who (1) collaborate and work effectively in teams, (2) commit to lifelong learning, (3) demonstrate effective communication skills, (4) use and generate evidence; (5) improve health and (6) are professional in their practice. Teacher dynamic and culture, student dynamic and culture and WIL contexts were highlighted as factors that support and hinder teaching and learning, in addition to contributing to the development of competent health profession graduates.

Discussion

Using CA as a novel approach, our study evaluated the six health professions and health sciences program and explored what factors support and hinder teaching and learning, and what teaching and learning factors contribute to the development of competent health profession graduates. Our analysis identified key variables involving students, teachers and a curriculum including WIL that affect the achievement of graduate outcomes. The four themes that emerged from our data demonstrated causal links among the curricula, the students and staff, and the development of desired graduate outcomes. We identified that strategies to facilitate desired graduate outcome development are often implied or ambiguous and could be interpreted differently by teachers. It is important for teachers to capitalize on episodic moments at WIL settings and to turn incidents into teachable moments and further enhance and consolidate the graduate outcome development. The team culture among teachers and students also contributes to creating a supportive environment for teaching and learning. Professional identity influences teaching practice and contextualizes expected professional behaviors for students. We captured the complex links between proximal and distal factors and the development of graduate outcomes and developed a contribution story, which could become a framework for future evaluation of health profession education programs.

Our analysis from document analysis and focus groups highlights that the target behavioral capabilities or competencies (e.g., oral communication, critical thinking, reflective practice, etc.) within curricular documents may not be explicitly articulated, and thus, affects the quality and efficiency, thus the outcomes of teaching and learning. This is not surprising, given recent work that has identified health care graduates from the same institution have multiple conceptualizations of preparedness for practice (26). These capabilities may not be taught in overt and transparent ways, that is either central to curriculum or valued through assessment practices. Such practice could have contributed to several implications in teaching, learning and assessment for both students and teachers.

It is well recognized that assessment drives learning, and students tend to prioritize a learning experience if it is linked to assessment (27, 28). When particular capabilities are not assessed explicitly, students may miss them or perceive them as less important. For many academics, especially sessional teachers, content-heavy courses coupled with large class sizes and limited contact time may impact on the pedagogical opportunities for incorporating behavioral capabilities into their teaching. It is important for courses, especially non-vocational courses, to establish a structured framework explicitly mapping the planned desired competency development into each assessment and activity.

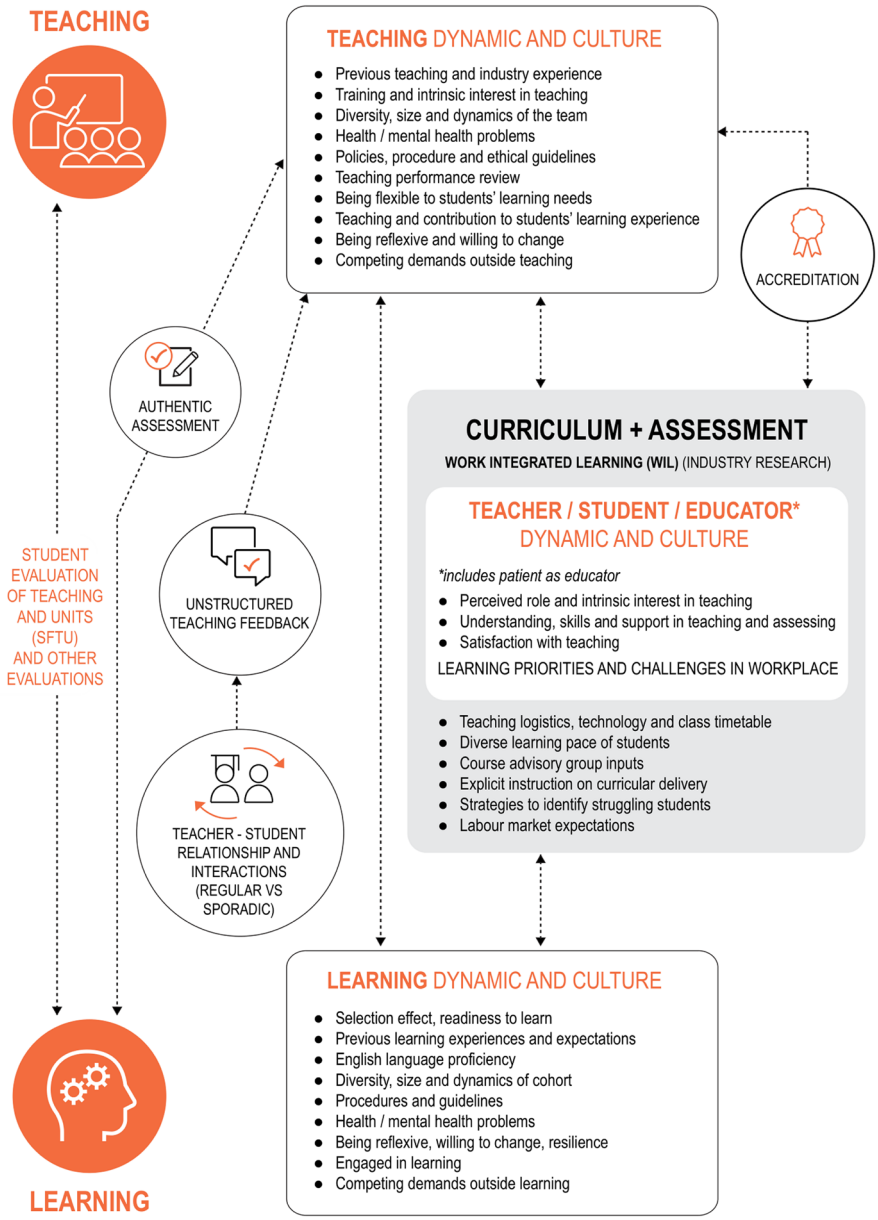

FIGURE 3
Contribution story of the proximal and distal factors influencing the achievement of graduate outcomes.

Within the Contribution Story, we highlighted the significance of acknowledging the complex interconnected multifactorial relationship between curricular activities, learning cultures, WIL and development of desired graduate outcomes. In a health-based practice setting, WIL provides a platform for students to begin to think, act and feel like a health professional (29). Students in this environment are ideally exposed to rich learning experiences encompassing authentic problem-solving related to health-related issues that promote their intellectual capacity to apply conceptual, procedural and dispositional knowledge to real healthcare settings (29). Other benefits of WIL include students developing professional identities, working in interdisciplinary teams, having smoother professional transitions due to consumer exposure and developing skills of adaptability to face the rapidly changing labor market (30, 31).

Given that WIL is characterized by context-dependent, highly complex and multifaceted pedagogical approaches (32), it may increase variability in learning experiences for students. Our analysis revealed that student learning during WIL was opportunistic and incidental. This practice challenged some students to utilize the WIL experience to enhance their professional learning or gain insights into professional expectations. While ensuring that a consistent WIL experience for every learner is not feasible and may lose authenticity, future strategies are required to support WIL educators to capitalize on opportunistic teachable moments in workplace settings.

This study reinforced the need for shifting the course evaluation focus from narrow student satisfaction measures to more detailed and nuanced evaluation measures. Other studies have challenged the reification of student satisfaction surveys arguing that they are unable to fully capture the breadth of influences on teaching quality and outcomes (33). Our final Contribution Story further highlights that current student satisfaction measures alone are inadequate to capture the complexities of teaching and learning in health professions education.

With its range and diversity of factors supporting and hindering optimal teaching and learning experience in health profession education, CA allowed us to adopt a systematic approach to evaluate teaching quality. CA provided the opportunity to acknowledge the complexity of the teaching and learning process, permitting us to make credible causal claims to link learning and teaching activities to learner development of graduate outcomes.

Strengths and limitations

The limitation of this study is the single Australian institution focus limiting the transferability of the findings to other institutions and countries. However, the representation of health profession and health science programs and breadth of data from documents and the heterogeneity of focus group participants in the analysis enhanced transferability of the findings. We acknowledge that the degree of influence by each factor in our Contribution Story on the development of graduate outcomes has not been measured because components intersect and interact in different combinations both contextually and temporally. We also acknowledge that our contribution analysis was built iteratively from one program to the next, and did not include examining the individual's influence on producing graduate outcomes (i.e., how an outcome was attributed to individuals) or profession-specific cultural norms, professional identity or profession history. However, concurring with Schumacher et al. (34), we argue that the process of CA can be used to analyze specific components of individual's behavior and practice attributed to achieving specific graduate outcomes. This application of CA enhances the scope for future research employing both contribution and attribution analysis in evaluating education programs. The choice of using the CA approach, a theory-based, impact evaluation method with the rigor applied to data analysis and involvement of the large and diverse research team further strengthened the study's interpretations and findings. Future research should consider testing the variables identified in this study as markers of education outcomes across other contexts.

Conclusion

Our study presents CA as a theory-based evaluation approach of health professions education, exploring multiple data sources as evidence and acknowledging the complexity of human, curricular and organizational factors toward high quality teaching. This Contribution Story also identifies teacher and student dynamics and cultures, and WIL contexts as important variables for evaluation of health professions education and provides a framework that can be used by others planning meaningful course evaluations within health education programs and beyond.

Data availability statement

The datasets presented in this article are not readily available because the data is not available due to the nature of the data and ethics requirements. Requests to access the datasets should be directed to TC, tammie.choi@monash.edu.

Ethics statement

The studies involving humans were approved by Monash University Human Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

CP and MSa: study conception and design. TC and MSa: data collection, analysis, and interpretation of results. TC, MSa, and CP: draft manuscript preparation. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Paradigms unfolded – developing, validating, and evaluating the Medical Education e-Professionalism framework from a philosophical perspective

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In order to ensure a strong research design, literature stresses the adoption of a research paradigm that is consistent with the researcher's beliefs about the nature of reality. In this article we provide an overview of research paradigm choices in relation to the creation of a Medical Education e-Professionalism (MEeP) framework discussing the research design, research methods, data collection and analysis to enhance the transparency of our previously published research. The MEeP framework was conceived to help Health Care Professionals (HCPs) safeguard the construct of professionalism in the digital context. This entire process was heavily informed by wider readings and deliberations of published literature on e-professionalism. Although the MEeP framework research journey has been published, the paradigms approach was not discussed in any detail. Considering that one of the duties of medical educator is to balance the service and science by bringing the theoretical underpinnings of one's research to public attention and scrutiny so as to nullify the notion of 'weak' research. We were compelled to unfold this paradigm story of the MEeP framework in a detailed manner. In an effort to make our research both robust and effective, this study portrays a philosophical approach to guide future research designs and methodological choices by detailing our rationale for pragmatism as a choice of paradigm.

KEYWORDS

paradigms, pragmatism, mixed-methods research, Medical Education e-Professionalism framework, e-professionalism

Introduction

In educational research, Mackenzie and Knipe (1) and Morgan (2) used the term paradigm to express the researcher's '*worldview*'. Whereas a more elaborative definition of paradigm was introduced by Morgan (2) as a "*set of assumptions, research strategies and criteria for rigor that are shared by the research community*" and "*a system of ideas, or world view used by researchers to generate knowledge*." Paradigm represents the '*ultimates*' encompassing ontological, epistemological, and methodological beliefs of a researcher, which often indicates the researcher's

viewpoint (3). This highlights the importance of paradigm which yield beliefs and directs the crucial steps in planning and execution of the research process. This step also establishes the researcher's philosophical orientation which has significant bearing on the research process and design (4). In order to ensure a strong research design, published literature stresses the adoption of a research paradigm that is consistent with the researcher's beliefs about the nature of reality (5). To accomplish this goal, Levers (6) explained that selection of paradigm aligns with researcher's perspectives of reality and should be made explicit in the process. Lincoln and Guba (7) communicated that a paradigm comprises of four elements, namely, epistemology (our ideas about knowledge), ontology (our existence), methodology (research design and methods) and axiology (the role of values in inquiry) (8, 9). As suggested in the literature, it was paramount to have a close-grained grasp of these elements to identify our position on a particular research paradigm, the underlying guiding assumptions, beliefs, norms, and the values of the chosen paradigm (10). This would help establish an understanding of our research while narrating the journey of the development of the MEep framework (11).

As our research centred on the ever-evolving field of the digital world and its impact on professionalism of healthcare professionals, it manifested new and evolving professional dilemmas and potential erosion of professionalism perspectives. There was no obvious philosophical paradigm to align with our research due to nature of data (enumeration and explanation) required. In order to conduct a cohesive and valid research study, we explored methodological paradigms along with ontological and epistemological perspectives by blending different knowledge claims and inquiry strategies. Similarly, having to select an appropriate lens for this research placed us at the crossroads of these research paradigms where a sharp division became unnecessary. Both epistemological and ontological aspects were needed for the evaluation of e-professionalism concept and later for the development and understanding of the essential attributes required for an effective digital professional. We adopted a complex multi-stage research design and used data from a systematic review, self-reported survey, and Delphi technique and experts' reviews to develop, validate and evaluate the MeEP framework. The results of all stages of the MeEP framework journey have been published recently (12–15). The MEeP framework's journey sheds light on professional competencies in terms of characters, characteristics and identifies constructs which can be inculcated in future healthcare professionals (HCPs) to become digitally skilled. However, it became evident that a pluralistic framework for HCPs to navigate through the dilemma of thriving in the digital realm was needed. Especially since one of the duties of a medical educator is to balance the service and science by appreciating the theoretical underpinnings behind one's research to public so as to nullify the notion of 'weak' research (10, 16). Therefore, in this research we aim to provide an account of the four elements of the paradigm followed by a structured process of rationalizing the paradigm choice in the journey of the MEeP framework.

Epistemology

Schwandt (17) defined epistemology as the study of the nature of knowledge and justification in line with Crotty's approach (18) "*a way of understanding and explaining how I know what I know*." Whereas Denzin and Lincoln (3) described it as "*a relationship between the knower and the knowledge*" investigating how the researcher makes meaningful sense of the world. This understanding can oscillate between positivist – "*knowledge as personal, subjective and unique*" to interpretivist – "*knowledge as hard, objective and tangible*" (19). Positivists dwelling on the philosophical perspectives base their knowledge on the external existence of reality. By employing quantitative methods (surveys and experiments), they infer using replicable statistical analysis thus dissociating the researcher from the whole process. For positivists, the formulation of hypotheses is crucial for the verification of knowledge. While on the other end of the spectrum, Interpretivists, or social constructivists, view knowledge as complex context-specific socially constructed entity (20). Interpretivists acknowledge the significance of history and practical experience in the advancement of knowledge. They believe in the crucial role of research participant and how one's expertise and cognitive base influence the whole research process. They strongly believe in the role of researcher's cognitive maturity that shapes the understandings and discussions with the study participants in each context. On the other hand, realism, which shares similarities with positivism, adopts a scientific approach to developing knowledge. However, realists being on the anti-positivist spectrum rely on triangulation to unveil the truth. Realists highlights the role of interpretations in the context of social environment (21). In articulating answers to the above questions, there are further terminologies coined to define subcategories of knowledge, *intuitive knowledge* (knowledge of beliefs, faith, and intuition), *authoritative knowledge* (knowledge gathered from people, books, leaders in organizations), *logical knowledge* (knowledge emphasizing reasoning), and *empirical knowledge* (knowledge of experiences, and demonstrable objective facts) (22). This, type of detailed discussion is not within the scope of this article. However during the MEeP journey we used the concept of epistemology lauded by Saunders et al. (23) as "*the acceptable knowledge in the field of study*," a useful classification of objectivism, constructionism and subjectivism (18).

Ontology

Ontology is regarded as "*the study of being*" as described by Crotty (18) and "*raises basic questions about the nature of reality and the nature of the human being in the world*" (3). It focuses on understanding the nature of reality and the assumptions we make about it. In other words, ontology examines the objective or subjective aspects of social entities and unfolds the true dynamics of the things. The ongoing ontological debate is whether social reality is individually constructed from consciousness or is it external and imposed on consciousness. In other words, do things exist independently of our mind, or is our world something constructed from our thoughts (19)? This implies that there are two ontological perspectives: realism and idealism. Realists argue the organic nature unrestrained of human discernment. On the other hand, idealists holding the opposing view, confess and endorses the allegory of Plato where human mind constructs its own reality using preconceived notions of shadows. Philosophical assumptions about the nature of reality play a pivotal role in our understanding and on the inferences drawn from the data. These orientate our thoughts about the research problem, its significance and

our approach to problem solving. Hence, ontology plays an essential role in our understanding of the things that constitute the world (24). In MEeP framework journey the ontological position is clear by using external multiple views to best answer the research question.

Methodology

'Methodology' refers to "*the process, principles and procedures by which a researcher approaches problems and seeks answers*" (25). While Langdridge (26) refers to methodology as a term rather than a process as a "*general way to research a topic," while "method is the specific technique (s) being employed.*" Hence, broadly speaking methodology is about research design and methods describe the approaches, and procedures. This includes data collection, participant sampling techniques, instruments used and data analysis conducted so as to answer the research question ensuring a substantial contribution to knowledge. In summary, methodology narrates the systematic process used in conducting the research including assumptions made, limitations encountered and addressed. Both methodology and methods used in this research are discussed in the latter half of this article.

Axiology

Axiology is defined as "*the philosophical approach to making decisions of value or the right decisions*" (27). Axiology involves the examination of values and the foundation upon which a researcher makes value judgments. A researcher's personal values, beliefs, and experiences can influence their research and may impact their ability to remain unbiased when it comes to the concept of value. There are two axiological positions: positivism, which emphasizes value-neutrality, and interpretivism, which acknowledges the presence of values in research. To achieve this understanding of definition and evaluation of the concept of right and wrong pertinent to the research is essential. Simply stated, it's about the ethical behaviour maintained during participant recruitment, data collection and the dissemination of findings to the wider audience. This understanding of axiology dates back to Mill's utilitarian ethics with an understanding that all humans have dignity and the right to choose, which should be respected (28). Keeping this in mind, four principles namely; privacy, accuracy, property and accessibility were upheld while dealing with research participants and data (29).

After identifying the four basic elements which form a paradigm, the next step was to designate an epistemology, ontology, and axiology to assist in developing the methodology (2). By seeking insights from Tashakkori et al. (30) whose advancing work on taxonomies of paradigms from pre-existing research by Candy (31) added a new pragmatic paradigm to the original taxonomy set. They borrowed elements from the Positivist, Interpretivist, and Critical paradigms (31). They kept "the research problem" as the central pivot, which we used while focusing on shaping the attitudes, values, beliefs, thoughts, and behaviour of medical students and changes on various levels, while reconciling eclectic views on how e-professionalism is understood, discovered, learned, valued, justified, and verified, thus challenging concrete ideas of science (32). For the purpose of this research, we broadly related our approach to 'pragmatism' for interrogating and evaluating ideas and beliefs regarding e-professionalism and their practical utility in maintaining the societal contract of profession. However, before we rationalize the principles of pragmatism in the context of this research, lets describe the evolution of this paradigm.

Pragmatism – a philosophical paradigm

Dewey (33) conceptualized epistemology as the "*theory of inquiry*" comprising of experiencing, knowing, and acting which demands a dynamic view of social life. Obviously, unravelling of '*truth*' about this dynamic world cannot be accessed by virtue of single scientific method. Historically, science is an amalgam of various collective truths ranging between objective and subjective assumptions about *ontology* (our existence), *epistemology* (our ideas about knowledge), *research methods*, and *human nature* which forms the basis to challenging the solid foundations of science (8, 9). Many philosophers agree that relational epistemology, non-singular reality ontological viewpoint, a mixed-methods methodology and value-laden axiology were the best way forward in understanding human behaviour (34–36). Drawing on the works of Creswell, Tashakkori, and Teddlie (36, 37) we identified the following characteristics of pragmatic research for MEeP framework journey;

- Rejection of the positivist notion (facts and measurable entities).
- Rejection of absolute post-positivist and constructivist notions (reality and cognition).
- An emphasis on workability in research.
- Choice of research design and methodologies that work for the research question/s.
- Use of the most feasible methodological approaches for knowledge acquisition.
- Choice of research methods well aligned with the purpose of research.
- Triangulation; identifying useful point of connections within the research and to avoid potential biases to enhance the quality of research.

It became obvious that pragmatism was an inclusive approach, which simultaneously appreciated the existence of reality (objectivism) and the individualized worldview (subjectivism) bringing multiple explanations and interpretations of science (23). Table 1 summarizes the nature of pragmatism on the above mentioned four elements of epistemology, ontology, methodology and axiology adopted during the MEeP framework journey.

Appreciating that pragmatism was not aligned to any one system of philosophy gave us the freedom of choice for methods, by viewing the social reality from a different lens that yielded transferable context rich findings (38). Additionally, the pragmatism '*world-view*' dissipated the clear divide between methodological choices, logic and epistemology sufficiently to pacify the paradigm wars (33, 39, 40). In an attempt to safeguard this important societal contract and understanding the phenomenon of e-professionalism viewing this problem through the philosophical lens of '*pragmatism*' seemed most appropriate.

TABLE 1 Summary of four elements of pragmatism for developing the MEeP framework.

Elements	Pragmatism
Epistemology	Depending upon the research question, focusing on the practicality and applicability of the research objectives and subjective and objective approaches can provide admissible knowledge integrating different perspectives in data interpretation
Ontology	Integration of multiple external views chosen in answering the research question
Methodology	Mixed or multiple method designs, quantitative and qualitative approaches
Axiology	Role of values in results interpretation, while the researcher adopts both objective and subjective viewpoints

MEeP framework came into being while keeping in mind how a model can be conceptualized, developed and applied to change professional behaviour of health care professionals about e-professionalism. To achieve this, following questions were probed in a phased manner.

1. What is the nature, degree, and professional use of social media by the undergraduate (UG) medical students?
2. What are the definitions of the constructs for the new proposed MEeP framework?
3. How can the key elements of new MEeP framework be identified?
4. Does the new MEeP framework have sufficient content and response process validity?
5. How does the MEeP framework impact on the reaction, learning and behaviour of learners?

This article provides our philosophical paradigm overview of the materials, methods, and data analysis approaches used while developing, validating, and evaluating Medical Education e-Professionalism (MEeP) framework in a phased manner (Table 2).

Applying the principles of pragmatism in context of MEeP framework

Research design

Keeping our pragmatist view of the world in mind, a unique literature review in the form of concept analysis (In press) prompted us towards developing a well-framed research objective, a concise research question and a well-aligned methodology. A significant and thorough literature review accomplished by assessing the theoretical published literature enabled us to refine the research objectives. Using the '*what works*' Pragmatic approach helped us to unpack the 'truth' of the emerging social reality of e-professionalism and avoiding the 'either-or' qualitative-quantitative polemic through the pragmatist and a pluralist research philosophy developed by Bilau (41). When making the 'theory choice' decision, a number of concerns in relation to prior conceptualizations of three of the fundamental elements: *ontology*, the perception of being subjective or objective in the real world; *epistemology*, the realm of understanding from reflections; and *axiology*, the researchers' persona of opinions and beliefs became evident (19).

Pragmatism's inherent focus was on the experience and action of the research question thus prompting us to look for multiple perspectives in developing MEeP framework (12, 13). Thus, revealing distinctions between how different stakeholders (medical staff and students) and published literature enact evaluations regarding e-professionalism. Likewise, the processing of data collection and results analysis revealed the peculiar differences and diversity of views between the different stake holders. Respecting the diversity of understandings, validation of the MEeP framework by panel of experts' relevant and relatable facets of our research were highlighted and endorsed (14). Building in scope to evaluate the MEep framework by introducing it to those whose professional behaviour had not been consolidated. Using Kirkpatrick's model with a sound theoretical underpinning of Theory of Planned Behaviour (TPB) we measured behavioural changes of digital natives (15). Pragmatism framed the appropriate methodology by unpacking the different aspects of this phased research questions at the design stage (Table 3).

Sampling strategy

In our sampling strategy, pragmatism was the key instrument in the selection of the most suitable participants. As narrated earlier, this research aimed to explore the phenomenon of e-professionalism and its impact on the societal contract. Pragmatism guided us into unravelling this abstract concept of e-professionalism as well aiding the development and evaluation of the new MEeP framework. Revisiting the key principle of pragmatism; inquiry as an experiential process we placed an emphasis on actionable research knowledge, by ensuring sampling decisions would be unbiased and adhered to the pragmatism dogma. Our objective was to explore what different attributes were necessary for an individual to be digitally professional and to develop a framework containing those key attributes for other healthcare professionals. Keeping this in mind and using a convenience sampling strategy (42), the use of Social Networking Sites (SNSs) by undergraduate medical students was probed (13). Convenience or opportunity sampling is often used by researchers as it aids in the selection of a defined population in this case undergraduate medical students (43). All registered undergraduate medical students at the Royal College of Surgeons Ireland Bahrain were approached by gatekeeper which also highlighted our axiological stance on this paradigm.

However, the sampling strategy was changed during the Delphi study (13) and expert validation (14). Pragmatism helped us to develop a more targeted selection of participants to allow for the exposure of a range of perspectives by searching for information rich respondents. Purposive or judgment sampling; is a technique known for the deliberate freedom of choice in selecting participants with peculiar characteristics (44). This sampling technique offers a targeted selection of participants aimed to establish macro–micro linkages by juxtaposing a diversity of perspectives. Patton (45) described these individuals as having a '*personal factor*' called as "*a caring trait about the evaluation and findings it generates*." These individuals included

TABLE 2 Summary of the phases involved in the research study.

	Phase I – Development		Phase II – Validation	Phase III – Evaluation
	Study 1	Study 2	Study 3	Study 4
Design	Convergent parallel		Concurrent embedded	
Rationale	An exploratory step in the development of the MEeP framework	A framework for healthcare professionals to help cope with the challenges of medical professionalism in the digital realm	To seek reassurance by consulting experts regarding the validity of the MEeP framework	To measure the impact of MEeP framework in changing professional behaviours of learners in the digital world
Aim	To identify the key concepts and threats to professional identity in the era of e-professionalism	To develop the MEeP framework	To validate the MEeP framework	To evaluate the MEeP framework at the behaviour level of Kirkpatrick's pyramid using Theory of Planned Behaviour
Approach	QUAL	QUAL-QUAN	QUAN-QUAL	QUAL-QUAN
Sampling strategy and participants	*SPIDER ($n = 44$ studies)	Convenience (SNSME $n = 381$) Purposive (Delphi $n = 15$)	Purposive ($n = 6$)	Convenience ($n = 59$)
Data collection	PRISMA technique	Online questionnaire and online multi-round iterative approach for Delphi	Online meeting with experts and online survey	(Online) Pre-post workshop survey and breakout room discussions
Analysis	Thematic	Descriptive and thematic analysis using grounded theory approach	Descriptive and content analysis	Descriptive and structural Equation Modelling – Thematic analysis

*PRISMA, preferred reporting items for systematic reviews and meta-analyses. *SPIDER – S, sample; PI, phenomenon of interest; D, design; E, evaluation; R, research type.

TABLE 3 Relationship of pragmatic paradigm elements to phased research questions.

Research questions	Ontology	Epistemology	Axiology	Study
Phase I – Framework development – To develop a Medical Education e-Professionalism (MEeP) framework which can describe healthcare professionals' expected conduct using SNSs. To develop a framework for healthcare professionals coping with the challenges of medical professionalism in the digital realm.				
What is there in the published literature related to suggested e-professionalism?	Knowledge – existing social phenomena. Idealism was applied	Qualitative literature review – Interpretative approach	Value – laden	Study 1
What is the degree, nature (social or educational) and professional use of SNS?	Knowledge – existing social phenomena. Idealism was applied	Reality – a result of the human mind, data from stakeholders' opinion – interpretivist approach	Value – laden	Study 2
What are the desired values and behaviours of digital professionalism that are needed for maintaining digital professional identity?	Knowledge – outside the social phenomena. Realism applied	Experts' opinions – Pragmatist's approach	Value – free	
Phase II – Framework validation – To perform Content Validity Indexes (CVIs), Face Validity Index (FVI), and inter-rater reliability of the MEeP framework				
Does the MEeP framework has sufficient content, face and response process validity?	Knowledge – outside and inside the social phenomena. Realism applied	Experts' opinions: rating scales and free text comments – Postpositivist approach dominated	Value – free but the content analysis f free text comments value laden	Study 3
Phase III – Framework evaluation – To determine educational impact of the MEeP framework among medical students				
How does the MEeP framework impact the reaction, learning and behaviour of learners?	Knowledge – outside and inside the social phenomena. Realism applied.	Reality – a result of the human mind, data from stakeholders' opinion using TPB – Interpretivist approach. But digital natives' perceptions and opinions – Pragmatist's approach dominated	Value – laden with surveys and deductive-inductive thematic analysis	Study 4

academics, clinicians, executives (deans and vice deans) and professionalism subject experts spanning from various generational archetypes. The evaluation of MEeP framework however utilized a convenience sampling strategy (15). Adhering to pragmatism principles aided the mapping, triangulation and sequencing of different steps used to answer our research question.

Data collection

In the choice of methods of data collection, the pragmatic approach gave us the power to exercise researchers' subjectivity during the observation process with a very small role for pre-defined theoretical classifications of resultant outcome interpretations, a possible limitation of our research. Focusing on the purpose of research; considering social, historical, and different constructs of professionalism, we integrated multiple realities and verified the assumptions by numerical calculations to create meaningful concepts (46). As Creswell (47) rightly argued pragmatism tackles problem-centred, pluralistic, real-world practice-orientated phenomenon which highlight the consequences of actions. Using the four key elements of the 'pragmatism' continuum (Table 1) developed by Creswell (38), we organized the research methods using both quantitative and qualitative approaches with inductive and deductive considerations using epistemological relativism (38).

Mixed-methods approach

We adopted a mixed-methods approach based on our epistemological relativism and the complexity of e-professionalism. The mixed-methods design belongs to a specific set of methods combining enumeration and description and thus creating a synergistic model of understanding and knowledge creation (38, 48). The value of mixed-methods studies has been progressively recognized within the field of medical education as a means to facilitate researchers who want to examine both breadth and depth of a specific issue or phenomenon (48). Using the Johnson et al. (49) definition of mixed-methods research, we integrated '*theory and practice*' by blending numerous frame of references, stances, perspectives, standpoints and views using the optics of qualitative and quantitative research, which complemented both our epistemological position and justified the rationale behind MEeP framework journey (50). The choice of mixed-methods approach was warranted for several reasons, two of which had resonated with us. First, the results from our first study (12) were used to inform and guide the method for the subsequent study. Although there is a plethora of research on the constructs and framework development of medical professionalism, very few studies have reported on e-professionalism and constructs needed to professionally navigate the digital world (12). A great number of the studies probed the opinions and perspectives of the participants regarding professionalism in the digital world. Some studies investigated desired online activities, professional online presence, and an understanding into the guidelines on professional use of digital media. Numerous examples from the literature indicated the erosion of professional integrity while in the digital world and have signalled blurred boundaries between professional and unprofessional lives (51–55). Despite the extensive epistemological description, the existing body of literature lacked both the realistic and idealistic ontological perspectives. In this context, our two studies made a unique contribution to the field of e-professionalism (12, 13). Second, based on the notion of complementarity, whereby a method was chosen to enhance, expand or clarify existing results using a different strategy (56), we used both quantitative and qualitative approaches synchronously to identify and highlight the utility of the MEeP framework and verify these findings from numerical and subjective positions.

Quantitative research does not tend to follow 'traditions' explicitly as clinical researchers consider case series, cross-sectional and case-control and randomized controlled designs as quantitative, while social scientists consider experiments and surveys as quantitative research (47, 57). Relying heavily on reductionism, quantitative methods categorize human dilemmas and experiences into numerical values. While qualitative approach using the psychodynamic lens views human dilemmas as too complex to reduce into numbers or categories (58). This approach explores the uncertainty especially of 'immature' concepts, complex human intentions and motivations using 'case-oriented' research (59–61). Creswell (47, 62) outlined five main qualitative traditions of narrative, phenomenology, grounded theory, ethnography, and case studies. To add further confusion, in the field of health research, another set of qualitative subdivisions have been made using the terms field-, action-, or library-based approaches. This dichotomy has led to an unhelpful polarizing of epistemologies between those considered positivists (biomedical orientation) on one side and those considered interpretivism (humanist orientation) on the other. This zealous divide between quantitative and qualitative approaches described by Bergsjø as a '*phony war*' dates back to the 1800s when extreme polarisation of positivism vs. interpretivism paradigms ensued (63). In our research, we explored both literature and ground realities around the topic of e-professionalism, erosion of professionalism in the digital world and the reasons why digital natives are not successful in safeguarding this vital construct.

During this exercise, we combined quantitative and qualitative research techniques and methodological approaches and merging concepts into a single research strategy with an idea of complementarity, timing, point of integration, typological and interactive perspectives (64, 65). In a research program, mixing of methods can span across studies however the strategy of mixing should be explained with firm justifications regarding sequential order. Qualitative and quantitative studies can be undertaken concurrently with the qualitative first, or quantitative first, or convergently when the qualitative and quantitative parts are conducted at the same phase of the research study (66, 67). Priority (equal, or either method prioritised), and the rationale regarding nature and timing of integration (full or partial, during data collection, analysis, or interpretation) (61, 68, 69). Keeping in view the different paradigmatic origins of qualitative and quantitative methods, caution must be used when conducting mixed-methods by avoiding a sharp dichotomy between their values and methods.

Developing the MEeP framework with a mixed-methods design involved the use of both qualitative and quantitative methods to explore the phenomena of e-professionalism in the context of digital natives' degree, extent, and nature of the use of Social Networking Sites and experts' opinions about the desired attributes in value, behaviour and identity constructs (13). This mixed-methods approach had similarities with the methodology used by some early research on conventional professionalism (70–74). However, a seminal work on e-professionalism by Ellaway (75) relied heavily on the review of existing literature. The use of both methods in our study design enabled us to generate new inductive knowledge, quantify and describe the phenomena of interest and generate new insights and

hypotheses. This was not a linear process, rather findings from each study typically influenced and informed the idea and design of more than one subsequent studies. Furthermore, the point of integration for different studies varied as described by other researchers. In order to achieve a successful integration of tangible relationships at various levels of methodology, the data analysis and interpretation and research rigor were maintained (68, 76, 77). By using Tashakkori's (38) approach, data was collected, analysed, results integrated, and conclusions were made using both quantitative and qualitative approaches in all three phases of our research (Figure 1).

As shown in Table 4, the pragmatic approach was contextual and application oriented. These reflections on the current challenges in medical education through a pragmatism lens provided us with an inclusive methodology leading to the production of a comprehensive and elaborative set of solutions to the research question.

Reflexivity

Reflexivity is defined as a continuous reflective process by the researcher to critically analyse attitudes, values beliefs and behaviours that can affect the interpretation of the study outcomes (78). Mixed-methods research goes beyond merely mixing quantitative and qualitative approaches while collecting and analysing data to maintain rigor and relevance, it also demands the researcher's reflexivity. Throughout our research, pragmatism nudged the researchers to adopt a reflexive stance during all stages of data collection. The role of reflexivity is essential in the research process to create a nuanced and context-specific understanding of the e-professionalism concept (79). During the systemic review (12) the need to develop a link between published literature, quantitative (SNSME) and qualitative (Delphi) (13) became clear in bringing new dimensions to the MEeP framework constructs. During the Delphi, reflexivity was undertaken through the circulation of plain language questions and later the interpretation of text generated codes, descriptors, and themes. These were fed back to the respondents to refine and endorse in an iterative manner. During the validation of the MEeP framework (14) a real-time online validation process using both rating scales and free text comments was another way to improve reflexivity. Pragmatist inquiry embedding the ethical considerations enabled us to adopt, adapt and involve respondents with different levels of knowledge and experience. The evaluation of the MEeP framework (15) was carried out by adhering to the '*moral responsibility*' principle of pragmatism, we presented the knowledge which has a promising future application in the field of medical education. Keeping the integral element of researcher's subjectivity as part of pragmatism, ambiguities were avoided in data analysis by evaluating the MEeP framework against Kirkpatrick's model using Theory of Planned Behaviour (TPB) (80).

Analysis, dissemination, and conclusions

In our work, pragmatism was a guiding force influencing the approaches and techniques while analysing data and drawing conclusions. Using the 'meta-interface' approach where purposeful consideration was given to the evidence obtained about the phenomenon of interest using qualitative and quantitative types of data (46). This unique approach identified contradictory and confirmatory elements of evidence and led to a revised understanding of e-professionalism. While developing the MEeP framework (13), we focused on the principle of actionable knowledge and avoided theoretical restrictions by using an iterative and

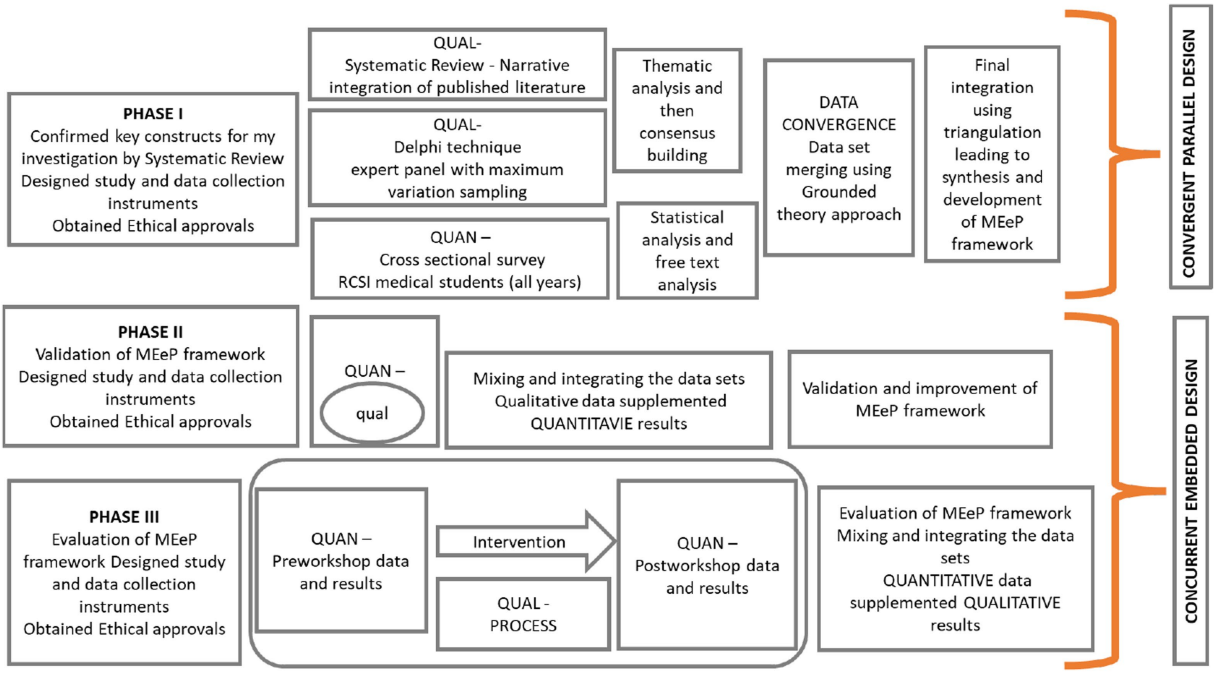

FIGURE 1
A visual illustration of the mixed-methods approach used in this phased research.

TABLE 4 Components of pragmatic research and their key features using illustrative examples from the MEeP framework journey.

Pragmatic component	Key features	Purpose	Illustrative example from the MEeP journey
Approach	Focus on application, context and usefulness	To address specific questions and practical needs	To understand attitudes, values, beliefs, modes of thought, and behaviour of medical students in digital context (12, 13)
Models and frameworks	Focus on key issues for success, important to policy makers and stakeholders	Without overly complex theoretical underpinnings keeping contextual relationship in mind	The ultimate impact on various levels, while reconciling eclectic views on how e-professionalism is understood, discovered, learned, valued, justified, and verified (13)
Designs	Focus on resources, context, replication and applicability of results	Address issues prevalent in multiple heterogeneous settings in real world with a rigor and relevance having few exclusion criteria	Development (e-Delphi) and validation (experts in an online manner) and evaluation (13, 14)
Measures	Reliable, valid, feasible, relevant, actionable, brief, broadly applicable, user-friendly and sensitive to change	Feasible and actionable in real world settings	Detailed and reproducible methodology, validated questionnaires, inductive-deductive-abductive approach to results interpretation (13–15)

pragmatic approach for data analysis (81). Rather theoretical underpinnings were used in an exploratory manner to interpret our findings. We integrated the three legacies of category-centred, case-centred and narrative qualitative methods by performing deductive as well as deductive reasoning (82, 83). This data analysis was based on useful knowledge as posed by the respondents, enabled us to connect pre-existing values, behaviour and identity-based constructs into one framework. While evaluating the MEeP framework (15), qualitative methods enabled deductive and inductive explorations of complex human phenomena with an emphasis on the theoretical underpinnings of TPB and MEeP framework constructs. Quantitative methods (TPB survey) complemented such explorations by enabling the testing of hypotheses arising from qualitative research.

Mixed-methods research can be framed in the context of multiple paradigms like; pragmatic, transformative, post-positivist, and constructivist (1). However, our choice of pragmatic paradigm helped us unpack the dynamic, iterative analytical process by bringing the interconnectedness between experience, knowing, and acting throughout the analysis and write-up phases. Interconnectedness was prominent by keeping the Delphi respondents in the loop and adhering to a prompt timeline of analysis and timely feedback of the findings in various rounds. Keeping the flexibility and adaptability in focus and using an iterative inquiry process allowed the fluidity of abductive, inductive, and deductive reasoning supporting the emergent ideas and data. The same principle was applied to other phased studies in early publications (12–15). This principle had a significant bearing on our dissemination strategy and the utilization of the research findings. Using the pragmatism inherent focus on practice, we probed new ways of knowing and understanding which showed multiple reverberations for the MEeP framework relevance and utility of our research findings. Using this newly developed and validated MEeP framework, we organized a podcast like panel discussion on e-professionalism where the generational perspective (medical student vs. clinical staff) and utility of the MEeP framework was discussed (Panel discussion can be provided on a reasonable request).

Rigor in mixed-methods research

As in any research paradigm, the goal is to enhance rigor by reducing the researcher's bias and improving trustworthiness using a transparent approach. Rigor in research pertains to open critique, explicit, open accessed, and free of bias conclusions drawn from an explicitly stated, transparent and replicable research design (84). Rigor is best achieved fulfilling six criteria starting with a clear purpose, adequate preparation, appropriate methods, significant results with an effective presentation and reflective critique (85). Thoughtful and deliberated planning helps the researcher to envision the goal by clarifying the research question and identifying the concepts. While methodological rigor refers to the systematic manner of data collection and analysis while theoretical rigor is the evaluation of theoretical underpinnings leading to relevance (86, 87). These steps introduce explicitness within the research process. Lincoln and Guba outlined four criteria for the trustworthiness of research; transferability (detailed contextual information to ascertain the applications results to one's situation), credibility (actual representation of results with supporting evidence), dependability (detailed study process for replication) and conformability (communication to the wider audience without researchers bias) were key parameters used to evaluate qualitative work while validity and reliability were used to assess the quality of quantitative research (88).

Conclusion

To summarize, the pragmatic research design was a major strength of the MEeP framework journey. Using a well-defined methodology and conceptual framework to shape the study design, data collection and analysis, we applied triangulation from multiple sources including digital natives and immigrants, surveys, published literatures, experts' opinions, and an educational intervention with a pre-post survey. However, the researchers' stance may have contributed to social desirability bias due to the sensitive nature of the topics, even though we emphasized the independence of interpretation

and the anonymity of data. Finally, publication of this phased research in the form of scholarly published articles in leading and cited international medical education journals speaks volumes towards the pragmatic nature, uniqueness, and novelty of the MEeP framework.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

SSG conceptualized this study idea. She searched, screened, and synthesized the literature, and drafted and revised the manuscript. SSG, DH, MY, and SYG together refined the idea and agreed on the layout and structure of this synthesis. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Medical students' perceptions of LGBTQ+ healthcare in Singapore and the United Kingdom

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Introduction: Lesbian, gay, bisexual, transgender, queer, and other sexual and gender minority (LGBTQ+) individuals have an increased scope of healthcare needs and face many barriers to accessing healthcare. However, LGBTQ+ healthcare education remains scarce, and students' understanding of LGBTQ+ healthcare remains largely uncharacterised. This study investigated the knowledge of and attitudes toward LGBTQ+ healthcare among medical students in Singapore and the United Kingdom (UK), two culturally different countries.

Methods: Medical students in two medical schools, one in Singapore and the other in the UK, completed self-administered cross-sectional surveys using multiple-choice, Likert scale, and free-text questions to explore their ideas, concerns, and expectations about LGBTQ+ healthcare education within their medical curricula.

Results: From 330 responses, students' knowledge levels were moderate overall, with pronounced gaps in certain areas, including terminology, sexual health, and conversion therapy. Deficiencies in knowledge were significantly greater among students in Singapore compared to the UK ($p < 0.001$), whilst LGBTQ+ students and non-religious students had more positive knowledge and attitudes than students not identifying. At least 78% of students had positive attitudes towards LGBTQ+ individuals, but 84% had not received LGBTQ+-specific medical education. Although junior UK students were more satisfied with the adequacy of teaching by their medical school's incorporation of LGBTQ+ inclusive teaching in a newer curriculum, qualitative analyses suggested that students in both countries wanted to receive more training. Students further suggested improvements to the medical curriculum to meet their needs.

Conclusion: Students in both schools lacked understanding of commonly-used terminology and topics such as sexual healthcare despite affirming attitudes towards LGBTQ+ healthcare. Although sociolegal contexts may affect students' perspectives, differences were less than thought, and students were equally keen to provide affirmative care to their patients. They emphasised a need for more formal teaching of LGBTQ+ healthcare professions to overcome healthcare disparities in these communities.

KEYWORDS

LGBTQ+, medical education, curriculum, attitudes, bias training

1. Introduction

Lesbian, gay, bisexual, transgender, queer, and other sexual and gender minority (LGBTQ+) persons constitute marginalised groups in society that face individual and systematic stigmatisation (1) and difficulties in accessing healthcare (2). Evidence suggests LGBTQ+ individuals may experience health disparities in a variety of domains compared to non-LGBTQ+ individuals (3, 4), such as the high burden of mental health problems encountered in LGBTQ+ populations; for example, the governmental United Kingdom LGBT survey concluded that 24% of respondents had accessed mental health services in a 12-month period (5), compared to 4.5% of all individuals in England in a similar period (6). The heteronormative endemic in society may contribute to the inaccessibility of healthcare for LGBTQ+ individuals, where society's heteronormative social order may subconsciously dictate medical interactions and act as a barrier to access to vital social institutions for LGBTQ+ individuals (7). Heteronormative beliefs at the point of care have also been attributed to discrimination of LGBTQ+ individuals by doctors, exacerbated by doctors' lack of knowledge and low self-efficacy in interacting with LGBTQ+ patients (8, 9). Educating healthcare professionals about LGBTQ+ healthcare is considered the most effective way to improve engagement with patients (10), prompting discussions to include diversity-related competencies in medical curricula (11), where medical curricula lack such content at present (12–14). It has been shown that LGBTQ+-focused educational programmes improve students' attitudes, knowledge, and comfort levels (9). However, it is essential to consider students' perspectives and motivation for change when planning educational interventions to reduce participant bias (9).

Limited research exists on students' perspectives regarding LGBTQ+ healthcare. American students expressed comfort in interacting with LGBTQ+ patients but felt a lack of formal education (15). Despite very recent calls from the British Medical Association for teaching and learning about LGBTQ+ healthcare needs in medical education without stereotypes (16), British students had low confidence in using sexual and gender terminology (17, 18). European surveys showed that knowledge and attitudes might depend partly on socio-demographic factors, including respondents' gender identification and religiosity (19, 20).

Singapore is an English-speaking country located in Southeast Asia that, until November 2022, retained male homosexual criminalisation inherited from British colonisation (21). Though Singaporean society may be growing in acceptance of the LGBTQ+ communities, widespread religious resistance and stigma still exist (21), where 57% of Singaporean society remains opposed to homosexuality compared to 13% of British society (22). Same-sex partnerships remain unrecognised in Singapore, with public policies that fail to affirm LGBTQ+ individuals in the workplace and housing (23). 60.2% of the LGBTQ+ community in Singapore have experienced abuse and discrimination regarding their sexuality and gender identity, exacerbating mental health issues (24). Gender-affirming care is reported to be challenging to access amid stigma and insufficient institutional and social support (25).

To the best of our knowledge, no study has characterised healthcare professionals' or future doctors' perceptions of the LGBTQ+ communities in Singapore. Though LGBTQ+ individuals in the United Kingdom also face discrimination, the social, cultural, and legal environment differs significantly between the United Kingdom and Singapore. LGBTQ+ issues are divisive across generational lines (26), so it is instructive to investigate how young people experience a curriculum created by an older generation, particularly in one country where, at the time this study was carried out, male homosexuality was illegal. This study compares how medical students perceive LGBTQ+ healthcare in a country where homosexuality was decriminalised more than 50 years ago, one where it was decriminalised only very recently, and where societal attitudes differ markedly in the two countries. Uniquely, the two medical schools in this study have similarly structured curricula and studies between medical students from both schools are actively encouraged and funded.

2. Materials and methods

2.1. Instrument development

The authors considered existing surveys at the time of survey design (27, 28) to contain stigmatising language towards the LGBTQ+ communities. We developed a new survey with more inclusive language and free-text components absent from previous surveys (29). The MEDLINE database was searched to identify relevant health needs, facilitated by discussions between the co-investigators, medical education experts, and a representative from an LGBTQ+ non-profit community organisation. The survey was piloted with members of an LGBTQ+-identifying healthcare staff network in London. Their responses were compared with students' responses to the factual questions. The entire survey was further piloted with six medical students to check for accuracy, flow, and understanding, and their suggestions were incorporated into the final version. The internal consistency of each survey section was measured using the alpha coefficient Kuder–Richardson 20 (KR-20) for dichotomous data or Cronbach's alpha for non-dichotomous measures in SPSS (version 28.0.0, IBM).

The survey consisted of socio-demographic questions, multiple-choice knowledge questions surrounding agreed-upon terminology to refer to people who identify in a particular way, and language commonly used in healthcare for LGBTQ+ individuals. Further questions probed students' knowledge of gender transitioning, blood donation restrictions, the prevalence of HIV/AIDS, HIV medication, whether homosexuality is a psychological condition and understanding of gender dysphoria. Students were also given clinical scenarios to assess whether they would ask for patients' preferred pronouns and what they would do for patients seeking conversion therapy. Care was taken to include a mixture of more general and specific knowledge questions, as judged by the expert panel developing the items. Attitudes and approval toward specific healthcare practices such as using gender-neutral pronouns, asking for consent before recording gender and sexual orientation, and providing affirming care were assessed on a 5-point Likert scale. Students were then asked to rate their learning regarding LGBTQ+ patients in various settings on a Likert scale and were asked about their sources of knowledge on LGBTQ+ issues and specific topics. Open-ended questions in the final section of the survey asked about difficulties faced when trying to learn more about LGBTQ+ patients, topics students wanted to learn more about, and changes they wanted to see in formal teaching regarding LGBTQ+ health issues. We utilised a pragmatist philosophical approach underpinned by realist ontology, using both a

quantitative approach to gather real-world perspectives and a qualitative approach to investigate students' reasons and needs behind these perspectives (30). Ethics approval was obtained from the Imperial College Research Ethics Committee (21IC7342) and the Nanyang Technological University Institutional Review Board (IRB-2021-521).

2.2. Procedures

Respondents were recruited via student newsletters and year-wide social media groups, inviting voluntary participation at a time selected to avoid survey fatigue and examination periods. Respondents self-completed the online Verint survey on their own devices and in their own time. Consent was given on an introductory page. A prize draw incentive for GBP£10/SGD$20 vouchers directed survey participants to a separate form to retain survey data anonymity. The complete survey is available as Supplement 1.

2.3. Participants

Inclusion criteria allowed medical students 18 years or older to participate during the academic year 2021–2022, registered at one of two specific medical schools, one in London (UK) and the other in Singapore (SG). At the time of the study, these medical schools were partnered with similar curricula [descriptions of curricula found on respective websites (31, 32)]. The SG medical school has teaching on delineating sex and gender. The UK medical school was implementing curriculum change at the time of the study, commencing with year 1 students who started in the academic year 2019–2020. From personal communications with faculty in 2023 and scrutinising the published learning outcomes in both curricula, the older curriculum had outcomes related to health inequalities and discriminatory practices but did not explicitly separate LGBTQ+ content. It is difficult to know how individual educators addressed these learning outcomes. The newer curriculum incorporates sensitivity training from Year 1 that explicitly includes hypothetical scenarios with gay and trans people, recognising heteronormative assumptions in clinical communications, teaching on working sensitively with gender and sexually diverse groups in Year 2 and patient cases with LGBTQ+ couples in Years 2 & 3. Teaching about gender as a social construct and the difference between gender and sex is also explicitly included in the newer curriculum. It is noted that certain aspects of the newer curriculum may not have been introduced at the time of this study. Students in years 1 to 3 in the academic year 2021–2022 received the newer curriculum, while students in years 4 to 6 received the older curriculum.

2.4. Data analysis

Quantitative data analyses were conducted in GraphPad Prism (version 9.5.0, LLC). Analyses were conducted overall, comparing medical schools, junior (years 1 to 3) and senior (years 4 to 6) years, LGBTQ+ identification, gender identification, and religiosity. Since no respondents identified as "other gender" (Table 1), and with the small number of non-binary respondents solely in the UK insufficient for statistical analysis, analyses were performed between respondents who self-identified as male and female, as in previous studies (33, 34). Further analyses were conducted between junior and senior UK students to assess the effect of changes in curricula on responses. Normality was assessed using the Shapiro-Wilks test. For knowledge questions, the Mann–Whitney U test compared between groups, with data shown as the median (interquartile range). Categorical data were assessed with Fisher's exact test and Chi-squared test. To reduce the variability from subjectiveness, responses from Likert scale data were grouped into positive and negative responses before statistical analyses, omitting neutral responses. The significance level for all inferential analyses was set at $p \leq 0.05$.

For the open-ended questions, thematic analysis was performed on NVivo (release 1.6.2, QSR International). Five investigators performed an iterative process of generating themes, at first very concrete and representative of the data, but which became more conceptual with repetitive rounds of discussion and coding (35, 36). Discrete ideas were discussed collaboratively between the investigators, where one response may have more than one discrete concept. Iterative review processes enabled the categorisation of these ideas into succinct codes. As more data were re-reviewed, codes were also revised and grouped. After coding all data, the codes were further reviewed and grouped into higher-level themes. Other investigators audited the final coding.

3. Results

3.1. Instrument piloting

The question about the proportion of LGBTQ+ individuals in each country was removed from the analysis since it is difficult to ascertain their true proportions, leaving twelve questions in the knowledge section. Compared with all students' responses for the knowledge section (median score 10 [8–11]; maximum score possible being 12/12), the expert group of 25 LGBTQ+ respondents scored significantly higher (12 [11–12], $p < 0.001$), demonstrating face validity. Statistical analysis of knowledge-based questions gave a KR-20 score of 0.59, perhaps unsurprisingly, since this section encompassed many unrelated facets of knowledge ranging from terminology to clinical scenarios. Non-dichotomous survey sections showed good levels of internal consistency with Cronbach's alpha of 0.81 in both the attitudes and sources of knowledge sections.

3.2. Demographics

346 respondents completed the survey. 16 respondents had already graduated and did not meet inclusion criteria, leaving 330 included entries, consisting of 151 UK and 179 SG respondents (Table 1) from approximately 1,500 and 700 eligible students in UK and SG, respectively. There were similar numbers of junior and senior students. 29% of all respondents identified as LGBTQ+, with 48% of UK respondents compared to 13% of SG respondents ($p < 0.001$). There was a similar proportion of LGBTQ+ students between junior and senior UK students (52% vs. 40% respectively, $p = 0.290$). 51% of all respondents identified with a religion, with a more significant proportion from SG than the UK (60% vs. 40%, $p < 0.001$).

TABLE 1 Demographics of respondents with comparisons between the United Kingdom medical school (UK) and Singapore medical school (SG).

Demographic	UK (n = 151)	SG (n = 179)	p-value	All (n = 330)
Age (median, IQR)	21 (20–22)	21 (20–22)	0.395	21 (20–22)
Year of study, n (% of total UK/SG/all respondents)				
Year 1	9 (6%)	33 (18%)	–	42 (13%)
Year 2	18 (12%)	50 (28%)		68 (21%)
Year 3	31 (21%)	31 (17%)		62 (19%)
Year 5 (UK)/Year 4 (SG)	30 (20%)	30 (17%)		72 (22%)
Year 6 (UK)/Year 5 (SG)	21 (14%)	35 (20%)		75 (23%)
Year 4 (UK)	42 (28%)	-		21 (6%)
*Junior students**	*58 (38%)*	*114 (64%)*	<0.001[+]	*172 (52%)*
*Senior students**	*93 (62%)*	*65 (36%)*		*158 (48%)*
Gender identification, n (%)				
Male	51 (34%)	94 (53%)	0.002[=]	145 (44%)
Female	94 (62%)	83 (46%)		177 (54%)
Non-binary	4 (3%)	0 (0%)		4 (1%)
Other gender	0 (0%)	0 (0%)		–
Prefer not to say	2 (1%)	2 (1%)		4 (1%)
Respondents identifying as LGBTQ+, n (%)				
Lesbian	7 (5%)	0 (0%)	–	7 (2%)
Gay	18 (12%)	8 (4%)		26 (8%)
Bisexual	36 (24%)	15 (8%)		51 (15%)
Transgender	3 (2%)	0 (0%)		3 (1%)
Queer	8 (5%)	0 (0%)		8 (2%)
Other LGBTQ+identity	1 (1%)	1 (1%)		2 (1%)
Total	*73 (48%)*	*24 (13%)*	<0.001[+]	*97 (29%)*
Religious identification, n (%)				
Identify with religion	61 (40%)	108 (60%)	<0.001[=]	169 (51%)
No religion	73 (48%)	67 (37%)		140 (42%)
Prefer not to say	17 (11%)	4 (2%)		21 (6%)

*UK junior students received the newer curriculum, whilst UK senior students received the older curriculum, [+]: Fisher's exact test, [=]: Chi-squared test. "%" represents the percentage of UK, SG, and all respondents (in their respective columns) who indicated the demographic option. IQR = interquartile range, n = the number of respondents, LGBTQ+ = lesbian, gay, bisexual, transgender, queer, and other.

3.3. LGBTQ+ healthcare knowledge

Of the 12 knowledge-based questions, respondents correctly answered an average of 10 [8–11]. UK students correctly answered slightly more questions than SG students (10 [9–11] vs. 9 [8–10] respectively; $p < 0.001$; Figure 1). Non-religious students answered slightly more correctly than religious students (9 [9–11] vs. 9 [8–10], respectively; $p < 0.001$) and LGBTQ+ individuals also answered significantly more correctly than non-LGBTQ+ respondents (11 [10–11] vs. 9 [8–10], respectively; $p < 0.001$). Considering that the expert group answered better than the undifferentiated population of students and the potential skew of results from the higher proportion of LGBTQ+ respondents in the UK than in SG, we compared the knowledge of non-LGBTQ+ students between the UK and SG; UK respondents still answered significantly better than their SG counterparts (10 [8–10] vs. 9 [8–10], respectively; $p = 0.049$). There were no differences when comparing junior and senior students ($p = 0.248$), including in the UK ($p = 0.717$), or between respondents who self-identified as male and female ($p = 0.277$). Considering specific questions, six questions had >30% of incorrect responses (Figure 2).

3.4. Attitudes towards LGBTQ+ healthcare

Students had positive attitudes towards using gender-neutral pronouns (79% positive), where significantly more UK than SG students ($p = 0.014$) and LGBTQ+ than non-LGBTQ+ students ($p < 0.001$) would use gender-neutral pronouns when enquiring about persons other than the patient. Still, there was no significant difference when comparing non-LGBTQ+ students between the countries (Figure 3). Further, students were 78% positive toward asking patients' consent before recording their gender/sexual orientation, with no significant difference between the countries when comparing

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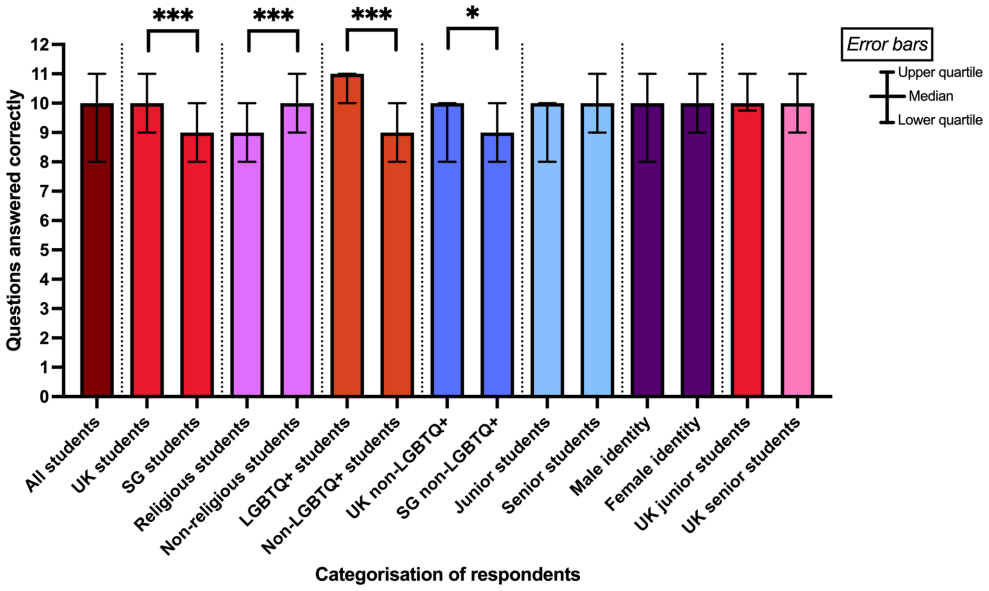

FIGURE 1
Comparisons of questions answered correctly from the Knowledge section of the survey between pairs of groups of respondents. * denotes $p < 0.05$, *** denotes $p < 0.001$ from Mann–Whitney U tests. The data were non-normal, where the bars in the figure show median values, and the error bars represent interquartile ranges.

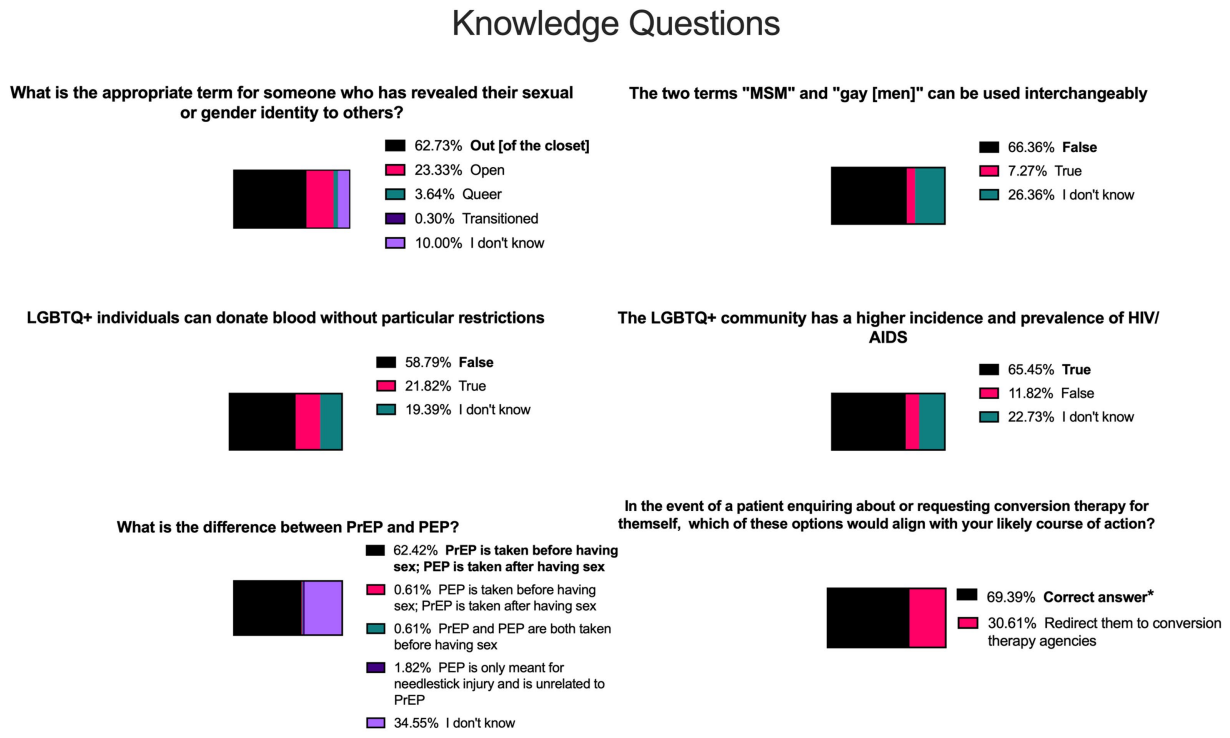

FIGURE 2
Knowledge-based questions most frequently answered incorrectly. Statements highlighted in bold and shaded in black show the correct answer for each question. Other shades of colours indicate incorrect answers or where students indicated "I do not know". *A correct answer consisted of one or more of the following answers: "Explain to them that conversion therapy does not have enough scientific evidence to support it", "Assist your patient in understanding more about various sexual orientations", and "Redirect them to organisations providing support services for LGBTQ+ individuals", without selection of the incorrect response "Redirect them to conversion therapy agencies". MSM = men who have sex with men, LGBTQ+ = lesbian, gay, bisexual, transgender, queer, and other, HIV = human immunodeficiency virus, AIDS = acquired immune deficiency syndrome, PrEP = pre-exposure prophylaxis, PEP = post-exposure prophylaxis.

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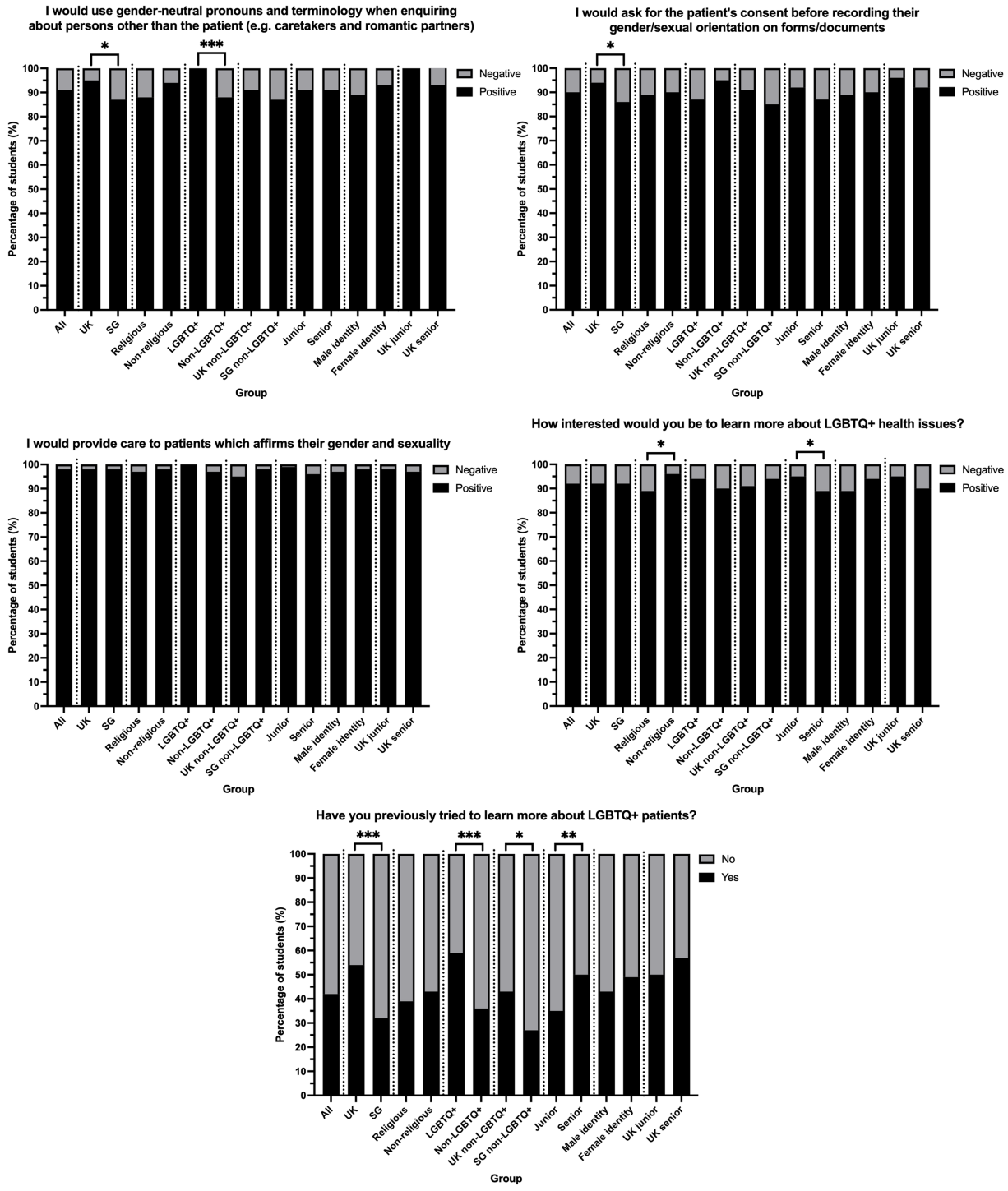

FIGURE 3
Comparisons between pairs of groups of the percentage of students with positive and negative attitudes towards LGBTQ+ healthcare. * denotes $p < 0.05$, ** denotes $p < 0.01$, *** denotes $p < 0.001$ from Fisher's exact tests comparing the numbers of students.

non-LGBTQ+ students and stage of studies. Additionally, 86% of all students wished to provide gender-affirming care, with similar proportions of positive responses between the countries.

When asked how interested students would be in learning more about LGBTQ+ health issues, 92% of respondents were interested or extremely interested in both countries. Non-religious students were more interested than religious students ($p = 0.035$), while more junior than senior students had greater interest ($p = 0.046$). Interest in learning more was not affected by LGBTQ+ identification or by country. 42% of all students had previously tried to learn more about LGBTQ+ patients, with significantly more UK than SG students ($p < 0.001$) and more LGBTQ+ than non-LGBTQ+ students ($p < 0.001$). When considering only non-LGBTQ+ students, more UK than SG students still tried to learn more previously ($p = 0.033$).

TABLE 2 Sources of knowledge and training with comparisons between the United Kingdom (UK) and Singapore (SG).

Topic	All respondents (%)	UK respondents (%)	SG respondents (%)	*p*-value (UK vs. SG)
The proportion of students who felt they received insufficient teaching in…				
"University modules"	84	77	91	0.011
"Clinical settings"	82	74	89	0.010
"Interacting with LGBTQ+ patients"	79	68	88	0.001
The proportion of students who did not feel confident in interacting with LGBTQ+ patients				
Do not feel confident	36	19	51	<0.001
Students receiving medical school teaching as a source of learning for these topics				
Blood donation restrictions	32	25	39	0.048
Sexual health	52	44	60	0.034
Gender-related health	14	21	9	0.028
Gender and sexuality-affirming care	8	11	6	0.311
Students receiving clinical placement teaching as a source of learning for these topics				
Blood donation restrictions	11	10	12	0.822
Sexual health	25	27	24	0.746
Gender-related health	6	9	4	0.251
Gender and sexuality-affirming care	4	7	2	0.170
Students learning from sources outside of education for these topics				
Blood donation restrictions	56	72	42	<0.001
Sexual health	63	71	57	0.055
Gender-related health	80	80	79	>0.999
Gender and sexuality-affirming care	32	38	26	0.095
Students did not learn about these topics from within or outside the curriculum				
Blood donation restrictions	25	20	31	0.104
Sexual health	9	11	9	0.814
Gender-related health	14	13	17	0.553
Gender and sexuality-affirming care	63	53	72	0.008

Moreover, more senior than junior students tried to learn more ($p = 0.007$), but this difference was insignificant ($p = 0.408$) in the UK alone. There were no notable differences across all questions between students who self-identified as male and those who self-identified as female.

3.5. Sources of knowledge about LGBTQ+ healthcare

84% of students were negative regarding the adequacy of teaching LGBTQ+ health throughout medical school (Table 2). Significantly more SG than UK respondents that felt they received insufficient teaching surrounding LGBTQ+ health in university modules (91% vs. 77% respectively, $p = 0.011$), clinical settings (89% vs. 74% respectively, $p = 0.010$), and in experiences in interacting with LGBTQ+ patients (88% vs. 68% respectively, $p = 0.001$). Only one respondent across both countries answered 'Strongly agree' to the three teaching areas. A more significant proportion of junior than senior UK students were optimistic about the adequacy of education in university modules (18% vs. 4%, $p = 0.040$), but unsurprisingly, senior students had experienced more clinical teachings ($p = 0.015$). Further, junior and senior UK students had similar adequacy of experiences in interacting with LGBTQ+ patients ($p = 0.076$). Junior and senior UK students also had no differences in confidence levels in interacting with LGBTQ+ patients ($p = 0.692$). However, significantly fewer SG than UK students felt confident (51% vs. 19% respectively, $p < 0.001$). Respondents identifying as LGBTQ+ felt much more confident in their interactions (52% positive) than their non-LGBTQ+ identifying colleagues (16% positive; $p < 0.001$).

When asked about the sources of learning for various topics, at least 75% of students did not recall receiving teaching from medical school or clinical placements about LGBTQ+ healthcare topics, especially surrounding gender-related health and providing gender-affirming care (89%; Table 2). However, more SG than UK students received teaching surrounding blood donation restrictions ($p = 0.048$) and sexual health ($p = 0.034$), but more UK than SG students received teaching on gender-related health ($p = 0.028$). 80% of students across both countries gathered information about gender-related health from outside formal education. Still, significantly more SG than UK students did not learn about gender and sexuality-affirming care (72% vs. 53%, respectively, $p = 0.008$). For gender-related teaching and providing affirming care, significantly more junior students on the newer curriculum in the UK learnt this than senior students taught

via the older curriculum (36% vs. 10% for gender-related teaching, $p < 0.001$; 22% vs. 3% for providing affirming care, $p < 0.001$). However, blood donation restrictions were better learnt by senior UK than junior students (57% vs. 22%, $p < 0.001$), and learning of sexual health content was similar ($p = 0.093$).

3.6. Difficulties faced when learning

Qualitative analysis found that many students found it challenging to find information. A lack of resources was mentioned by many students, where LGBTQ+ healthcare was considered a sensitive topic. Students noted the conservative nature of Singaporean society with societal discrimination, where LGBTQ+ individuals were reluctant to communicate their LGBTQ+ identities and religiosity affected stigma.

> "Society here is pretty conservative, and there are many Christians who generally have a poor opinion of the LGBTQ+ community, so this combination of factors makes it hard to discuss/learn about these issues in a medical context". SG student

Difficulties were described in terms of a lack of teaching in the UK and an apparent lack of university interest and investment, which was more evident in senior compared to junior UK students. Students reported difficulty finding reliable information, with information often expressing stigmatising and homophobic attitudes. The information available seemed limited to sexual health.

> "Less formal sources of information out there … There's also just nothing on it in our med school teaching; the only time it was even briefly mentioned was during ID [infectious disease]". UK senior student

Moreover, UK students did not know how, what, where, and whom to ask for information surrounding LGBTQ+ healthcare. LGBTQ+ and non-LGBTQ+ students voiced similar difficulties when trying to learn more.

3.7. Topics students wanted to learn

Qualitative analysis showed further that communication skills were a common topic students wanted to learn, especially regarding how to be sensitive and respectful towards LGBTQ+ patients and how to make LGBTQ+ patients comfortable. Providing inclusive care was mentioned by many UK students, encompassing gender-affirming care and intersectionality. Guidance for patients seeking conversion therapy was mentioned. Symbolism in the form of rainbow badges and lanyards and ways to show support for LGBTQ+ individuals were expressed by many students. Students wanted to learn about barriers and stigmas that the LGBTQ+ communities faced when accessing healthcare and how societal discrimination affected their healthcare.

> "I'd like to know more about the experiences of LGBTQ+ patients and what change they'd like to see in healthcare". UK junior student

Regarding specific healthcare topics, students especially wanted to learn about transgender healthcare, such as hormone therapy and gender reassignment surgery. Gender dysphoria was another key topic. Mental health was commonly mentioned, as well as sexual and reproductive health, including aspects such as fertility and family planning. However, many students were unsure or did not know what topics they wanted to learn.

> "Not that I can think of, but I know learning about it is extremely important. I think the medical school should be doing more to dismantle homophobia and transphobia within the student cohort – I know of many people with these beliefs". UK junior student

3.8. Changes to curriculum proposed by students

It was evident from the qualitative analysis that students wanted more teaching and emphasis on LGBTQ+ health issues in their curricula. This was consistent across students, regardless of LGBTQ+ identification.

> "More, more, more. The LGBTQ+ community is unfairly disadvantaged everywhere, including in healthcare. There needs to be more awareness, understanding, and knowledge for treating such patients, so they feel comfortable seeking treatment". UK senior student

Junior students mentioned some sexual health and gender teaching in the newer UK curriculum, whereas senior students perceived a lack of education that junior students did not mention. SG students mentioned no teaching.

> "Teaching regarding such issues is inexistent, so a good start would be to implement small modules on the intricacies of caring for LGBTQ+ patients." SG student

Students in the UK wanted an earlier start to teaching, with sustained regular teaching throughout the curriculum. SG students wanted their medical school to be more open and mentioned the stigma and personal views that medical educators may have and the difficulty of making changes in SG.

> "It [teaching] barely exists. I feel that stereotypes and misinformation are rife among my batchmates, and I feel the school should do more to ensure we can nurture doctors who will create a safe space for LGBT patients". SG student

UK students wanted less heteronormative language used throughout the course and preferred pronouns to be more respected. Students across both schools wanted to be taught by LGBTQ+ individuals or simulated sessions with self-identifying LGBTQ+ patients.

4. Discussion

There is a need to expand medical training to incorporate LGBTQ+ healthcare needs better to address the ongoing

discrimination in healthcare contexts against these communities. This study contributes to the sparse data on LGBTQ+ medical education in Singapore and the United Kingdom. Overall, knowledge was generally adequate but lacking in certain areas, especially in SG, compared to the UK. Though attitudes towards healthcare needs were positive, our novel qualitative component showed that most students reported low confidence that their medical training sufficiently prepared them to address LGBTQ+ healthcare needs and considered that the inclusion of such content is needed.

4.1. Knowledge

Significantly more pronounced in SG than in the UK, it was evident that medical students lacked knowledge surrounding LGBTQ+ healthcare, echoing previous arguments that medical education fails to train and acknowledge future doctors to address LGBTQ+ healthcare inequalities (37). Basic terminology, such as "out [of the closet]" and "men who have sex with men," were not well understood. Knowledge of healthcare topics such as blood donation, pre-exposure prophylaxis, and HIV prevalence was also lacking. This is important since prior studies found that a lack of knowledge among doctors led to discrimination against LGBTQ+ patients (8, 9). Our findings suggest that this lack of knowledge may have already existed at medical school and that changes in undergraduate curricula may help to reduce discrimination (11). It was apparent that UK students possessed greater knowledge than SG students even when accounting for sexual orientation, perhaps in part, as mentioned by junior UK students qualitatively, the newer curriculum incorporating gender-related teaching. This contrasted with senior students' responses of a "lack of teaching" and "no teaching" in SG, reinforcing findings from the USA of insufficiency of formal education at medical schools (15). An advantage of this study was that the junior and senior divide in the UK accurately reflected the years of new curriculum changes. UK junior students appreciated the increased university interest and investment in LGBTQ+ healthcare, and they expressed fewer difficulties when trying to learn compared to senior students. However, the lack of difference in knowledge questions answered correctly between UK junior, and senior students may be explained by learning content through clinical years, potentially via real-world experiences with LGBTQ+ patients, that might have counteracted the lack of teaching in their junior years in the older curriculum. Differences in perceptions of LGBTQ+ healthcare between the countries may also be explained by the sociocultural and legal differences between the two countries. Despite this, the differences between the medical schools were not great, with UK respondents answering one more correct question in the knowledge section on average, suggesting that the UK curriculum could be further inclusive, given the much lengthier period since the legal acceptance of LGBTQ+ individuals and the expected 'excellent care' of LGBTQ+ patients from their doctors required by the General Medical Council (38).

Religiosity seemed to be linked to lower knowledge levels, corroborating previous European studies (19, 20). The high proportion of religious respondents in SG compared to the UK may contribute to the differences seen between students in the two countries since religious resistance and stigma may negatively affect students' perceptions of healthcare (21), where religious beliefs that disapprove of same-sex relations present as a frequent motivator to support conversion therapy (39). This may also explain the many SG respondents that would redirect patients enquiring about conversion therapy to specialist agencies despite the lack of evidence supporting this practice (40) and its harm toward patients (41). Although medical schools may have some slight ability to affect physicians-in-training's heteronormative prejudices (8, 9), shifts in societal attitudes and beliefs towards LGBTQ+ persons are crucially needed, especially in SG. The practices and perspectives of medical students are contextual, and knowledge from a broad array of settings may help to understand and improve the healthcare disparities experienced by LGBTQ+ persons. Many SG students mentioned that religiosity and stigma may affect patients' willingness to be open to healthcare providers about their sexual orientations, meaning students may not have much exposure to openly self-identifying LGBTQ+ patients, compared to the UK, where students may have more opportunities to do so.

4.2. Attitudes

At first, the greater number of UK students having strongly positive attitudes compared to SG suggests that UK students may be more accepting of the LGBTQ+ communities. The difference in attitudes between countries may be attributed to the increased proportion of LGBTQ+ respondents in the UK since attitudes were similar after accounting for LGBTQ+ identification. This finding, although less significant than hypothesised, shows that students are keen to know more and provide affirmative care to LGBTQ+ patients regardless of the sociolegal contexts and the fact that LGBTQ+ care is not specified in the Singapore Medical Council's outcomes for graduates (42). A similar study found that both non-heterosexuality and religiosity were significant predictors of students' attitudes (43), corroborating our findings that non-religious students had greater interest in learning more about LGBTQ+ healthcare. A consistent trend across previous studies with medical students was an association between the male gender and negative attitudes (33, 34). Our study found that gender was not associated with negative attitudes, suggesting that gender identity may not affect awareness and interest in LGBTQ+ healthcare issues, and this highly educated group of students are equally motivated to provide affirming care for LGBTQ+ individuals. This suggestion is further supported by free-text responses, which found that students had similar concerns regarding difficulties when trying to learn more regardless of LGBTQ+ identification and voiced similar ideas and expectations for curricula change.

The greater proportion of UK students that would ask for patients' preferred pronouns than in SG may reflect the lower amount of stigma and increased exposure surrounding the topic in the United Kingdom; indeed, some academic journals have recently adopted including authors' preferred pronouns (44). Ascertaining this information is vital to mitigate the stigma and discriminatory environment associated with heteronormative perspectives and attitudes among healthcare providers and to nurture healthy doctor-patient relationships that provide optimal outcomes (45, 46).

4.3. Sources of knowledge

Medical school training improves knowledge and awareness of LGBTQ+ healthcare issues (47). The barriers to effective curricular

materials have previously been mentioned in the literature, including the absence of trained faculty, perceptions from faculty that LGBTQ+ issues are not relevant to the curriculum, content being absent from examinations, and a lack of teaching role models to discuss sexual orientation or gender identity (15, 17, 18, 48). In this study, most students did not feel they had adequate teaching at medical schools surrounding LGBTQ+ patients, which was distinctly more negative in SG than in the UK. Despite the high proportion of LGBTQ+ respondents, this suggests that students want to learn about these topics, but the opportunities are not necessarily present for them to do so.

Many students did not knowingly have interactions with LGBTQ+ patients, supported by the greater proportion of SG than UK students feeling less confident to interact with LGBTQ+ patients, and obtained their information from outside medical education. This finding is not unexpected, given that in the USA, where modest improvements in LGBTQ+ medical education have been made, many medical schools still have no such content in their curricula (49). This may reflect the lack of willingness in SG to discuss LGBTQ+ behaviour and health.

Results suggest that students have some amount of learning about LGBTQ+ sexual health in the senior years of medical school, but there is a significant lack of gender-related teaching in SG. This is corroborated by qualitative data suggesting that LGBTQ+ healthcare education focussed on sexual health, perhaps to the detriment of other important LGBTQ+ healthcare issues such as mental healthcare and healthcare for non-cisgender individuals. Promisingly, more UK and junior respondents learnt about gender-related and gender-affirming topics introduced in the newer curriculum. However, this did not seem to affect students' knowledge or attitudes towards LGBTQ+ individuals. These results suggest that further changes may be needed in the curriculum. It was outside this study's scope to formally analyse the effect of the newer curriculum's coverage of LGBTQ+ inclusive content on students' perceptions. Nonetheless, hetero- and cis-normative assumptions in the hidden curriculum, which fails to provide equality, diversity, and inclusion for LGBTQ+ people, may still present a concern for medical curricula to address (50).

4.4. Future directions

This study indicates that medical schools, especially in SG, could usefully provide more teaching and emphasis on LGBTQ+ healthcare, echoing calls from previous studies (15, 17). As well as being on sexual healthcare, this could also give the students a holistic understanding of the diverse healthcare needs that LGBTQ+ individuals have. Through the qualitative component of our study, students proposed topics they wanted to learn, such as improving communication skills with the LGBTQ+ communities, supporting patients, and providing inclusive care. Our study provides students' perspectives on changes to the curriculum that medical schools could utilise. Given the potential challenges that both the literature and students in this study expressed (such as lack of trained faculty), temporary interventions may include single lectures (9, 51), online self-administered modules (52), or mixed interventions incorporating didactic lectures, patient groups, and small group sessions (47). To overcome prejudice and biases and improve students' comfort with LGBTQ+ patients, using additional clinical vignettes and simulations, with the presence of faculty and doctor role models, is also valuable (33, 53, 54), which has been introduced in the UK medical school. Students had further suggestions, including sustained teaching throughout the curriculum and delivery by LGBTQ+ individuals, which corroborated previous findings (55). Future qualitative work in this area would provide further in-depth analyses and better capture students' perceptions of LGBTQ+ healthcare.

5. Conclusion

The foundation for doctor-patient relationships is established during medical school, and healthcare education influences students' attitudes, knowledge, and skills. This study found slight differences between SG and the UK, where students in the UK were more knowledgeable about LGBTQ+ healthcare, and SG students expressed greater inadequacy in teaching LGBTQ+ healthcare topics. These differences may be attributed to the sociolegal disparities between the countries. There is a need for a review or further review of medical curricula to improve medical students' training surrounding LGBTQ+ health and create a more equitable healthcare environment, where necessary. Although there may be societal hesitation to include LGBTQ+ health teaching in SG, our study suggests that irrespective of the sociolegal contexts, future doctors want to be equipped with the knowledge and training needed to practice without discrimination and bias.

5.1. Limitations

Limitations of the present study include a higher response rate to the survey in SG compared to the UK, which may have affected the interpretations of this study's results. We cannot know for sure how this disparity should be interpreted. It could mean non-responders and students who did not volunteer to complete the survey were more conservative or less interested in LGBTQ+ healthcare. Alternatively, the differences in response rates may reflect the potential increased appeal of this topic in SG, where LGBTQ+ issues are less openly discussed, and students may be more willing to engage with LGBTQ+ health issues. It could also reflect the increased dissatisfaction of SG students on LGBTQ+ coverage in their curriculum; thus, students perceive themselves as drivers of change. Singaporean national values may also play a part, where service to the community is stressed by the university throughout education. This may mean SG students were more willing to be helpful and collaborative in completing the survey. Finally, our results were only garnered from students in two medical schools, so they may not be generalisable across the entirety of the United Kingdom and Singapore's medical schools.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Imperial College Research Ethics Committee (21IC7342) and Nanyang Technological

University Institutional Review Board (IRB-2021-521). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

Author contributions

MF, TZ, RA, XY, SO, AT, SS, and AB contributed to the conception and design of the study. MF, TZ, RA, XY, and SO acquired and analysed data. AB and SS audited the qualitative coding. MF prepared the original draft of the manuscript, with contributions from TZ, RA, SO, and XY. SS, AB, and AT provided supervision and critically revised the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

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A blended learning approach for teaching thoracic radiology to medical students: a proof-of-concept study

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Introduction: The best way to impart knowledge to medical students is still unclear. Therefore, we designed a blended learning course in thoracic radiology including both "traditional" in-class time as well as online learning modules. The aims were (1) to investigate students' attitudes toward this blended learning approach; and (2) to test whether it improved their knowledge about thoracic radiology.

Methods: A prospective study was conducted at the local medical center; 156 fourth-year medical students completed this study. Before and after the course, students had to complete (1) questionnaires to investigate their attitudes (7-point Likert scale); and (2) an objective test to assess their knowledge (multiple-choice/free text questions; results as % of correct answers).

Results: Regarding (1), the course led to an improvement in all items compared to baseline, exemplary: interest in thoracic radiology (precourse 4.2 vs. 5.4 postcourse) and the fulfillment of students' expressed requirements regarding the teaching content (4.5 precourse vs. 6.2 postcourse). Furthermore, the great majority (88%) of our participants wished for more online learning offerings in the future. Regarding (2), the course led to improved knowledge on the objective test (precourse: 40% vs. postcourse: 63% correct answers).

Conclusion: This feasibility study showed the successful design and implementation of a blended learning approach in thoracic radiology. Furthermore, it revealed medical students' positive attitudes toward this approach and showed an increased knowledge in thoracic radiology. Thus, such approaches might be used to enrich the teaching armamentarium in medical education and to further enhance interest and knowledge in thoracic diseases among medical students.

KEYWORDS

medical education, online learning, blended learning, radiology education, thoracic imaging

1 Introduction

The best way to impart knowledge to medical students is still unclear and remains the focus of ongoing research (1–4). In the vast majority of medical schools, teaching is still based mainly on traditional, *ex cathedra* concepts (4–6). Previous studies have proposed that students' discontent with the current teaching system might be one of the various reasons for their declining participation rates in recent years (2, 7–9).

However, there is growing interest in more innovative, student-centered approaches including, in particular, online teaching and learning (2, 9, 10). As a reaction, such online-based formats have been added to radiology education curricula, with great success regarding the effectiveness of learning and positively influencing students' attitudes toward learning (11–16). Notably, blended learning approaches attracted much attention in recent years (17–20). In its essence, blended learning combines both online and onsite learning resulting in a beneficial mix and allowing for a possible greater educational impact (19–21). In a "flipped classroom," an autonomous, online-based learning phase precedes a face-to-face, onsite learning session (18, 22). In the online phase, students actively and autonomously acquire knowledge serving as a basis for the face-to-face phase. In the subsequent onsite phase, the main focus is to deepen the acquired knowledge and to further enhance the learning process (18, 20).

If used properly, this shift from instructor-centered teaching to student-centered learning can promote accelerated learning and might foster i.a. the learning and motivation (18–21).

On the other hand, the success of this blended learning course strongly depends on an adequate acquisition of knowledge in the online phase (18, 22). Thus, students' motivation to actively participate and to prepare themselves prior to the face-to-face session is crucial. From lecturers' perspective, a "traditional" onsite course has to be transformed into an online/hybrid format (14, 18). As a dedicated teaching platform and multimedia material is required, this requires additional effort and can be a time-consuming and potentially expensive process.

Over the last 2 years, the coronavirus disease 2019 (COVID-19) pandemic has acted as a catalyst for such innovative concepts as lecturers were forced to critically rethink teaching formats in medical education (22–28). As a positive consequence, several attempts have been made to implement various teaching formats (22–26). However, as courses were mostly implemented under considerable time pressure, they can be seen as "emergency remote teaching" instead of dedicated and embedded in a structured, curricular framework. Nevertheless, even after overcoming the pandemic, such innovative and "digitally supported" teaching concepts are not provided throughout all medical universities.

Thus, we designed a blended learning course in thoracic radiology and implemented it into the teaching curriculum of our faculty. In the scenario chosen for this study and as mentioned above, students had to acquire basic knowledge independently outside the classroom before attending a live didactic course (17, 29). For this purpose, we developed an online platform, which served as a basis for the online education part.

We deliberately chose thoracic radiology as the subject because it is (1) a common field in diagnostic imaging; and (2) includes basic knowledge almost every medical student will need as a doctor (30, 31).

First, we aimed to investigate students' general interest in this blended learning approach. Second, we aimed to test whether this specific course design can improve students' knowledge and understanding about thoracic radiology.

2 Methods

2.1 Study setup and course design

This study was conducted prospectively at the Department of Diagnostic and Interventional Radiology, University Medical Center Mainz. It was performed in accordance with the "Checklist for Reporting Results of Internet E-Surveys (CHERRIES)" (32) and with the "Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies" (33) (Checklist S1). Institutional review board approval was waived by the Ethics Committee of the Medical Association of Rhineland-Palatinate.

For this study, a dedicated course on thoracic radiology was designed using a blended learning approach. The course was part of the officially predetermined curriculum of our university medical center, delivered to fourth-year medical students and embedded into a pre-existing curricular course in radiology; other courses of the officially predetermined curriculum included i.a. Interventional Radiology, Cardiovascular Radiology, Oncological Imaging and Neuroradiology. It was conducted as a hybrid course consisting of a structured online learning platform and one 90-min dedicated onsite course with face-to-face teaching. Before the online part as well as after the onsite part, participants' knowledge about thoracic radiology as well as their attitudes toward the course design was captured. To this end, dedicated questionnaires as well as an objective knowledge test were designed (see section 2.3 for more details). Before each part of the course (online and onsite), participants were informed that the survey results would be anonymous and that they were collected for research purposes only. Figure 1 gives an overview of the setup of our blended learning course.

2.2 Course program (online and onsite)

The course program was based on the "Radiological Curriculum for Undergraduate Medical Education in Germany" of the German Radiological Society (DRG) (30) as well as on the "Curriculum for Undergraduate Radiological Education" of the European Society of Radiology (ESR) (31). Design and implementation of the course followed the waterfall model (34) and was a multi-stage process.

Online teaching was performed via a dedicated, newly designed online learning platform. Content was composed by a consortium of several experts in the field of thoracic radiology, pulmonology, and didactics. Images were drawn by a web designer; the online learning platform was built by a professional programmer and could be accessed via a standard web browser. The platform consisted of six modules, which had to be studied by the students autonomously before the onsite course was given. Modules transmitted knowledge about technical basics as well as normal and pathological findings in X-ray, CT, and ultrasonography. Modules were: basics chest X-ray, basics chest CT, basics ultrasonography, pathological findings chest

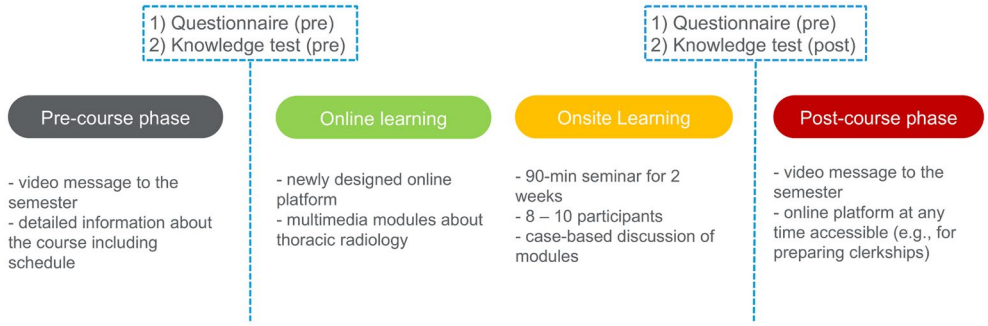

FIGURE 1
Overview of the setup of our blended learning course in thoracic radiology.

imaging, pathological findings CT/X-ray and pathological findings ultrasonography. An example of the structure of the online learning platform is provided in the Supplementary Figure S1.

In order to enhance the learning experience, online content was enriched with different features (clickable color highlighting, video loops on demand, image magnification). An example of how each of these features was used in the platform is provided the Supplementary Figure S2.

Onsite courses were given as 90-min face-to-face seminars. Based on the modules mentioned above, there was a case-based discussion in which the participants could deepen their understanding in thoracic radiology. In order to have the same knowledge base, modules of the onsite and online part matched. Courses were carried out as block training on a daily basis during 2 weeks in July 2022 and given by consultant radiologists with considerable experience in thoracic imaging. Group size for the onsite courses was 8–10 students.

2.3 Questionnaire and test design

A dedicated questionnaire was designed together with the Institute of Occupational, Social and Environmental Medicine (ASU) of the University Medical Center Mainz. The questionnaire comprised various sections covering in particular the following topics: interest and knowledge of thoracic radiology; the students' expressed requirements for teaching content and teaching medium in thoracic radiology; the use of online learning in general and in thoracic radiology; attitudes toward online learning before, during, and after the pandemic; and technical aspects of online learning as well as the current and possible future role of online learning. In the questionnaire, particular attention was paid to the assessment of the online learning platform as it was newly designed for this course. Participants were asked to answer the questions using a 7-point Likert scale. Compared with a 5-point scaling system, a 7-point Likert scale provides higher variance and thus higher reliability. Other scales such as 9- or even 11-point scales would not add any more value regarding the information obtained and could even strain our participants' abstraction capabilities. The questionnaires are provided in the Supplementary material (Precourse evaluation S2 and Postcourse evaluation S3).

The objective test was based on the content of this thoracic radiology course as well as on the curricula of the "German Radiological Society" (DRG) and the "European Society of Radiology" (ESR) for undergraduate radiological teaching (30, 31). It was composed by a consortium of several experts in the field of thoracic radiology, pulmonology, and didactics. For a more balanced assessment, multiple-choice as well as free text questions were used. Design of the questions corresponded to current specifications (35, 36). The entire test is provided in the Supplementary material (Quiz thoracic radiology S4).

2.4 Validation

The questionnaires and objective test underwent a two-step validation to further enhance the quality of the study. First, cognitive pretesting was performed on a sample of 10 participants (medical students in their last year; feedback was given via oral survey) (37); second, pilot testing was performed on a cohort of 25 participants (medical students in their last year; feedback was given via written survey) (38).

2.5 Data collection and statistical analysis

Survey results were collected via an established online survey tool (SurveyMonkey[1]). After the questionnaires and the test were designed, web links were encoded in QR codes, which were implemented in the presentations of the courses. Students were asked to scan the QR codes with their smartphones to access the questionnaires. In case of technical problems, we provided tablets. Final survey results were exported from SurveyMonkey as a CSV file and subsequently analyzed using R 4.2.2 (A Language and Environment for Statistical Computing, R Foundation for Statistical Computing[2]; last accessed February 2023). Figures were plotted using the ggplot2 and Likert packages (39). Means and standard deviations were calculated to analyze the results regarding descriptive statistical analysis (40), regression analysis was performed to identify possible relationships between variables (see section 3.3 for detailed description).

1 www.surveymonkey.com
2 https://www.R-project.org

3 Results

3.1 Participants' demographics

In total, 156 of 160 students completed the questionnaires (97.5% response rate). Demographic data recorded were gender (40.4% male, 59.6% female), age (mean 25.9 years), current study year (mean fourth study year) as well as possible vocational training before medical studies. A tabular overview is provided in the Supplementary Table S5.

3.2 Survey results

The following survey results are presented in written form as well as graphically (Figures 2–8). To increase comprehensibility, the text contains only the key findings and summarizes "strongly disagree," "disagree," and "somewhat disagree" as disagreement, and "somewhat agree," "agree," and "strongly agree" as agreement. For statistical analyses, the original 7-point categories were used.

3.2.1 Use of online learning resources and interest in thoracic radiology

A great majority of the participants stated that they use online learning media (86%), with an average of 12 h of use per week. This remained unchanged after the course. One-fourth of our participants had already used online learning media before (27%). If online learning media were used, online learning platforms were ranked in first place (16%), before eBooks (10%) and apps (12%).

Prior to the course, an overwhelming majority stated that they were interested in diagnostic imaging in thoracic radiology (83%). Before the course, only one-third of the participants stated that they had previous experience in thoracic radiology (31%), mostly from textbooks (37%), followed by curricular courses (21%) and webinars (11%) (Figure 2).

3.2.2 Attitudes toward online learning in medical education in general

Only a few participants were satisfied with the online learning courses provided before the pandemic (8%). About the half of our participants were satisfied with the online courses provided during the pandemic (45%). However, the great majority of the participants wished for more online learning offerings in the future (89%) (Figure 2).

3.2.3 Student demands for teaching content in thoracic radiology

Before the course, participants demanded a better theoretical and practical knowledge of thoracic radiology (54%), a better understanding of thoracic anatomy (63%), and to be able to better differentiate between pathological and normal findings (50%). After the course, an overwhelming majority of our participants stated that their requirements for teaching content were fulfilled regarding their theoretical and practical knowledge of thoracic radiology (91%), their understanding of thoracic anatomy (92%), and their ability to differentiate between pathological and normal findings (93%) (Figure 3).

3.2.4 Students' preferences and requirements for teaching media in thoracic radiology

Before the course, a great majority of the participants ranked online learning platforms as their preferred learning type that would motivate them the most to learn thoracic radiology (70%), before scripts/lecture notes (10%), apps (7%), and books (5%). After the course, these high expectations were fulfilled as the great majority stated that online learning platforms motivated them to become involved with thoracic radiology, even in the future (73%). Furthermore, students chose the online platform as their preferred teaching type (Figure 4).

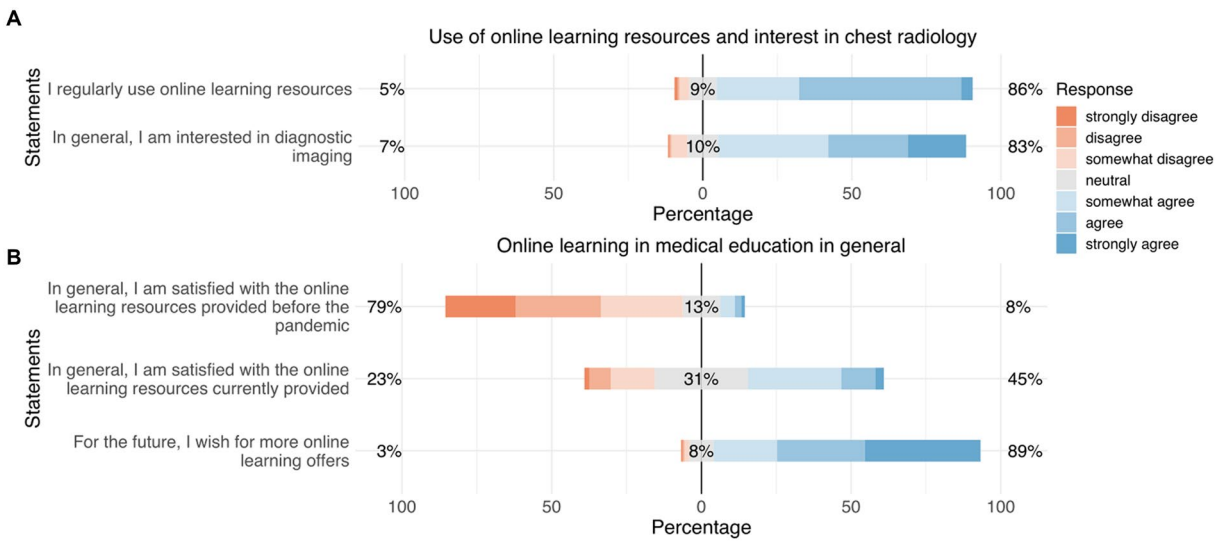

FIGURE 2
Responses regarding "use of online learning resources and interest in thoracic radiology" **(A)** and "online learning in medical education in general" **(B)**. Orange represents "disagreement," gray represents "neutral," and blue represents "agreement."

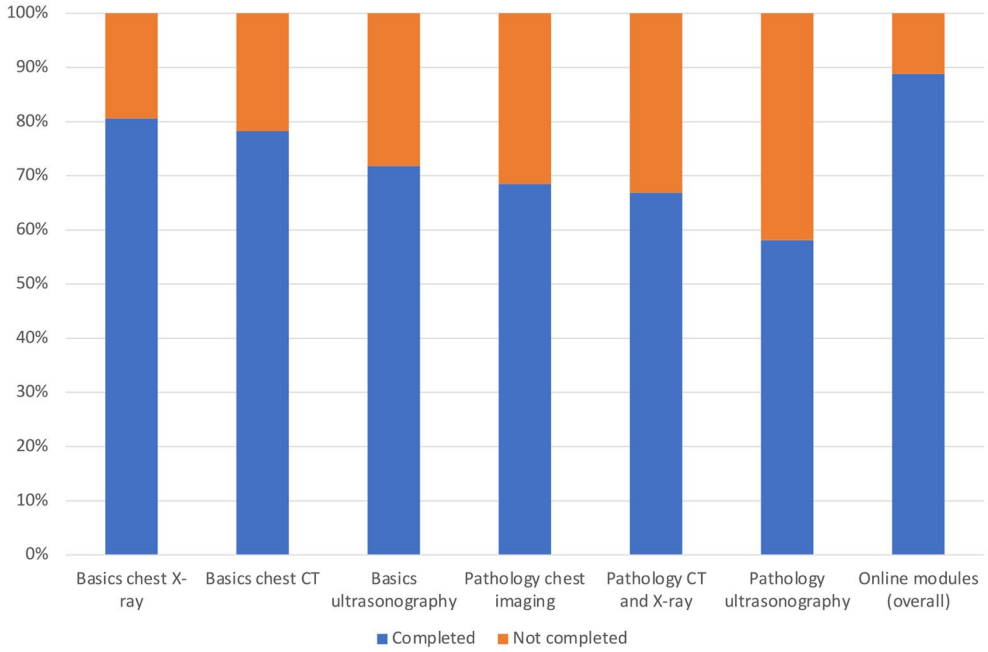

FIGURE 8
Completion rates of each module in %. Blue represents completion, whereas orange represents lack of completion/no completion.

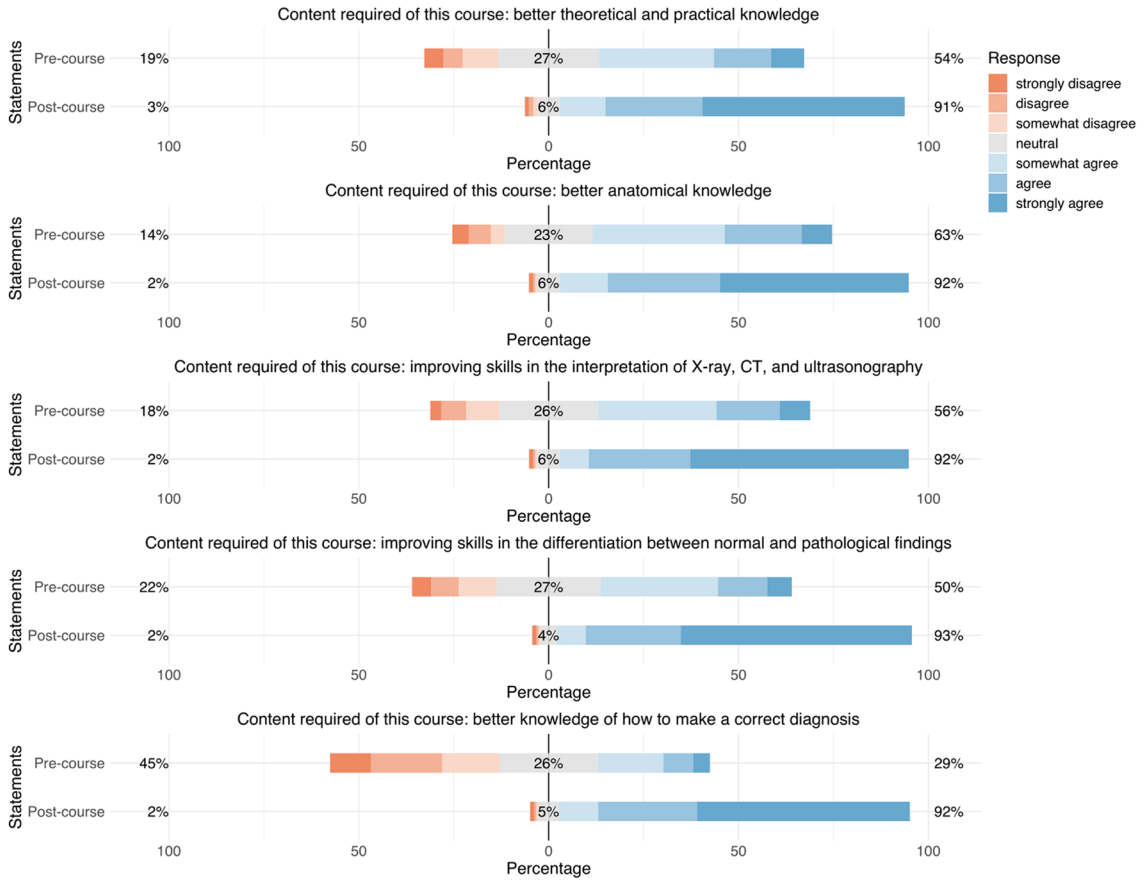

FIGURE 3
Responses regarding "requirements on teaching content in thoracic radiology." Precourse results are compared to postcourse results. Orange represents "disagreement," gray represents "neutral," and blue represents "agreement."

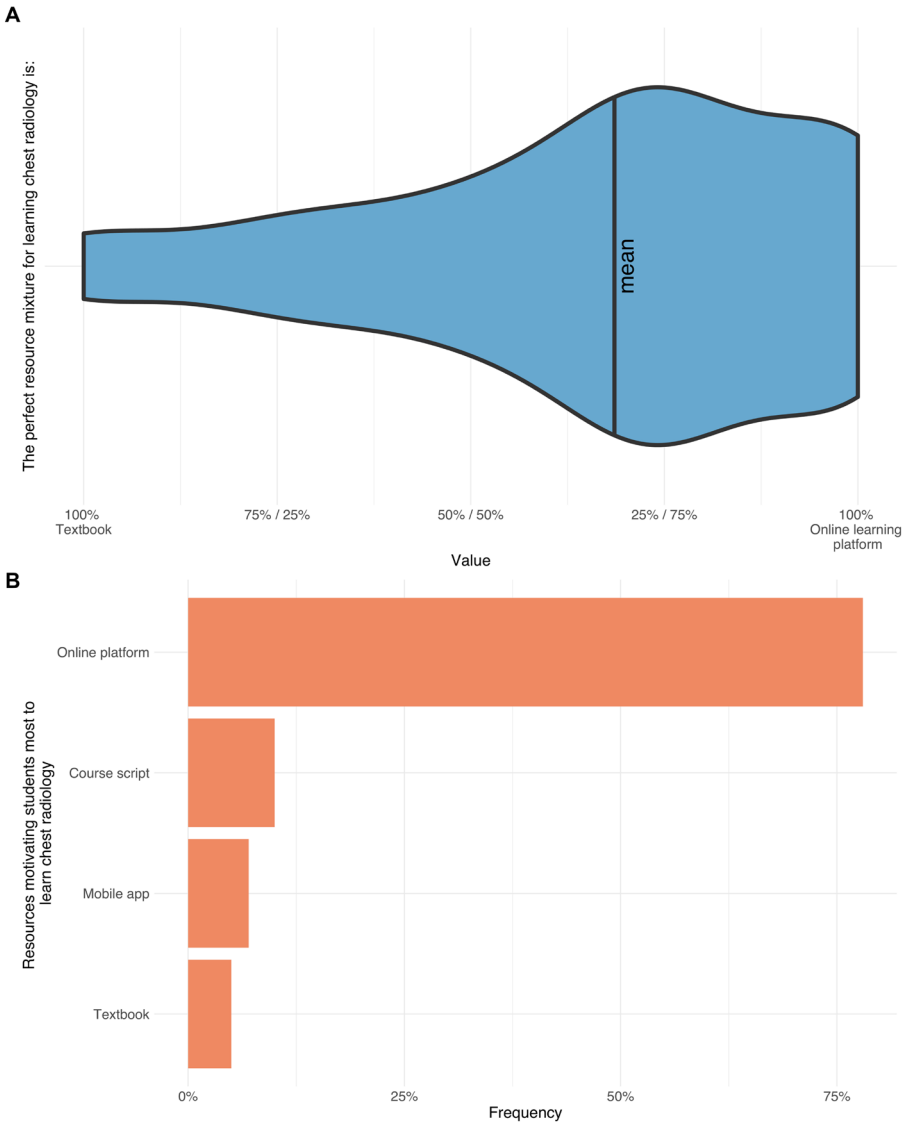

FIGURE 4
The upper violin plot depicts the preferred teaching type (online platform vs. textbook/lecture notes) (66%) **(A)**. The bars demonstrate the ranking of the teaching types motivating the participants most to learn thoracic radiology: Online platform (78%), course script (10%), app (7%), and textbook (5%) **(B)**.

3.2.5 Subjective self-assessment of knowledge in thoracic radiology

Before the course, participants stated that they had rather little knowledge of thoracic radiology in general; for example, knowledge about X-ray (18%), CT (15%), ultrasonography (13%), spatial orientation (35%), and thoracic anatomy in general (37%) (Figure 5).

After the course, participants stated that they had the same or improved knowledge regarding all items; for example, knowledge about X-ray (59%), CT (58%), ultrasonography (52%), spatial orientation (73%), and thoracic anatomy in general (72%) (Figure 5).

3.2.6 Evaluation of online learning modules regarding design, technical aspects, and content

In general, participants were satisfied with the online learning modules; for example, regarding user friendliness (72%), playback of the videos (82%), content (74%), and the level of difficulty of the learning materials (61%) (Figure 6).

3.3 Objective test before and after the course

Before the course, participants achieved a mean score of 40% on the objective test. After the course, participants achieved a mean score of 63% on the objective test (Figure 7).

Furthermore, a detailed analysis of the completion rates of the modules of our blended learning course was performed - broken down by each module separately. Results were depicted graphically (Figure 7) as well as in tabular form (Supplementary Table S7) (completion "yes/no" in %). Interestingly, a total of 11% of our participants did not complete any module.

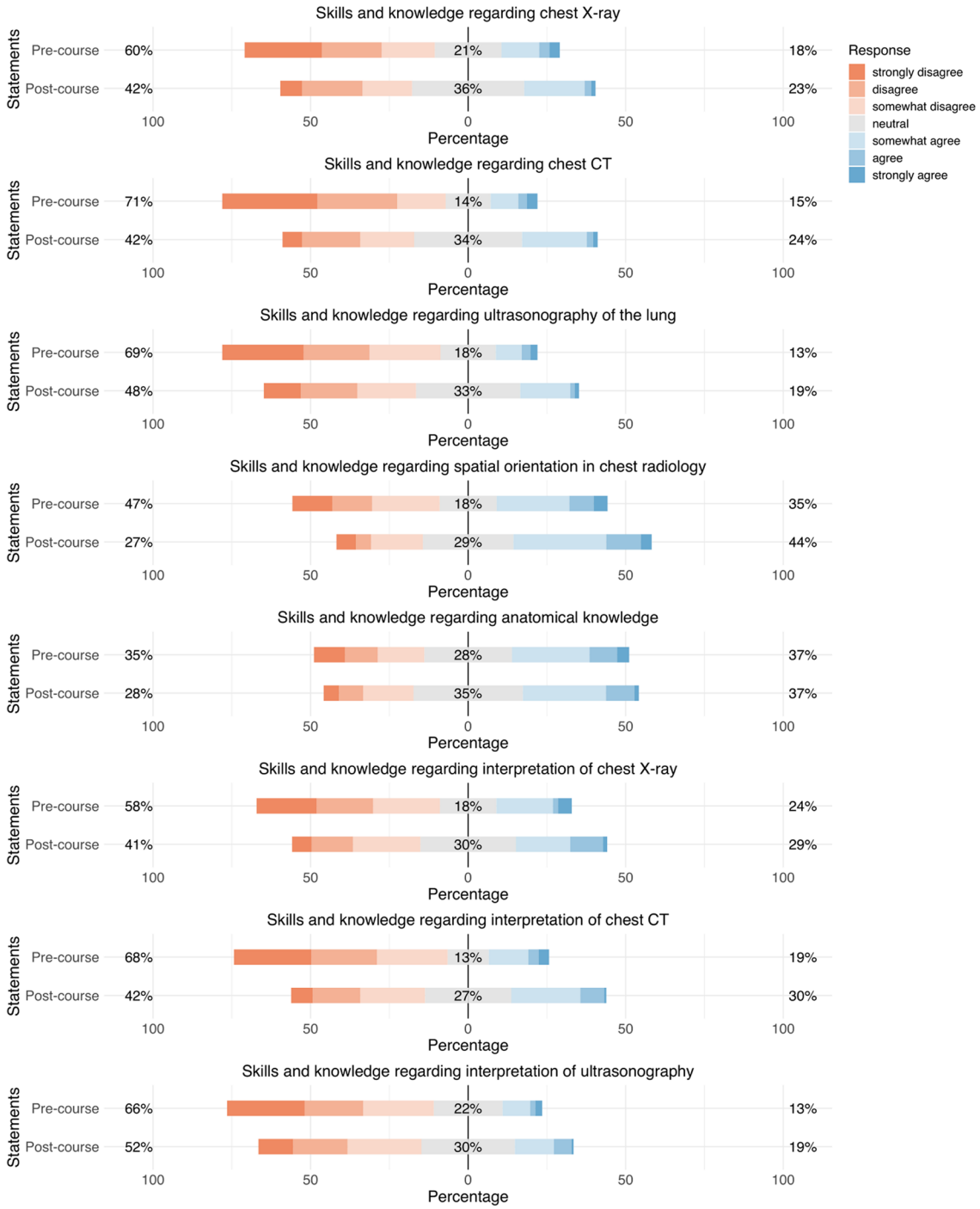

FIGURE 5
Responses regarding "subjective self-assessment of knowledge in thoracic radiology." Precourse results are compared to postcourse results. Orange represents "disagreement," gray represents "neutral," and blue represents "agreement."

Based on these results, we aimed to investigate if there is a possible relationship between the completion of the modules and the results in the knowledge test. For this purpose, (sub-) results of the knowledge test were analyzed, again broken down by each module separately. Supplementary Table S10 provides detailed information including results in pre- and posttest (mean ± standard deviation) and possible differences between pre- and posttest ("gain/loss of knowledge") including its statistical significance (p-value) and its effect size (Cohen's d). As a conclusion, regarding all modules there is a statistically significant knowledge gain between pre- and posttest.

In order to identify possible relationships between the completion of the modules and the (sub-) results in the posttest, a regression analysis was performed. Supplementary Table S8 provides a summary of the most important findings regarding the effect on the posttest. All data from the regression analysis

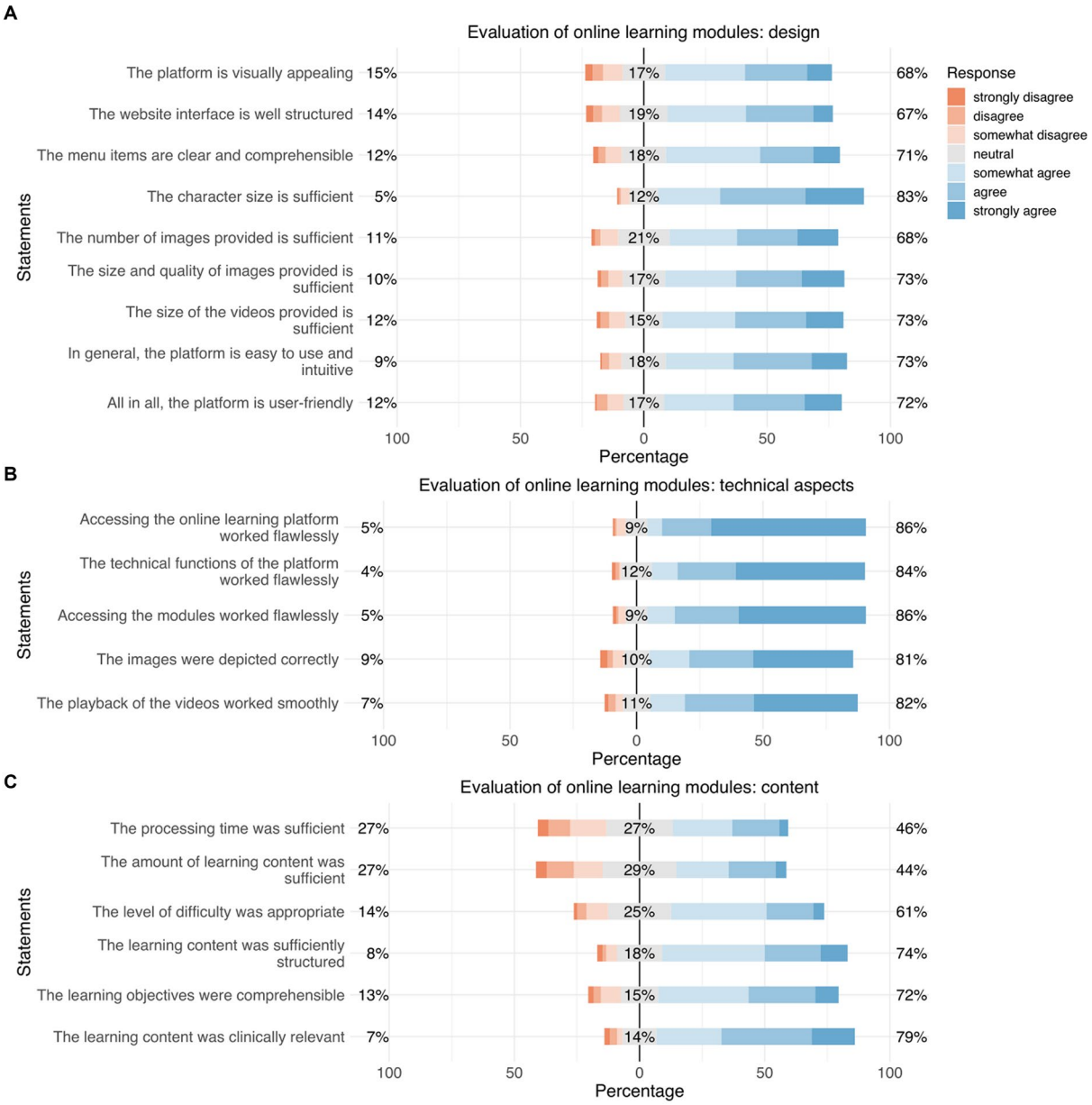

FIGURE 6
Responses regarding "evaluation of the online learning modules: design" **(A)**, "evaluation of the online learning modules: technical aspects" **(B)**, and "evaluation of the online learning modules: content" **(C)**. Orange represents "disagreement," gray represents "neutral," and blue represents "agreement."

(including analysis of the pretest) is provided in the Supplementary material (Supplementary Tables S8, S9).

In summary, completion of the modules leads to significantly better results in the posttest. However, even more interesting is the "no module" subgroup – those 11% of participants who did not complete any module (Supplementary Table S7). As those 11% only attended the onsite part of our blended learning course, they could somehow serve as a comparative internal reference group. According to our results, this subgroup has significantly worse results in the posttest regarding all modules (Supplementary Table S8). Of course, this conclusion must be considered with the utmost care as the "no module" subgroup was never intended to serve as a reference group. However, there is a trend that those participants who have completed both parts of the blended learning course perform better than those who have not completed both parts.

Furthermore, as a head-to-head comparison between the novel learning approach presented herein and conventional teaching methods was not possible, we performed an "internal quality control" in order to investigate a possible change of knowledge of the participants. To this end, we compared the official examination results of the year in which our study took place to examination results from the previous year. The results from this analysis are provided in the Supplementary material (Internal quality control S6). In summary, there was no statistically significant difference regarding the examination results.

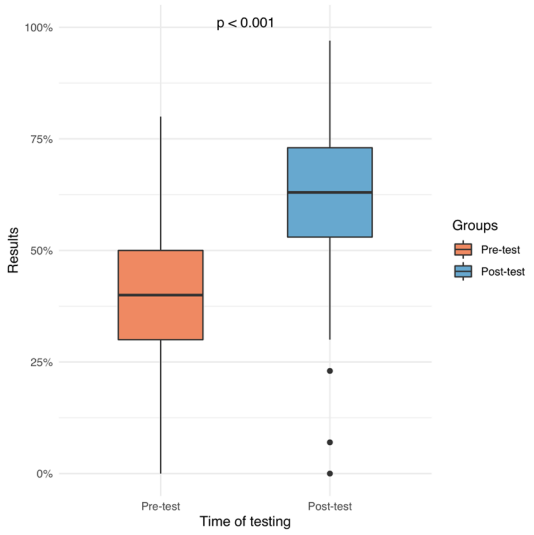

FIGURE 7
The left plot depicts the precourse results (mean 40%, IQR 30–50%). The right plot depicts the postcourse results (mean 63%, ICR 53–73%). This was statistically significant ($p < 0.001$).

4 Discussion

This feasibility study showed the successful design of a blended learning approach in thoracic radiology and its implementation into a pre-existing radiology curricular course. Furthermore, it revealed medical students' positive attitudes toward this approach and showed an increased knowledge in thoracic radiology. As the best way of transferring knowledge in medical education is still unclear, such approaches might be used to enrich the teaching armamentarium and to further enhance interest and knowledge in thoracic diseases among medical students.

One explanation for these positive results might be the increased flexibility of self-determined learning, and our results are in line with this notion. Students appreciated the broad online course content, which they could use anywhere at any time and at their own pace without having to attend a class. Another point is that the flexibility of self-determined learning could be particularly important in meeting the needs of an increasingly diverse student community (41). The maximal learning and teaching flexibility provided by such courses could accommodate, for example, students with disabilities and thus further enhance inclusivity (41).

On the other hand, from students' perspective, it requires higher stringency, commitment and intrinsic motivation as they - as first - have to obtain knowledge at their own (21). This includes, e.g., watching prerecorded lectures and/or completing online education modules (17). As this is an additional learning burden compared to traditional classroom teaching, approval among students may soon disappear. And in fact, previous studies suggest that both medical students and lecturers had difficulty motivating themselves (or the students, respectively) to follow online courses (2, 9). In order to be successful, thus, students' motivation to engage with it is crucial. Possible solutions to this include, e.g., learning content that is designed "activating" as possible by, e.g., videos or short quizzes. Furthermore, a structured framework including learning goals and timetables for each learning module are necessary to guide students through the information jungle (14). These steps are necessary to improve students learning behavior in a successful and self-determined manner and to avoid leaving students behind. Interestingly, our results indicate that students were additionally motivated to become involved with thoracic radiology after using our modules. They even plan to use the modules in the future in order to refresh their knowledge of the subject. Such a refresher might be of particular interest before clerkships in, for example, pulmonology or thoracic surgery.

From lecturers' perspective, the prior onsite course was changed from instructor-centered teaching to student-centered learning. This step can be somewhat critical and requires high commitment as lecturers have to face new requirements and "evolve" from being the (only) source of information to being a "guide on the side" helping students in the "information jungle" (14). However, this step is most crucial to further enhance students' learning experience, to show them that they are benefitting from their own efforts and – thus - to avoid motivational problems on both sides (14, 42).

Taking the above-mentioned steps together, at best, this leads to a maximum effective in-class time in which students and teachers can really focus on core topics that are, e.g., difficult to understand and need more time for explanation. From students' perspective, this might result in an enhanced learning effect.

Despite the possible benefits of a blended learning approach, there is no doubt that the implementation of new teaching concepts require additional effort (43, 44). This is especially true for the transition from traditional, onsite teaching to online or hybrid teaching. First, IT infrastructure has to be installed or adjusted to online teaching. Mostly, its installation results in both a time-intensive and expensive process depending on the local conditions of the institution (43). Regarding the course on thoracic radiology presented herein, radiology departments might have an advantage compared to other specialties as solid IT-solutions or IT-infrastructure might be already available making the switch to online teaching easier.

Furthermore, faculty and lecturers are required to adapt the teaching concept to an online format which is again time-consuming. However, once the material has been made suitable for an online module, it has to be updated periodically, but the lecturer does not have to present the same lecture over and over again. Regarding content creation, a clearly defined curriculum including time tables and learning goals helps here as mentioned above (14). Furthermore, triggered by the pandemic, there is a bouquet of online available teaching resources including online teaching platforms as well as a wide variety of national and international guidelines which can be used for content creation (30, 31). For example, the German Radiological Society launched an interactive online learning platform providing a broad variety of online courses comprising prerecorded lectures, case-based training, educational imaging data, etc., for medical students as well as professionals.[3] Such innovative teaching projects not only allow for broad "knowledge on demand" but may also enhance the harmonization of radiological teaching content in the future. This is especially true when it comes to inter-faculty implementation of a certain curriculum involving more than one medical school as such tools might provide a certain level of standardization.

3 http://conrad.drg.de

Results from previous studies suggest that there is a trend is toward digital learning and teaching in medical education (2, 9, 23, 26, 45). However, there is lots of room for improvement and constant further development is crucial.

4.1 Limitations

Due to the specific course design within the framework of a regular curricular radiology course and the curricular regulations of the faculty a head-to-head comparison between our blended learning approach and conventional classroom teaching was not possible. Consequently, statements regarding the superiority of our learning approach compared to conventional approaches are limited. However, an "internal quality control" regarding a possible change of knowledge on the objective test results was performed. In summary, there was no statistically significant difference regarding the examinations results [see also point 3.3 of our results section as well as our Supplementary material (Internal quality control S6)]. Despite these results, however, it must be said that the comparability is limited, and it is difficult to draw conclusions from this: (1) Examinations used for this quality control do not only contain thoracic radiology questions but represent the entire spectrum of the curricular radiology course and (2) the groups including their learning environment are not equal.

Furthermore, this study is questionnaire-based and subject to typical pitfalls. We had to consider selection bias, meaning that interested participants were more likely to complete the questionnaire (46). However, as courses were delivered to all fourth-year medical students, there was no preselection of the participants. Furthermore, the high response rate of our study implies that the pool of participants was representative of the students. Second, there was a potential for social desirability bias, meaning that participants chose the answer they assumed to be favorable (47). In order to attenuate this, we chose an anonymous, untraceable study design and informed the participants that the results were for research purposes only. Due to the specific course design, the onsite course always followed the online part. Thus, we cannot exclude position bias, meaning that participants might have been influenced by the sequence in which the content was presented (48). Furthermore, this blended learning approach was integrated into a pre-existing curricular radiology course which might have affected participants' knowledge and attitudes toward our blended learning course due to "surrounding" learning activities. Regarding technical issues, the tools used by the participants for their online teaching were not standardized and this use of different tools may have affected the results.

Due to the short follow-up of 2 weeks, this study can only provide a snapshot as we did not examine long-terms effects. Further longitudinal assessments several months or even years after the study would be valuable to examine effects on long-term retention, a possible impact on the development of clinical skills and the practical application of knowledge. As this study included only medical students as participants, such follow-up studies could, for example, also focus on lecturers' attitudes toward this teaching concept. Such an approach might reveal possible differences in students' and lecturers' attitudes toward possible teaching concepts in the future. As this is a single-center study with a specific cohort of students, its findings may not be easily generalizable to other medical schools or student populations limiting the external validity of the study. Thus, further studies should include different medical schools from different nations to investigate the potential of this teaching concept in order to help harmonizing medical curricula around the world.

Finally, this study mainly focused on the assessment of knowledge gain as primary learning objective. However, besides the acquisition of knowledge and practical skills there is an ongoing discourse including fundamental aspects of medical education, of what constitutes effective learning and of the professional attributes required of doctors (49). As medical educators should prepare learners in the best way for their future professional roles it is crucial to expand our perspectives about learning and to consider several relevant learning theories as the foundation of teaching and learning approaches in medical education (4, 49).

5 Conclusion

This feasibility study showed the successful design and implementation of a blended learning approach in thoracic radiology into a pre-existing radiology teaching curriculum. First, our study revealed medical students' great interest in and acceptance of this learning approach. Second, the learning approach presented herein led to an increased knowledge in an objective test in thoracic radiology. Thus, approaches as the one presented herein might further stimulate the evolution of teaching and learning in medical education. However, further studies including, e.g., head-to-head comparisons with conventional teaching approaches as well as studies focusing on lecturers' attitudes toward new learning approaches are necessary to generate more evidence regarding these novel teaching and learning approaches.

Data availability statement

Data cannot be shared publicly because of institutional and national data policy restrictions imposed by the Ethics committee since the data contain potentially identifying study participants' information. Data are available upon request (contact via weimer@uni-mainz.de) for researchers who meet the criteria for access to confidential data (please provide the manuscript title with your enquiry).

Ethics statement

The studies involving humans were approved by Ethik-Kommission bei der Landesärztekammer Rheinland-Pfalz. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

FS: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. YY: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. LM: Conceptualization, Data curation, Formal

analysis, Funding acquisition, Methodology, Resources, Software, Validation, Visualization, Writing – review & editing. PG: Conceptualization, Data curation, Investigation, Validation, Writing – review & editing. DP: Data curation, Formal analysis, Investigation, Methodology, Software, Supervision, Visualization, Writing – review & editing. PD: Conceptualization, Data curation, Investigation, Supervision, Validation, Writing – review & editing. AW: Data curation, Investigation, Validation, Writing – review & editing. ML: Data curation, Investigation, Validation, Writing – review & editing. RK: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing. JW: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2023.1272893/full#supplementary-material

CHECKLIST S1
Guideline for reporting observational studies.

PRECOURSE EVALUATION S2
Questionnaire investigating various aspects of teaching and learning in radiology and medical education (precourse).

POSTCOURSE EVALUATION S3
Questionnaire investigating various aspects of teaching and learning in radiology and medical education (postcourse).

QUIZ THORACIC RADIOLOGY S4
Test consisting of both multiple-choice and free text questions on thoracic radiology.

SUPPLEMENTARY TABLE S5
Demographic characteristics of the participants.

INTERNAL QUALITY CONTROL S6
Examination results from the year 2021 compared to the examination results from 2022 (the year in which our study took place) ("test").

SUPPLEMENTARY TABLE S7
Completion rates of the modules (%).

SUPPLEMENTARY TABLE S8
Results of the regression analysis investigating various influencing factors regarding their impact on the objective knowledge test ("posttest").

SUPPLEMENTARY TABLE S9
Results of the regression analysis investigating various influencing factors regarding their impact on the objective knowledge test ("pretest").

SUPPLEMENTARY TABLE S10
(Sub-)results of the knowledge tests, broken down by each module separately.

SUPPLEMENTARY FIGURE S1
Overview of the structure of the online learning platform for thoracic radiology.

SUPPLEMENTARY FIGURE S2
Examples of several features which were included to enrich the teaching content of the online learning platform.

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Survey of attitudes toward performing and reflecting on required team service-learning (SASL): psychometric data and reliability/validity for healthcare professions students in preclinical courses

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Purpose: Previously we assessed healthcare professional students' feelings about team-based learning, implicit bias, and service to the community using an in-house paper survey. In this study, we determined whether this survey is a reliable and valid measure of prospective medical students' attitudes toward required service-learning in an Immunology course. To our knowledge, no published questionnaire has been shown to be dependable and useful for measuring such attitudes using only eight survey items.

Methods: Fifty-eight prospective medical students in Colorado (CO) and 15 in Utah (UT) completed the same Immunology course using remote technology. In addition to the usual course content, students were required to write critical reflections on required team service-learning. On the last day of class, they completed the survey of attitudes toward service-learning (SASL).

Results: Data analyses found Cronbach's alpha values of 0.84 and 0.85 for the surveys of UT and CO students, respectively. Factor analysis of CO student data revealed only one Eigenvalue greater than one (3.95) justifying retention of a single factor termed "attitudes toward required service-learning." In addition, CO students' attitudes toward community service were highly positive, while UT students' attitudes were nearer neutral ($p < 0.0001$).

Conclusion: Our factor analysis and good Cronbach's alpha values support the conclusion that the SASL was a reliable measure of prospective medical students' attitudes toward required team service-learning for an Immunology course. Moreover, we used the SASL to distinguish these attitudes in CO versus UT students, and, thus, the SASL appears to be a valid measure of this difference. Calculation of similarly good Cronbach's alpha values – for a predecessor of the SASL among pharmacy, masters, and medical students at another institution – indicates that the SASL may be useful more widely. However, the reliability and validity of the SASL needs to be demonstrated more rigorously for other healthcare students at different universities.

KEYWORDS

critical reflection, healthcare professions, preclinical courses, psychometric data, questionnaire validity, service-learning, student attitudes, survey reliability

Introduction

Healthcare professional students' cognitive empathy and compassion are fostered when they perform team-based service-learning (1–3). Moreover, written critical reflections on these experiences further promote students' professional development (4–7). By exposing their implicit biases during service-learning, students are often moved to reflect on this dissonance, reconcile it, and, thus, work to avoid having it adversely affect their personal and professional behaviors (8, 9). Reconciliation of dissonance exposed by reflective practice is considered a primary mechanism to explain why such work can foster students' cognitive empathy and compassion (8–12).

In this regard, writing critical reflections in teams on aspects of humanism in medicine for biochemistry courses has been found to foster patient-centered orientations in medical students, but this higher patient-centeredness lasts only as long as students are required to reflect (13). Likewise, cognitive empathy scores of medical students in biochemistry courses rose in association with reflections on service-learning, but only while students continued this work (14). Therefore, it has been argued that team-based work and reflective practice should continue throughout healthcare professionals' careers to maintain their sense of compassion and help them to avoid burn-out (1, 2, 8, 15).

Despite evidence that indicates service-learning activities are beneficial, students may anticipate significant costs associated with participation that might act as a barrier for student engagement. For example, undergraduate college students felt they would have less time for their schoolwork (16) ($p < 0.0001$), and healthcare professions students have particularly heavy course loads during preclinical training. Such is also the case for prospective medical students hoping to gain access to our medical school by performing well, academically, in a Master of Science in Biological Sciences (MSBS) program. Therefore, to foster student engagement, there is a need to provide students with quantitative as well as qualitative evidence that students perceive value in service-learning activities.

A number of investigators have developed surveys to quantify students' attitudes toward service-learning, but none focuses fully on students' feelings about their experiences after performing community service (e.g., 16–18). Moreover, most such surveys measure attitudes in undergraduate college students, so there is a need to measure these attitudes among professional and graduate students who frequently have more demanding course workloads than undergraduates. Many of these other surveys are also quite demanding of students' time, and may, sometimes, lead to survey fatigue.

For example, Shiarella and associates' 46-item community service attitudes scale focuses more on undergraduate students' expectations about the service rather than their experiences of it (16). Similarly, the 43-item civic attitudes and skills questionnaire of Moely et al. assesses students' broader opinions about community service and social justice, but not their feelings about having participated in such service (17). While these attitudes, of students who may be planning to serve, are important, so are their feelings after they have done so.

In another 55-item survey, attitudes toward participating in service-learning by business and nonbusiness graduate and undergraduate students are measured, as are factors that encourage or discourage participation, but no evidence of the reliability or validity of the survey is reported (18). Service-learning has also been used to foster positive attitudes toward older adults in college and occupational therapy students (19, 20). But, again, neither of the latter papers report data supporting the reliability or validity of a survey concerning students' attitudes toward service to the community. Other studies have focused on the ways in which service-learning helps to foster students' professional development through improved humanistic characteristics, such as compassion, but they do not assess surveys of attitudes toward community service for reliability and validity (21–23). Finally, a 30-item questionnaire was used to assess service learning in the health professions, but this survey was designed for faculty and no data regarding reliability or validity were provided (24).

The aim of the present study is to develop more formally a much shorter 8-item questionnaire that we have used in prior research (8, 9, 11, 12, 14, 25). In that prior work, we used the survey to indicate healthcare professions students' attitudes toward community service for preclinical basic science courses, but we did not attempt to determine the survey items' collective reliability or validity. Hence, we tested two hypotheses concerning this questionnaire termed the survey of attitudes toward performing and reflecting on required team service-learning (SASL). Though designed for healthcare professions students, this short survey can, hypothetically, be used for any undergraduate or graduate course.

> *Hypothesis 1:* The SASL is a *reliable* measure of students' attitudes toward performing and reflecting on required team service-learning.

> *Hypothesis 2:* The SASL is a *valid* measure of students' attitudes toward performing and reflecting on required team service-learning.

Methods

Participants and team formation

Rocky Vista University Master of Science in Biological Sciences (MSBS) students participated in this study during their second semester of the MSBS program and as part of their Immunology course. Immunology was chosen for this study because the Immunology course directors were amenable to including service-learning in their course, while other preclinical

course directors were not amenable. A major goal of these students was to perform well enough in the program to gain admission to our medical school. In this regard, 100% of MSBS graduates in this study achieved this goal, although the MSBS program also has an 8% attrition rate.

The Immunology course ran from January to May 2023. Fifty-eight MSBS students participated in the study in Parker, Colorado (CO), and 15 participated in Ivins, Utah (UT). In CO, 40 students (69%) identified as female and 18 (31%) were male. Additionally, 30 (52%) described themselves as White, while 10 (17%) said they were Asian, 9 (15%) were Black/African American, and 9 (15%) were Hispanic. Students in CO were between 21 and 37 years old (mean = 25.5 years old). In UT, 6 students identified as female (40%) and 9 (60%) were male. Also, 10 (67%) UT students said they were White, 2 (13%) were Asian, and 3 (20%) were Hispanic. Students in UT were between 22 and 44 years old (mean = 26.2 years old). In CO, teams of students were formed randomly on the first day of a Medical Humanities class in August of 2022 (first semester), and each team was comprised of six or seven students. Teams of three or four students were assigned in UT before the first day of the Immunology course in January 2023. Team service-learning projects were required as part of the course, and four written team and individual critical reflections on this community service, spaced throughout the semester, were assessed and contributed 10% of students' grades in the course. Each student performed at least five hours of service usually with other members of their team. Teams were also expected to relate their service-learning to other Immunology course content.

Teams of students identified and selected their own community service projects for approval by one of us (LV). These projects in CO included service at homeless shelters, hospice and palliative care institutions, Special Olympics (and similar events), and Project Angel Heart (to feed immunocompromised people). In UT, students volunteered at food banks, helped maintain gardens to provide fresh food to community members, and worked with the Eagle Point ski patrol.

Survey

Using our prior five-item survey of healthcare professions students' attitudes toward selecting, performing, and reflecting on team service-learning projects (14), we modified and expanded the survey to include three more items concerning community service and two items to measure students' opinions about their teammates (Table 1). CO and UT students completed this survey on the final day of their Immunology course. A faculty member in UT and an administrative assistant in CO, who were not involved directly in the course, distributed and collected the anonymous paper surveys and sent them to one of the authors (LV) for tabulation and analyses of the data. As secondary measures of students' attitudes toward community service, we determined the mean word counts of their written critical reflections. And we report the results of university student evaluations of the instructor (LV) who assessed their critical reflections.

This study (HIRB# 2018–0006) satisfies the criteria for exemption as determined by the Rocky Vista University Institutional Review Board (IRB). Informed consent was obtained from students to publish their written critical reflections.

Statistical analyses

Cronbach's alpha values were calculated using GraphPad Prism 9.5.1 Software Inc. (La Jolla, CA) for two-way analyses of variance yielding mean square values where Cronbach's alpha = 1 – (residual mean square/row factor mean square). Pearson Intercorrelation values were calculated with the statistical program Stata, which was used for factor analysis of the survey items (26).

To begin to test the validity of the SASL, CO and UT students' mean and median SASL scores and their mean and median responses to individual survey items were compared statistically using unpaired *t*-tests and nonparametric Mann–Whitney tests. The mean word counts of CO and UT students' written reflections were also compared statistically using an unpaired *t*-test. When necessary, one-way analysis of variance and the Kruskal-Wallis test were used to compare more than two groups at a time, and the one sample *t*-test was employed to determine if the means of sets of data were significantly different from neutral. These latter statistical comparisons were made using the GraphPad Software.

Results

> *Hypothesis 1:* The SASL is a reliable measure of students' attitudes toward performing and reflecting on required team service-learning.

Cronbach's alpha values for the UT ($n = 15$), CO ($n = 58$), and combined ($n = 73$) student survey results at the end of the second semester Immunology course were 0.84, 0.85, and 0.88, respectively, demonstrating good survey reliability (100% response rates). In the first semester, Cronbach's alpha was 0.84 for CO student responses at the end of their Medical Humanities course ($n = 57$, 98% response rate). For the five-item predecessor survey (14) on which the current survey was based, Cronbach alpha values for 191 medical, 104 masters, and 146 pharmacy student responses in biochemistry courses were 0.84, 0.88, and 0.90, respectively (new analyses of data obtained previously at another institution, (14, 25)).

Prior to conducting a factor analysis on one set of data (i.e., CO student responses in the second semester), the inter-correlations among the questionnaire items were obtained to check that items had at least an average moderate association with other items. As can be seen in Table 2, this was found to be the case. Items 2 and 4 were not included in our psychometric analyses of survey responses because they did not include the words "service-learning" or "community service." Rather, these items focused more on students' feelings about their teams (Table 1).

An exploratory factor analysis was performed using the statistical program Stata (26) for CO students at the end of their Immunology course. More specifically, we used the default 'principal factor' method in Stata that analyses the common variance, instead of the total variance which is analysed via principal components analysis. We took this approach as we are examining the factor structure of this questionnaire for the first time. Only a single Eigenvalue was greater

TABLE 1 Statistical comparisons of mean and standard deviation (SD) values of CO ($n = 58$) and UT ($n = 15$) students on individual items of the survey of attitudes toward performing and reflecting on required team service-learning (SASL)[a].

Using the scale below, please indicate the extent to which you agree or disagree with the following statements:

1 **Strongly Disagree**	2 **Disagree**	3 **Somewhat Disagree**	4 **Neither Agree/ Disagree**	5 **Somewhat Agree**	6 **Agree**	7 **Strongly Agree**

CO mean	CO SD	**UT mean**	UT SD	*p* (t-test)	**Effect size (*r*)**	*p* (Mann-Whitney)
1. Having a team service-learning project in Immunology was very engaging.						
6.57	0.62	5.67	1.05	< 0.0001	= 0.453	= 0.0002
2. I would have been better off on another team in Immunology.						
1.81	1.33	1.46	0.88	= 0.37	= 0.108	= 0.62
3. Next year, Immunology should continue to expect teams of MSBS students to perform service-learning projects and to write reflections on their experiences with the projects.						
6.45	1.03	4.93	1.53	< 0.0001	= 0.476	< 0.0001
4. All things considered, I could not have been assigned to a stronger team in Immunology.						
5.95	1.66	6.14	1.23	= 0.68	= 0.050	= 0.98
5. I gained very little from our service-learning project and written reflections on the project.						
1.67	1.02	2.87	1.41	= 0.0004	= 0.405	= 0.0008
6. Immunology should continue to use teams for service-learning in future courses.						
6.36	1.02	5.87	1.25	= 0.11	= 0.187	= 0.034
7. Writing reflections on our service-learning project fostered my professional development.						
6.00	1.18	4.33	1.50	< 0.0001	= 0.479	< 0.0001
8. Encounters with people in our service-learning project caused me to study for Immunology with more interest than likely would have occurred without the project.						
4.62	1.83	3.67	1.92	= 0.079	= 0.207	= 0.098
9. Encounters with people in our service-learning project will help me to be engaged with people regardless of the setting or disposition of the person.						
6.52	0.80	5.40	1.40	= 0.0001	= 0.434	= 0.0003
10. Encounters with people/venues in our service-learning project helped me to see my potential biases toward people/venues more clearly.						
6.31	1.01	4.93	1.67	= 0.0001	= 0.434	= 0.0003
11. Of what biases did you become aware during encounters with people/venues in your service-learning project?						
12. Please provide additional comments in the space below and on the back of this form.						

We also show results for nonparametric statistical comparison of median values, since many sets of data were skewed especially for CO students.
[a]Items 2 and 4 are also included in the table, although these items were not included in the final version of the survey, because they do not include the words "service-learning" or "community service" and instead concern students' feelings about their teams.

than 1 (i.e., an Eigenvalue of 3.95, equating to 85% variance explained) justifying the retention of a single factor. The factor loadings are all greater than the typical 0.4 cut-off (Table 3). In Table 3 the factor loadings represent the simple correlation between each item and the underlying factor. The uniqueness value represents the variance that is not shared with other variables (it is equal to 1 – communality). For example, 27% of the variance in item 1 is not shared with other variables in the overall factor model. If uniqueness is relatively high (e.g., over 0.60), then the item can be questioned as fitting well within the overall set of items. We provide uniqueness values alongside the

TABLE 2 Pearson Inter-correlations among the questionnaire items.

	Item 1	Item 3	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10
Item 1	–							
Item 3	0.77	–						
Item 5	0.61	0.70	–					
Item 6	0.52	0.74	0.54	–				
Item 7	0.24	0.50	0.34	0.45	–			
Item 8	0.48	0.47	0.48	0.44	0.36	–		
Item 9	0.35	0.42	0.35	0.41	0.52	0.22	–	
Item 10	0.30	0.45	0.55	0.42	0.51	0.39	0.64	–
Average	0.47	0.58	0.51	0.50	0.42	0.41	0.47	0.47

TABLE 3 Factor loadings and uniqueness values from exploratory factor analysis of the Survey of Attitudes Toward Performing and Reflecting on Team Service-learning (SASL).

	Factor loading	Uniqueness value
1. Having a team service-learning project in (name of course) was very engaging.	0.73	0.27
3. Next year, (name of course) should continue to expect teams of MSBS students to perform service-learning projects and to write reflections on their experiences with the projects.	0.88	0.13
5. I gained very little from our service-learning project and written reflections on the project. (Reverse scored)	0.75	0.35
6. (name of course) should continue to use teams for service-learning in future courses.	0.75	0.39
7. Writing reflections on our service-learning project fostered my professional development.	0.60	0.47
8. Encounters with people in our service-learning project caused me to study for (name of course) with more interest than likely would have occurred without the project.	0.58	0.58
9. Encounters with people in our service-learning project will help me to be engaged with people regardless of the setting or disposition of the person.	0.60	0.41
10. Encounters with people/venues in our service-learning project helped me to see my potential biases toward people/venues more clearly.	0.67	0.34

factor loadings as they provide complementary additional information for evaluating the quality of items. The Cronbach's alpha of the questionnaire for this set of data across all eight items was 0.85. These results provide evidence for the reliability of the SASL.

> *Hypothesis 2:* The SASL is a valid measure of students' attitudes toward performing and reflecting on required team service-learning.

A comparison of the two student groups in Immunology was conducted to provide some preliminary evidence for the utility and validity of the survey. The mean score on the survey for CO students was significantly higher than for UT students (Figure 1A, $t\,(71) = 4.79$, $p < 0.0001$), and this difference was of near crucial practical importance ($r = 0.49$) (27). That is, an r value of 0.49 has been reported to be equivalent to treatment by a drug that reduces the death rate from 74.5 to 25.5% - difference equals 49% (28). Also, the mean score of CO students in Immunology (Figure 1A) was statistically indistinguishable from their prior mean score at the end of their first semester Medical Humanities course (prior mean = 6.25, $p = 0.42$). The learning objectives for the service-learning component of Immunology were the same as this component in Medical Humanities. The stability of CO students' SASL scores across the second semester of the MSBS program supports the notion that the survey is valid and reliable (17), although correlation analyses were not possible because surveys were anonymous.

The survey items and the mean responses to each item by CO and UT students are also shown in Table 1 for service learning in the second semester of the MSBS program. Similar means were observed for CO students in the first semester when the course name in Table 1 items was "Medical Humanities" instead of "Immunology" (data not shown). Except for items 2 and 4, the mean responses of UT students were closer to neutral than for CO students as also indicated by their overall SASL scores for their attitudes toward performing and reflecting on team service-learning (Figure 1A). For example, even in the case of item 8 (Table 1), the mean value for CO students (4.62) was significantly greater than neutral (i.e., 4.00, $p = 0.01$), whereas this mean for UT students (3.67) was statistically indistinguishable from neutral ($p = 0.51$).

Moreover, in association and in keeping with their less enthusiastic attitudes toward required service-learning for their Immunology course (Table 1; Figure 1A), UT students' written reflections concerning service-learning were considerably shorter than those of CO students (Figure 1B, $t\,(166) = 7.87$, $p < 0.0001$), and this difference was of crucial practical importance ($r = 0.52$) (27). Consistent with the latter finding, UT students exhibited less *critical* reflection than CO students in their final written reflections ($p < 0.0001$). It is, however, also conceivable that, in the latter case, the author who assessed the reflections (LV) was biased in favor of CO students with whom he had formed relationships during the first semester of the MSBS program (See results). We define *critical* reflection as the extent to which

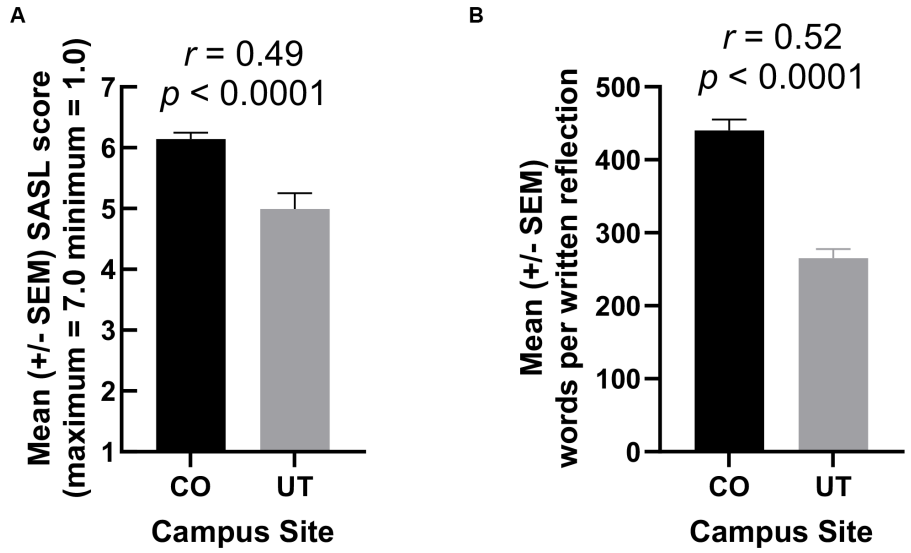

FIGURE 1
(A) Mean CO and UT student scores on the survey of attitudes toward performing and reflecting on required team service-learning (SASL). **(B)** Mean words per written reflection by CO and UT students concerning their team service-learning projects for their Immunology course.

students describe their self-examination and compassionate behavior in their written reflections, as discussed by us elsewhere (9).

CO and UT students could also be distinguished by their answers to questions 11 and 12 of the survey (Table 1). Although most students did not respond to question 12, those CO students who did answers question 12 were much more positive than UT students (Chi-square = 7.36, $p < 0.01$). In CO, students who answered usually said "loved service-learning" (or something similar), while UT students who replied were more likely to give responses like "service-learning is out of place in Immunology." And, while not statistically significant (Chi-square = 2.51, $p = 0.11$), CO students answered question 11 more frequently (46 of 62 responses) than did UT students (8 of 15 responses) (Table 4). According to all the results, the SASL appears to be a valid as well as reliable measure of healthcare professions students' attitudes toward selecting and performing team community service projects in preclinical courses.

Discussion

The purpose of our study was to develop more formally a short 8-item questionnaire – now termed the survey of attitudes toward performing and reflecting on required team service-learning (SASL) – that we have used in prior research (8, 9, 11, 12, 14, 25). In our prior work, however, we did not attempt to determine the survey items' collective reliability or validity. Here we used factor analysis to formally assess SASL's reliability (our hypothesis 1), and we provide evidence for its validity (our hypothesis 2).

Reliability and validity of the SASL

The exploratory factor analysis of the SASL for responses of 58 CO students in their Immunology course revealed a single Eigenvalue greater than one justifying a single factor we call "attitudes toward required service-learning" for the SASL (Table 3). A good Cronbach's alpha value of 0.85 for the same set of data provides further evidence of the reliability of the SASL. And the Cronbach's alpha value of 0.88 for all 73 CO and UT MSBS students in Immunology during the spring semester of 2023 further supports this conclusion. While further testing of SASL's reliability is needed among other healthcare professions students and college students more broadly, reassessment of prior data for the predecessor of the SASL indicates that the SASL will be found to be more widely reliable. That is, this five-item precursor survey administered to 191 medical, 104 masters, and 146 pharmacy students in biochemistry courses yielded Cronbach's alpha values of 0.84, 0.88, and 0.90, respectively (new analysis of data obtained previously at another institution, 11, 25). Hence, we feel the SASL is likely a reliable indicator of how health professions students feel about their required service-learning experiences in preclinical basic sciences courses.

In addition, we provide preliminary data that the SASL is useful and valid for detecting differences in attitudes toward required service-learning when students' experiences vary. UT students were much closer to neutral than CO students in their attitudes toward community service both according to the SASL (Figure 1A) and individual items on the survey (Table 1). While the population sizes of these two groups are quite different (i.e., 15 in UT vs. 58 in CO), the magnitude and effect sizes for their differences are profound. For example, according to item 7 "Writing reflections on our service-learning project fostered my professional development," the mean UT response of 4.33 was indistinguishable from the neutral value of 4.00 (GraphPad one sample t-test, $t(14) = 0.86$, $p = 0.40$), while the mean of 6.00 for CO students was well above neutral (one sample t-test, $t(57) = 12.86$, $p < 0.0001$). And the effect size for CO students

TABLE 4 Summary of written statements of biases expressed by students in the survey about their team- and service-learning experiences (42 of 58 CO and 8 of 15 UT students stated one or more of their biases in response to question 11 in Table 1).

Nature of negative biases in CO	Number (%) of times expressed	Nature of negative biases in UT	Number (%) of times expressed
Homeless people	11 (17.5)	Homeless people	3 (20.0)
Proximity bias	9 (14.3)	Proximity bias	2 (13.3)
English 2nd language	4 (6.3)		
Hospice/palliative care	4 (6.3)		
Special needs people	3 (4.8)		
Research bias	2 (3.2)		
Privileged Americans	2 (3.2)	Privileged Americans	1 (6.7)
Premature judgment	1 (1.6)		
Alcohol/drug addiction	1 (1.6)		
Poverty prevalence	1 (1.6)		
Immune complications	1 (1.6)		
Dying people	1 (1.6)		
Going outside comfort	1 (1.6)		
Expecting thanks	1 (1.6)		
Speaking not listening	1 (1.6)		
Not caring for self	1 (1.6)		
Criminal background	1 (1.6)		
Older people	1 (1.6)		
		Volunteering	2 (13.3)
No answer	16 (25.4)	No answer	7 (46.6)

($r = 0.86$) was much greater than the minimum of 0.50 required for the label "crucial practical importance" (27).

From where might the difference in attitudes toward service-learning have arisen in CO versus UT students?

Several factors may have contributed to the differences in CO and UT students' attitudes toward community service in their Immunology course. For example, CO students had a greater proportion of women students, and women seem to have a more positive view of service-learning than do men (18). However, the main reason for the difference between CO and UT student scores seems to us to be the relationships of the students to the faculty member grading their critical reflections on service-learning experiences. To be effective at promoting personal growth and professional development, students need to embrace the vulnerability they feel in writing these personal reflections (8, 29). Having formed good relationships with students as Director of their Medical Humanities course during the first semester of the MSBS program, one of us (LV) provided a safe space for teams of CO students to exhibit this vulnerability in their written reflections for Immunology.

For example, CO students' rating of LV on the university course evaluation form for Medical Humanities averaged 4.7 (five-point Likert scale) for the item "This faculty member effectively helped me to learn the course material and contributed to my development as an active, independent learner." And this rating was described by the university as "much higher" than the average ratings of other faculty members teaching, specifically, in the MSBS program, as well as in all preclinical courses at the university. In keeping with this result, LV's rating by CO students on the same item for Immunology in the second semester averaged 4.8, which was also "much higher" than the average for other faculty members. In contrast, the average rating of LV on the same item by UT students was 3.8 and "lower" than other faculty members at the university. But LV had little opportunity to form relationships with UT students in the first-semester Medical Humanities course, and UT students and LV had no opportunity to get to know and trust one another on a personal level in Immunology in the second semester. These differences in the ratings of LV by CO students in the first and second semester and by UT students in the second semester were highly statistically significant (Kruskal-Wallis test for these three sets of data, $p < 0.0001$). And the effect size of the differences ($r = 0.58$) was estimated to be of crucial practical importance (27).

To attempt to improve UT students' attitudes toward service learning in Immunology in future years, another of us (BT) will assess UT students individual and team reflections concerning service-learning experiences. BT directed the Medical Humanities course in UT during the first semester of the MSBS program and, so, was able to form trusting relationships with UT students. This trust was built, in part, owing to his assessment of written critical

reflections by students on related experiences in UT Medical Humanities meant to elicit students' dissonance, vulnerability, and resolution of this dissonance (8) without service-learning. In support of these possibilities, BT's average rating, for the UT Medical Humanities course and on the university course evaluation item discussed above, was 4.6, which was also "much higher" than the average rating of other faculty members teaching preclinical courses at the university.

Similarly, when BT and LV cotaught Medical Humanities remotely in 2020, and LJV assessed critical reflections on service-learning for both CO and UT students, both BT and LV received average ratings of 4.6 on the above survey item by both CO and UT students. Then, after forming good and trusting relationships with both groups of students in Humanities, LV received average ratings of 4.6 from both groups of students for assessing their reflections on community service for the subsequent remote Immunology course in 2021. Hence, we believe the strategy above, to have BT assess reflections on service-learning by UT students for Immunology, will significantly improve UT students SASL scores in future years.

More broadly – for faculty members in other courses and at different institutions – attempts to promote students' personal growth and professional development through critical reflection on service-learning should involve forming trusting relationships between the students and faculty members. We believe, only then, will students embrace the vulnerability they feel in reflecting on and writing these personal reflections and, thus, foster their compassion and professional development (8, 29).

Use of community service to foster other aspects of professional development: impact of service-learning

Around the world (30–32), and particularly in the US (10, 33–41) the issue of implicit bias remains poorly controlled. For example, negative attitudes toward people of color and others result in discrimination in their healthcare by those expected to deliver it (39–41). But one way to foster bias mitigation through critical reflection on team community service has been shown by us also to promote empathy and compassion in prospective medical students (8, 9). Such training efforts have potential to be applied in other healthcare professions (39, 41). These curricula would foster the health of those people against whom there are unconscious biases and, thus, promote public health (42).

Similarly, other investigators have used "a pedagogy of discomfort" (32, 33), and the "transformative learning model" of Sukhera et al. (36) parallels our methods and findings. Like us (8, 9, 11, 12, 14), Sukhera and associates initiate experiences that produce dissonance by uncovering students' implicit biases. These experiences then lead to self-examination and critical reflection by the students. This reflection then often fosters behaviors such as listening to people's stories with genuine interest and compassion. Many other recent publications also make strong cases to promote and maintain healthcare professions students' empathy and compassion through sustainable curricula (e.g., (10, 37, 38)), and such results can be achieved using reflection on service to the community (3, 29).

Limitations/Conclusions

Our study was limited to 73 prospective medical students in a second-semester Immunology course at a single university. Nevertheless, Cronbach's alpha for CO students (n = 58) remained stable for the SASL near a good 0.85 value in the first as well as in the second semester. This value was also near 0.85 when calculated for the population of just 15 UT students. Moreover, a factor analysis, with a single Eigenvalue of 3.95, strongly justified retention of a single SASL factor we termed "attitudes toward required service-learning." These results provide evidence for the reliability of the SASL. While our current studies were limited to MSBS students alone, reassessment of previously obtained data concerning a predecessor survey to the SASL supports the notion that the SASL will be found to be more widely reliable. Using those prior data for that five-item survey, we calculated Cronbach's alpha values of 0.84, 0.88, and 0.90 for 191 medical, 104, masters, and 146 pharmacy students, respectively, in Biochemistry courses at another university (14, 25).

Our data also indicate that the SASL is valid and useful for detecting differences between populations of students with different experiences of community service-related activities, at least at our institution. For example, UT students' attitudes were nearer neutral toward performing team service-learning, while the attitudes of CO students were highly positive (Table 1; Figure 1). We attribute these large differences to two main factors. Firstly, CO students became accustomed to performing service-learning in their Medical Humanities course in the semester preceding their Immunology course, whereas UT students did not. And we think, more importantly, UT students had no opportunity to build trusting relationships with the faculty member assessing their reflections about their service-learning experiences – and who was likely seen as requiring the service in the first place. In contrast, CO students formed relationships with this faculty member as Director of their Medical Humanities course during the first semester of the MSBS program. These trusting relationships are, in our view, essential since students' critical reflections on team community service experiences become very personal and reveal their vulnerabilities as well as strengths in coping, productively, with the dissonance evoked through service-learning and related activities (8, 29). Although we believe the SASL will prove valid in identifying other such experiential differences of service-learning in different groups of students at other universities, the extent of this SASL utility remains to be established.

Similarly, it would be ideal to perform follow up studies with the participants in our study, not only to survey them, but also to implement curricular interventions aimed at maintaining positive attitudes toward service-learning during their continued training in medical school. In this regard, the first semester inter-professional education (IPE) course for first-year medical and physician assistant students at our institution does include critical reflection on team community service. Unfortunately, however, this IPE course is the only one that requires service-learning experiences in the entire curricula of those programs. Hence, we, as well as most other healthcare training programs, should foster student compassion by including regular critical reflection on such experiences throughout our curricula.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by this study (HIRB# 2018-0006) satisfies the criteria for exemption as determined by the Rocky Vista University Institutional Review Board (IRB). Informed consent was obtained from students to publish their written critical reflections. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

LW: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Writing – original draft, Writing – review & editing. SR: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. BT: Conceptualization, Writing – review & editing. BS: Conceptualization, Writing – review & editing. AH: Conceptualization, Writing – review & editing. JF: Conceptualization, Writing – review & editing. NM: Conceptualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Early introduction of simulation in the medical curriculum: the MedInTo perspective

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Despite the increasing body of evidence supporting the use of simulation in medicine, a question remains: when should we introduce it into the medical school's curriculum? We present the experience and future perspectives of the MD program in Medicine and Surgery of University of Turin-MedInTo. Since its launch, MedInTo has been dedicated to integrating innovative teaching approaches at the early stages into the medical curriculum. Herewith, we describe a case-based approach for our activities, which includes the utilization of simulation for emergency medical care training for students and the integration of virtual and augmented reality technology. Dedicated surgical training activities using virtual-augmented reality and life-like simulator for students are also described.

KEYWORDS

simulation, medical education, medical curriculum development, medical student, virtual reality

Introduction

The early introduction of simulation in the medical curriculum has become increasingly prevalent in recent years (1). Simulation refers to the use of realistic scenarios and equipment to replicate clinical situations for educational and training purposes (2). Integrating simulation into medical education offers several benefits, including enhanced learning experiences (3), improved clinical skills (4–6), and increased patient safety (2, 6).

Evidence supporting the use of simulation learning to deliver medical training is available across all grades and specialties, ranging from surgery (7, 8), including robot surgery (9), infectious diseases, pediatrics, orthopedics (10), and internal medicine (11–15).

However, despite the increasing body of evidence supporting the use of simulation in medicine, a question remains: when should we introduce it into the medical curriculum? Is an early approach feasible?

Aiming to contribute to this topic, we report the experience and future perspectives of the MD program in Medicine and Surgery of University of Turin-MedInTo. Since its launch, MedInTo has been devoted to integrating innovative teaching approaches into the medical curriculum. Entirely taught in English, MedInTo takes place in the teaching facilities at San Luigi Gonzaga University Hospital (Orbassano, Torino, Italy), whose campus-type environment aims to optimize the integration of students with the clinical areas. Since early in the degree program, the curriculum combines scientific and clinical knowledge with interactive teaching methods. The educational goals of our degree program are particularly suited for students interested in scientific research and cooperation. The proximity of

teaching, research, and hospital facilities promotes communication between students and teaching staff, as do the integrated courses and the practice-based learning opportunities.

When referring to the early introduction of simulation, here are some key points summarizing the conceptual framework on which the MedInTO has been designed.

- **Experiential learning**: Simulation provides students with hands-on, experiential learning opportunities that bridge the gap between theory and practice (16). By engaging in realistic scenarios, students can apply their knowledge and develop critical thinking, clinical reasoning, and decision-making skills in a safe and controlled environment (17).
- **Skill acquisition**: Simulation-based training allows students to practice and refine their technical skills before working with real patients. They can learn and practice procedures such as suturing (18), phlebotomy (19, 20), or catheter insertion (21) on high-fidelity manikins or virtual reality simulators. This early exposure helps students gain proficiency and confidence in performing these skills (22, 23).
- **Teamwork and communication**: Healthcare is a collaborative field that requires effective teamwork and communication among healthcare professionals. Simulation scenarios involving interprofessional teams provide opportunities for students from various disciplines (e.g., medicine, nursing, pharmacy) (24) to learn and practice teamwork (25), communication, and coordination skills (26). They can learn how to communicate effectively, delegate tasks (27), and work together to provide optimal patient care (28). This approach has the potential to support the identification of further educational needs based on the experience of the clerkship (29).
- **Mistake management and patient safety**: Simulation offers a safe environment to make and learn from mistakes without compromising patient safety. Students can encounter challenging clinical situations, experience the consequences of their actions, and receive immediate feedback (30) from instructors (31). This iterative learning process helps develop clinical judgment, error recognition, and error management skills, thereby reducing the risk of errors and enhancing patient safety (6, 32).
- **Ethical and complex scenarios**: Simulation allows students to engage with ethical and complex scenarios that may be challenging to encounter in real-life clinical settings (33). This includes navigating dilemmas (34), making ethical decisions, and engaging in difficult conversations with patients and their families. Simulation provides a platform to reflect on the ethical dimensions of healthcare, fostering the development of empathy and professionalism (33).
- **Bridging the gap between classroom and clinical practices**: Early exposure to simulation can help ease the transition from the classroom to clinical practice (35, 36). By familiarizing students with realistic patient cases, medical technology, and clinical environments, simulation can reduce anxiety (37) and enhance students' preparedness and confidence when interacting with real patients (35, 38).
- **Research and innovation**: Simulation-based education provides opportunities for research and innovation in medical education. It allows educators to develop and evaluate new teaching methods, curricula, and assessment tools (39, 40). Additionally, advancements in technology, such as virtual reality (41) and augmented reality (42), continue to expand the possibilities of simulation-based training in healthcare education (43).
- **Economization of resources**: Early exposure to simulated scenarios and/or dummy instrumentation allows for maximizing the cost-benefit balance between early skill acquisition while reducing the economic and human costs of medical teaching and learning (44–47).

The above-mentioned points constitute the conceptual framework supporting the design of education activities aimed at optimizing the integration of simulation into the medical MD curriculum, especially in an early phase. A summary of ongoing or upcoming activities is listed below.

Simulation for emergency medical care for students

This learning experience aims to help the students understand the basis of emergency medical services. Emergency medical care is characterized by interventions that are done "outside the hospital," where the environment or evolution of risk deeply influences the intervention patterns. For these reasons, this training is crucial for students who are approaching the completion of their medical studies career. Thus, we employed the "learning by doing and learning by feeling" (48) methodology to guide them in thinking and acting as real EMC operators.

The experience is made both in the simulation center and in the nearby environment to empower the simulation alternating structured and eco-dynamic environments.

After 1 h of technical skill learning (patient approach, skill acquisition, etc.), students were inserted in the "simulation circuit" (Figure 1). In both the center and nearby environments, four contemporaneously simulative stations were organized (Supplementary Video). Students approached four different cases: Managing a simplified emergency call center, an indoor heart failure, handling a psychiatric-aggressive patient, and addressing an outdoor trauma. Each station was 30 min long and students rotated through them until the routine was completed. A final debriefing was carried out by the trainer at the end of each station.

Anatomy first: the anatomage table

Basic disciplines, such as human anatomy, form the core subjects in medical and health science education. They are crucial for understanding the functioning of the human body and providing a basis for clinical training and practice. The most ancient and prestigious medical schools have a tradition of hands-on human body dissection, leading to the establishment of institutes dedicating to normal human anatomy, where human cadavers were stored and dissected by teachers and medical

FIGURE 1
Schematic summary of the simulation for emergency medical care for students' activity.

students. As powerful as this approach is, the availability of human cadavers, the legislation, and the costs related to their maintenance make it less accessible to a large number of students (49). For this reason, thanks to technological advancements and the increased use of 3D modeling, an increasing number of interactive 3D atlases are now accessible, with the vast majority being available online. The first coordinated effort to produce an interactive 3D atlas based on real data was the 1986 "Visible Human Project," leading to the dissection of a full human cadaver into 4 mm thin slices, each meticulously photographed and segmented. Additionally, MRI and CT scans were incorporated to better highlight the visualization of different structures. The results were first published in 1994. Recently, a US-based company, Anatomage, developed a state-of-the-art device, featuring four fully segmented interactive cadavers, cut at a higher resolution (up to 0.8 mm). These digital cadavers are loaded onto a dissection-sized touchscreen table that can be used for performing a virtual dissection. This device is now present in a significant number of anatomy institutions all over the world, and although it cannot fully replace hands-on dissection, it is a very powerful teaching device for medical students at the early stages of their education (50).

To date, the Anatomage table has been introduced in anatomy teaching for undergraduate medical and nursing students in the MedInTO course. It is used both for teacher-directed learning and self-dependent study learning. In our experience, we highlighted that Anatomage enhanced active learning by allowing the students to clarify doubts and share their anatomical knowledge, thereby improving communication skills.

Moreover, the Anatomage table can be used for many different applications. It not only displays preloaded 3D datasets but also functions as a powerful DICOM viewer with automated rendering capabilities and high GPU specs, making it suitable for personalized medical applications, including diagnosis and surgical planning. Additionally, it proves invaluable in teaching on real datasets using non-invasive imaging techniques. Recently, one interesting application has been proposed to use it as a virtual autopsy device, with a special focus on dental analysis for disaster victim identification (51). The presence of this device in the simulation facility serves as a perfect companion to help students revise the real anatomical reference related to procedures they might be testing on real field.

Virtual and augmented reality

Virtual and Augmented reality (VR and AR) are relatively old technologies, with their early appearance in the late 50s and late 60s of the last century, respectively. Although VR originally started with a leisure scope ("Sensorama" was the grandfather of immersive 3D cinema), this technology has a natural declination for testing and simulation in nature (8). The high cost of these devices made this technology accessible to institutions and high-end companies, primarily utilizing them for medical, flight, and automotive simulations. The remarkable and rapid advancements in computer graphics technology, possibly linked to the increased efficiency of GPU data processing in machine learning (ML) and artificial intelligence (AI), has massively contributed to popularize this technology. This technology is affordable to the mass consumer market, consequently making it more accessible to research institutions and small companies with a focus on R&D (52, 53). AR has also benefited a lot from improvements in Computer Vision (CV) field, with the commercialization of head-mounted AR devices allowing 3D stereoscopic view of digital objects and the possibility of interacting with those, even with bare hands. Interactive AR is also called mixed reality (MR or XR). The potential of these technologies can be limited only by imagination, and medical simulation is already harnessing significant advantages from them (53–55). VR can be easily used

to recreate various medical scenarios, including emergency rooms, operating rooms, ambulances, and even consulting rooms. The possibility of interacting with the scenes gives a perfect opportunity to develop flexible platforms that allow multiple scenarios with only one computer and a headset. It is also possible to train specific skills, for instance, in surgery, using haptic devices that simulate scalpels or other surgical instruments, and it can simulate the interaction with skin and other deeper tissues, using a force feedback logic.

Another example of virtual reality is the 3D virtual reconstructions of organs (56). In the surgical field, they have proved to be valid tools in different settings, including aiding in surgical indications—helping the surgeon to choose, for example, between a radical or a partial surgery—and assisting in the decision-making process preceding surgery (i.e., surgical planning). Additionally, they serve as valuable tools in surgical training; and intraoperative navigation (57).

Augmented and mixed reality are increasingly used in medical simulation, to digitally enrich the visual perception of users (students, residents, and medical doctors), representing a powerful aid to medical simulation. For instance, with the aid of computer vision, it is possible to map the environment and the hands of students to trace their ability to perform certain skills. Additionally, this technology enables the superimposition of deeper anatomical structures (e.g., vascularization, major nerves) to train performing safely minimally invasive procedures.

In robot-assisted surgery (58), for example, 3D virtual reconstructions can be presented, handled, and modified according to the surgeon's needs and sent into the robotic console via software, reproducing the real surgical procedure and simulating the different surgical steps.

Finally, the use of mixed approaches with XR-enhanced phantoms or mannequins represents a powerful tool compromising the flexibility of a VR scene with the training on a real object, designed to give the user an experience as similar as possible to the real field. A startup company "Intravides," from the University of Turin, which has collaborated with neurosurgery planning and remote assistance, has now begun to work in the safer environment of a simulation room to plan minimally invasive surgery.

A more expensive, yet powerful, solution is the immersive technology, which allows you to project any sort of scenario in a real room, with the possibility of interacting with the digital content. The possibility of interacting and blending a real environment with a digitally enhanced one brings it closer to XR, although this kind of technology is often referred to as VR.

Virtual reality technology for doctor–patient communication

To effectively educate and train medical students in the essential skill of doctor–patient communication, a comprehensive program was implemented, utilizing virtual reality technology and a virtual campus. The program was developed through a collaboration between the School of Medicine and Surgery, Department of Clinical and Biological Sciences, University of Turin, and iGoOver Srl (www.igoover.it), a company specializing in experiential training using innovative methodologies and technologies. Thanks to a 2-year agreement, research and didactic training were carried out. Additionally, over 50% of the students in the course were from European and non-European countries.

Virtual reality immersion training is an effective teaching method for fostering empathy among students in medical and health professions (59, 60). This innovative approach aimed to provide students with practical experiences and valuable insights into communication strategies in emotionally charged medical scenarios. The program comprised two informative sessions that focused on different aspects of effective communication.

To ensure the authenticity and relevance of the training, four carefully crafted clinical cases were developed in collaboration with experienced oncologists. Each case had distinct communication goals, addressing various challenging scenarios. In the first case, the objective was to convey a diagnosis and discuss the need for surgery, emphasizing the importance of postoperative follow-up for accurate assessment. The second case involved communicating the results of a histological exam, explaining the necessity of chemotherapy to prevent relapse, and discussing potential side effects. The third case centered around a patient's deteriorating condition during chemotherapy, requiring the delicate task of conveying the decision to transition from active therapy to supportive care. In the fourth case, students were tasked with persuading a patient who had undergone surgery to accept a more aggressive treatment plan, emphasizing the ongoing presence of the disease.

To enhance the realism of the training, professional actors were enlisted to portray the patients, enabling students to engage in authentic interactions during consultations. This approach allowed students to develop their communication skills through direct patient interaction and by observing doctor–patient communication in the plenary room. Recent studies found that prior exposure to simulation training, such as communication skills, medical humanistic care, and checklist completion in subsequent asthma exacerbation simulation-based training, can improve the performance of medical students (61, 62).

Following each session, dedicated time was allocated for discussion and debriefing, facilitating an open dialogue where students could reflect on their strengths and areas requiring improvement. This critical reflection period provided students with the opportunity to analyze and refine their communication abilities, resulting in enhanced proficiency and confidence.

Furthermore, in addition to the practical training, the program incorporated mindfulness-based concepts to equip students with valuable tools for managing emotions during challenging medical communications. A recent systematic review on the impact of mindfulness-based interventions on doctors' wellbeing and performance (63) reported how doctors exposed to mindfulness-based interventions exhibited lower levels of negative wellbeing (burnout, stress, and anxiety) and higher levels of positive wellbeing (empowerment, dedication, and satisfaction). The authors highlighted that patients may, indirectly, benefit from mindfulness-based interventions because doctors who had undertaken such interventions were reported to provide more empathic and patient-centered care.

By integrating these innovative approaches, the Medicine and Surgery degree program demonstrated its commitment to

preparing future medical professionals with the necessary expertise in doctor–patient communication.

The success of this pioneering initiative showcased the effectiveness of utilizing virtual reality technology, realistic clinical cases, and dedicated reflection periods, solidifying the program's impact on nurturing well-rounded and proficient medical practitioners.

Virtual-augmented reality and life-like neurosurgical simulator for training: evaluating a hands-on experience for residents and students

In the recent years, growing interest in simulation-based surgical education has led to various practical alternatives for medical training. More recently, courses based on virtual reality (VR) and three-dimensional (3D)-printed models have become available. We suggest a hybrid (virtual and physical) neurosurgical simulator that has been validated, equipped with augmented reality (AR) capabilities that can be used repeatedly to increase familiarity and improve the technical skills in human brain anatomy and neurosurgical approaches. This method could be used not only in neurosurgical training but also in certain aspects of some general surgical training for medical students.

New, high-fidelity, cadaver-free simulators "UpSurgeon" together with other devices, such as Google glass for augmented reality and a camera for remote acquisition and PC vision, provide an opportunity to increase access to skills laboratory training and operative room tutoring. Surgical skills laboratories augment educational training by deepening one's understanding of anatomy and allowing the safe practice of technical skills. The neurosurgical field has historically evaluated skills by subjective assessment or outcome measures, as opposed to process measures with objective, quantitative indicators of technical skill and progression. We have designed a pilot training schedule with spaced repetition learning concepts to evaluate its feasibility and impact on proficiency. Then, we could observe the different steps of surgical procedures in videos, interact with surgeons, and share the images with other experts for the evaluation of the surgery. Additionally, these images could be shared with students or residents for teaching purposes. The 6-week module used (2) macrosuture-microsuture, (3a) bone simulator for drilling, (3b) endoscopic maneuvers exercises with fruit (basic activities for resident and MD students), (4) a simulator of a pterional, suboccipital, interhemispheric, endoscopic endonasal approaches representing the skull, dura mater, cranial nerves, and arteries, (5) simulator of surgical clipping, tumor resection (UpSurgeOn S.r.l.). Neurosurgery residents and students completed a video-recorded baseline examination, performing different craniotomies, dural opening, suturing, and anatomical identification. These were recorded using a smart phone and or under a microscope. Participation in the full 6-week module was entirely voluntary. In the 6th week, all residents and students repeated the initial examination, which was recorded on video. Videos were evaluated by three neurosurgical attendees who were not affiliated with the institution and who were blinded to participant grouping and year. Scores were assigned via global rating scales (GRSs) and task-based specific checklists (TSCs) previously built for craniotomy (cGRS, cTSC) and microsurgical exploration (mGRS, mTSC). Participants who underwent a 6-week simulation course showed significant objective improvement in technical indicators, particularly individuals who were early in their training. Small, non-randomized grouping limits generalizability regarding the degree of impact; however, introducing objective performance metrics during spaced repetition simulation would undoubtedly improve training. A larger multi-institutional randomized controlled study will be shared to elucidate the value of this educational method.

The hybrid AR and 3D-printed neurosurgical simulator could be a valid tool for neurosurgical training, capable of enhancing personal technical skills and competence. In addition, it could be easy to imagine how patient safety would increase and healthcare costs would be reduced, even if more studies are needed to investigate these aspects. The integration of simulators for training in neurosurgery as preparatory steps for the operating room should be recommended and further investigated given their huge potential.

Laparoscopic pelvic box trainers

In the last few years, both surgery and surgical education have undergone a dramatic evolution with the advent of minimally invasive surgery. In this field, laparoscopy is a surgical procedure done through one or more small incisions, using small tubes, cameras, and surgical instruments. This approach is technically complex, as it requires both classical surgical skills and psychomotor skills associated with minimally invasive surgeries (e.g., good hand–eye coordination) (64). Training simulators, such as laparoscopic pelvic box trainers, have therefore been developed for different surgeries (urology, gynecology, etc.) (Figure 2). These learning resources could be extremely useful for students to face for the first time the required dexterity and psychomotor skills that characterize surgery. Without the use of a simulative environment, experiencing the fundamental surgical steps would only be possible by participating in a surgical residency program or performing surgical procedures on patients (65).

DoNTStoptraining

Medical schools aim to provide the best possible medical education, but do they train students to become physicians? The day after they graduate, medical students should switch from an educational to a professional mindset. Is it something they can accomplish in a matter of hours? MedInTo project "DoNTStoptraining" sets up a network of simulation-based events, with the goal of training students in proficiency for managing social and cognitive skills required to become physicians focused on patient safety and appropriate self-management from the first day of professional practice (Figure 3). While the early introduction of simulation in the medical curriculum brings

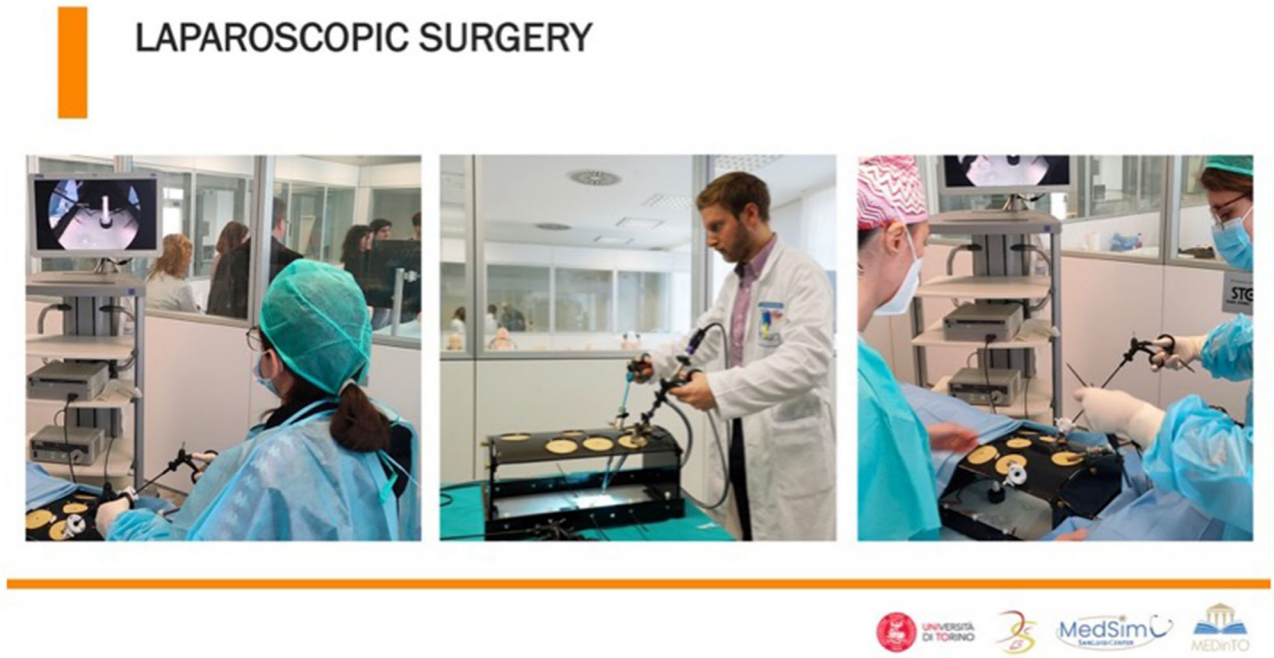

FIGURE 2
Laparoscopic surgery training in the simulation environment.

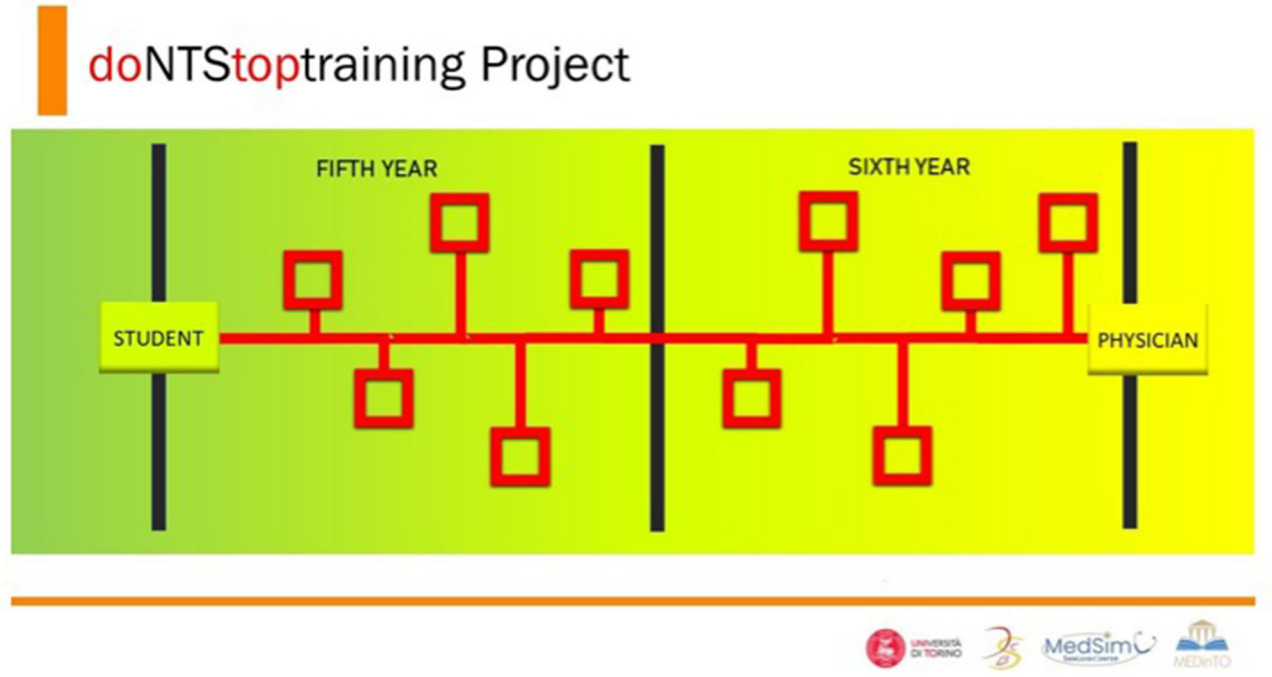

FIGURE 3
DoNTStoptraining project is a network of simulation-based events with the goal of training students in proficiency for managing social and cognitive skills essential to becoming a physician focused on patient safety and appropriate self-management from the first day of professional practice.

numerous benefits, it is important to strike a balance between simulation and clinical exposure. Simulation should supplement, not replace, real-life patient care experiences. Integrating simulation strategically throughout the curriculum ensures that students receive a comprehensive education that prepares them for clinical practices.

TABLE 1 Standardization and assessment: points to consider.

Implementation of a competency-based approach	The implementation of a competency-based approach in medical education is advocated, wherein the curriculum is structured around clearly delineated competencies and desired learning outcomes. Competency-based education places emphasis on the practical skills and abilities that students should possess, rather than solely focusing on their acquisition of knowledge. This feature enables adaptability in the development of educational curricula.
The significance of accreditation standards	Accreditation bodies assume a pivotal role in the establishment of standardized medical education. To assure the quality and consistency of medical programs, standards are established that institutions must adhere to.
Curriculum design	It is imperative for medical schools to have a meticulously organized curriculum that encompasses fundamental subjects such as basic sciences, clinical skills, and professional growth. Curriculum committees frequently engage in the periodic evaluation and revision of curriculum to integrate emerging information and optimal methodologies.
Core competencies	The term, "core competencies," refers to the fundamental abilities and skills that are expected of all medical graduates. These competencies encompass various areas, including effective communication, sound clinical reasoning, and adherence to ethical principles in practice. These competencies are fundamental to the process of curriculum design.
The incorporation of evidence-based procedures	The incorporation of evidence-based procedures should be prioritized in medical education. The integration of contemporary research findings and adherence to established clinical recommendations are of paramount importance to guarantee that students are acquiring the most up-to-date knowledge.
Clinical exposure and experience	It is imperative to guarantee that students are provided with sufficient opportunities for clinical exposure and experience. Clinical rotations, clerkships, and internships play a crucial role in the acquisition of practical skills and experiential knowledge.
Procedures of assessment	The standardization of assessment procedures is crucial to accurately measure the student performance. The assessment methods encompassed in this category consist of written examinations, evaluations of practical abilities, objective structured clinical examinations (OSCEs), and assessments pertaining to professionalism.
National licensing examinations	National licensing examinations are implemented in numerous countries as a means of guaranteeing that graduates possess a baseline level of proficiency. The examinations are frequently revised to align with advancements in medical knowledge and the implementation of new practices. This implementation should be taken into account when curricula are designed.
Enhancement of faculty development	Offer continuous chances for professional development to faculty members to ensure their currency in medical knowledge and pedagogical techniques.
Implementation of continuous improvement	It is imperative for medical schools to have a process that facilitates ongoing enhancement and refinement. Systematically gathering feedback from both current students and alumni can be a valuable practice in identifying potential areas for improvement within the program.
Promotion of interprofessional education	The promotion of interprofessional education is advocated to equip students with the necessary skills to effectively collaborate with other healthcare professionals, thereby mirroring the dynamics of real-world healthcare environments.
Attention to diversity and marginalized communities	The integration of training programs focused on cultural competence, health disparities, and diversity is crucial in equipping students with the necessary skills to effectively cater to various patient populations.
Integration of a global health perspective	Integrate a global health perspective into the curriculum to equip students with the necessary knowledge and skills to address healthcare and public health concerns in a global context.
Telemedicine and digital health technology	The integration of telemedicine and digital health technology is imperative in the contemporary digital era, necessitating the inclusion of corresponding training.
Ethical considerations	It is imperative to ensure that the principles of ethics and professionalism are taught and tested with a high level of rigor.

"Introduction to taking care" clerkship

We recently reported the results from a sentiment analysis of the logbooks written by the first-year students of the degree program. These students participated in the interprofessional education (IPE) clerkship "Introduction to Taking Care." The IPE involved first-year MD students in tandem with third-year nursing students (Academic Year 2021-2022). The IPE included different teaching activities, such as the ability to practice a venipuncture, female urinary catheterization, the ability to check arterial blood pressure.

In the teaching location, MD students were supported by the third-year nursing students, who acted as peer coachers, under the supervision of a clinical tutor.

Our results support the finding that the utilization of an *Advanced Medical Simulation Centre (AMSC)* was frequently linked to positive sentiments. In this setting, the sentiment analysis of the logbooks showed that positive sentiments including "improvement," "help," and "satisfied" were frequently reported in association with the AMSC (66).

Clinical exposure vs. simulation training: cost-effective considerations

By definition, the simulation program should not replace clinical exposure. The available data on its effectiveness derive from limited experience on several specific tasks that use non-homogeneous assessment tools, often developed internally and not previously validated (67–69). The effectiveness also depends on the students' willingness to feel fully involved in the proposed clinical scenario, without underestimating the almost realistic nature of the

TABLE 2 Pillars of long-term retention of the skills acquired after simulation training.

Follow-up assessments	Schedule follow-up assessments at regular intervals (e.g., 6 months, 1 year, and 2 years) after the initial simulation training to gauge the retention of knowledge and skills.
Comparison with control groups	Include control groups of individuals who did not receive simulation training to compare their performance with those who did. This allows for a more robust assessment of long-term retention.
Standardized assessments	Use standardized and validated assessment tools to measure the retention of specific knowledge and skills taught during simulation training.
Clinical performance	Evaluate participants' clinical performance in real patient care settings to assess the application of skills learned through simulation training.
Self-assessment and reflection	Encourage participants to self-assess their knowledge and skills periodically and reflect on their performance in real clinical scenarios. Self-assessment can provide insights into perceived retention.
Feedback and debriefing	Conduct feedback sessions and debriefing with participants to discuss their experiences and any challenges faced when applying simulation-trained skills in practice.
Longitudinal studies	Consider conducting longitudinal studies that track participants' performance and patient outcomes over an extended period to assess the sustained impact of simulation training.
Maintenance training	Offer maintenance or refresher training sessions to reinforce and update the knowledge and skills acquired during the initial simulation training.
Peer review and feedback	Encourage peer review and feedback among healthcare professionals to provide insights into the retention and application of simulation-based training in clinical practice.
Patient outcomes	Assess the impact of simulation-based training on patient outcomes, such as reduced complications, improved recovery rates, or enhanced patient satisfaction, over the long term.

situation. Simulated training supports students in acquiring new skills, particularly for their initial interactions with patients at the beginning of their careers and for the acquisition of clinical practice in subsequent years. However, the relationship with patients and their clinical and behavioral complexity cannot be replaced with simulated training either during visits or during diagnostic or therapeutic decisions. The simulation program prepares them, increasing their awareness.

Standardization and assessment: points to consider

The process of standardizing medical curriculum and examinations is a multifaceted and continuous endeavor with the objective of ensuring that medical education remains up-to-date, rigorous, and pertinent. The subject matter encompasses various essential elements, as detailed in Table 1. It is essential to acknowledge that the standardization of medical education is a dynamic undertaking that necessitates flexibility in response to evolving medical practices and healthcare demands. However, with technological advancements and new education approaches arising, including simulation training, international efforts involving different stakeholders are imperative to improve standardization, consistency, and comparability of the medical curricula.

For accomplishing this objective, it is essential to establish a continuous partnership among medical educational institutions, accrediting entities, healthcare organizations, and regulatory agencies.

Assessment of long-term retention following the simulation-based training

The main objective of education is to facilitate the enduring acquisition of knowledge and/or skills (70). In the realm of medical education, physicians undergo training to effectively transfer and adapt their knowledge to a diverse range of forthcoming clinical difficulties, drawing upon a well-preserved expertise. As stated earlier, numerous studies have provided evidence about the efficacy of incorporating simulation into the medical curriculum as a means to enhance knowledge, skills, and behaviors (71–74).

Nevertheless, evaluating the extent to which memory is retained following the training for intricate technical skills poses a challenging task (70). A meta-analysis conducted in 2013 examined the use of simulation in pediatric training and identified a lack of educational simulation models that are essential for the acquisition and retention of skills. This scarcity can be attributed to the limited number of comparative studies conducted in medicine when specifically targeting the retention of acquired skills and knowledge (75). Despite the increase in data on simulation-based training in medicine, many of these new studies use a "no intervention group" as a control and poorly define the timing and frequency for repeating the simulation sessions (75). Moreover, there is heterogeneity in re-training recommendations (76–78). It is part of the MedInTO mission to assess long-term retention of the skills acquired after the simulation training and to determine factors that can influence this pedagogical process (Table 2) (76).

Conclusion

Simulation in medicine is increasingly available, portable, and advanced.

Is an early introduction into medical curricula feasible? Our experience at the MD program in Medicine and Surgery of University of Turin-MedInTo supports our team in pursuing this goal. Continued efforts are required to improve, with a particular focus on non-technical skills, and standardize curricula and assessments.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent was not required to participate in this study in accordance with the local legislation and institutional requirements. No animal was involved in this study.

Author contributions

DL: Conceptualization, Data curation, Methodology, Writing—original draft, Writing—review & editing. FA: Conceptualization, Validation, Visualization, Writing—original draft, Writing—review & editing. CC: Conceptualization, Visualization, Writing—original draft, Writing—review & editing. DG: Conceptualization, Visualization, Writing—original draft, Writing—review & editing. MM: Conceptualization, Visualization, Writing—original draft. LOd: Methodology, Visualization, Writing—original draft, Writing—review & editing. LOs: Conceptualization, Visualization, Writing—original draft, Writing—review & editing. PP: Conceptualization, Writing—review & editing, Data curation, Formal analysis, Supervision. SR: Conceptualization, Writing—original draft, Writing—review & editing, Visualization. GR: Conceptualization, Data curation, Formal analysis, Supervision, Writing—review & editing. SS: Conceptualization, Data curation, Methodology, Writing—original draft, Writing—review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2023.1280592/full#supplementary-material

SUPPLEMENTARY VIDEO

The "Simulation circuit" as part of the simulation for emergency medical care for students' activity. In both the center and nearby environments, four contemporaneously simulative stations were organized.

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Exploration of validity evidence for core residency entrustable professional activities in Chinese pediatric residency

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Introduction: This study seeks to explore validity and reliability evidence for core residency entrustable professional activities (CR-EPAs) that were developed by Peking University First Hospital (PKUFH) in 2020.

Methods: A prospective cohort study was conducted in PKUFH. Trainers (raters) assessed pediatric residents on CR-EPAs over 1 academic year, bi-annually. Critical components within a validity evidence framework were examined: response process (rater perceptions), the internal structure (reliability and contributions of different variance sources), and consequences (potential use of a cutoff score).

Results: In total, 37 residents were enrolled, and 111 and 99 trainers' ratings were collected in Fall 2020 and Spring 2021, respectively. For rater perceptions, all the raters considered CR-EPAs highly operational and convenient. In all ratings, individual EPAs correlate with total EPA moderately, with Spearman correlation coefficients spanning from 0.805 to 0.919. EPA 2 (select and interpret the auxiliary examinations), EPA 5 (prepare and complete medical documents), EPA 6 (provide an oral presentation of a case or a clinical encounter), and EPA 7 (identify and manage the general clinical conditions) were EPAs correlated with other EPAs significantly. The results of the generalizability theory indicated that the variability due to residents is the highest (nearly 78.5%), leading to a large size of the reliability estimates. The matching results indicate that the lowest error locates at 5.933.

Conclusion: The rating showed good validity and reliability. The ratings were reliable based on G-theory. CR-EPAs have a magnificent internal structure and have promising consequences. Our results indicate that CR-EPAs are a robust assessment tool in workplace-based training in a carefully designed setting.

KEYWORDS

competency, postgraduate medical education, entrustable professional activities, pediatrics, China, validity

Introduction

Competency-based medical education (CBME) was widely used in postgraduate medical education (PGME) and has become a symbolic approach to reform medical education (1).

Competence is a complex, interrelated, multidimensional construct to be acquired by medical professionals for safe and effective clinical practice. By adhering to the two core principles of CBME, which involve redefining the criteria for a competent physician and emphasizing the achievement of competent graduates, CBME has demonstrated an enhancement in clinical practice and an improvement in patient safety (2). Given China's large population, it has established a series of policies to ensure a safe health system with only qualified professionals practicing, emphasizing the implementation of CBME in PGME (3). In its capacity as a trailblazer in pediatric residency training within China, Peking University First Hospital (PKUFH) initiated its pediatrics residency program as far back as 1946. Remarkably, this initiative preceded the Chinese National standardized resident training guidelines by nearly seven decades (3).The pediatric residency program at PKUFH was accredited by the Chinese Medical Doctor's Association (CMDA) and provisional accreditation by the Royal College of Physician and Surgeon of Canada (RCPSC). As proposed by Melle et al., we tried to implement five core components of CBME in the pediatric residency program (Appendix 1) (4) since 2012. The establishment of the Core Competency Framework for Residency Education by the China Consortium of Elite Teaching Hospitals in 2018 marked a significant milestone. Prior to this development, a comprehensive framework for residency education had not been in place (5).

The CanMEDS framework of RCPSC has been implemented in our institute as outcome competencies (Appendix 1). A stratified rotation is systematically conducted for each resident, wherein a highly specific competency-based assessment approach, encompassing both formative and summative evaluations, is meticulously delineated. Throughout the course of their rotations in various subspecialties, residents can expect to receive continuous feedback from their trainers and the program director, typically occurring at regular intervals of approximately every 2–3 months. The clinical competency committee (CCC) was held semi-annually. The rotation of certain subspecialties might be extended if a resident fails to meet the minimum criteria.

Through our practice, competency itself somehow is not easy to be understood nor to be observed by trainers, which creates a gap between competency and the daily tasks of doctors. As a tool to close the gap, the milestones initiative showed satisfactory validity as an assessment tool for competency (6); however, it is a rather complex system. Entrustable professional activities (EPAs), initiated by Ten Cate (7), provided a sound alternative approach for assessment in CBME (8–10), which might be the solution for sequenced progression of competency and programmatic assessment. EPAs are a bundle of clinical tasks vital to competency assessment (11, 12); in that way, EPAs can link routine clinical tasks to competency assessment. For instance, the commonplace task of "history taking" necessitates the demonstration of multiple competencies, encompassing roles such as medical expertise, effective communication, advocacy for health, and professionalism. Through the supervision of this "history-taking" process, trainers gain valuable insights into the trainee's overall competency. After supervision, entrustment decision-making was performed accordingly so that the competency could be translated into trusted behavior, which is easier for implementation in a nationwide fashion.

Based on the foundation of CBME, we further began exploring the development of EPA in PGME. In 2020, a modified Delphi method consisted of two iterative rounds and one consensus meeting to develop the core residency entrustable professional activities (CR-EPAs; Figure A1 in Appendix 2). A 15-item competency assessment framework mainly focused on generic and core professional activities, as in Table 1 (13). The supervision rating scale of nine-point Likert items was initially set up according to Chen et al. in EPA implementation studies (14, 15). Considering that the nine-point span is too sparse to be informative in assessing the least requirement for residents (16), we modified the nine-point scale into an eight-point scale (Table 2). To minimize the need for faculty training, we use the same supervision scale level across all the CR-EPAs.

The aforementioned CBME has been implanted in the PKUFH pediatric residency program. Aiming at understanding CR-EPAs in a practical assessment setting, revealing how it would integrate into our previous CBME system and explicit training perils and problems, we conducted a prospective cohort study in the pediatric residency training program of PKUFH. This research aimed to gather validity evidence for CR-EPAs in the pediatric residency training setting and inspect if CR-EPAs could provide reliable and meaningful data for evaluating residents. The study was organized into a three-component investigation: response process (rater perception), internal structure (variance components reliability), and consequences (potential use of a cutoff score).

Materials and methods

Study design

This study aimed to gather validity evidence for CR-EPAs. To gather information ahead and follow the trainees for a period of time,

TABLE 1 CR-EPAs[a].

EPA 1	Gather history and perform physical examination during patient encounter
EPA 2	Select and interpret the auxiliary examinations
EPA 3	Provide diagnosis and differential diagnosis
EPA 4	Develop the comprehensive management plan for patients
EPA 5	Prepare and complete medical documents
EPA 6	Provide oral presentation of a case or a clinical encounter
EPA 7	Identify and manage the general clinical conditions
EPA 8	Identify clinical emergency and critical illness and provide initial management
EPA 9	Transit and hand over the patient
EPA 10	Obtain informed consent for tests and/or procedures
EPA 11	Perform general procedures of a physician
EPA 12	Provide patient education and health advocacy
EPA 13	Deliver bad news to patients and/or family members
EPA 14	Deliver clinical teaching and instruct near-peers
EPA 15	Prepare and respond to public health events

[a]Peking University First Hospital; EPAs, entrustable professional activities; CR-EPAs (13), core residency EPAs.

TABLE 2 EPAs supervision scales as used in Peking University First Hospital Pediatric Department.

Description of competence	Original code (17)	Coded in this study
Trusted to observe only	1b	1
Trusted to practice EPA only under proactive full supervision as coactivity with rater	2a	2
Trusted to practice EPA only under proactive, full supervision with rater in room ready to step in as needed	2b	3
Trusted to practice EPA only under reactive/ on-demand supervision with rater immediately available, all findings double checked	3a	4
Trusted to practice EPA only under reactive/ on-demand supervision with rater immediately available, key findings double checked	3b	5
Trusted to practice EPA only under reactive/ on-demand supervision with rater distantly available, findings reviewed	3c	6
Trusted to practice EPA unsupervised	4	7
Trusted to supervise others in practice of EPA	5	8

EPAs, entrustable professional activities.

a prospective cohort study that implemented CR-EPAs in the PKUFH pediatric residency training program over 1 academic year (July 2020 to June 2021) was conducted. The rating was achieved in January 2021 and July 2021, denoting residents' performance in Fall 2020 and Spring 2021, respectively.

The SPSS (version 23.0.0) and R (version 4.0.1) were used for statistical analysis. The Prism (version 9.0.0) was used for visualizing the analysis.

Ethics approval and consent to participate

In accordance with the Declaration of Helsinki, the institutional review board at PKUFH granted this study (2021-107). Before participating, informed written consent were obtained from each resident and trainer in accordance with relevant guidelines and regulations.

Study participants

As forementioned well-launched CBME in PKUFH Department of Pediatrics, both the trainers and residents were familiar with the concept of competency and competency assessment. Residents in the PKUFH Department of Pediatrics residency training program were selected as the subjects of this study. It would maximumly reduce systemic errors to a certain extent. Inclusion criteria were (a) having finished at least 9 months of rotation during the study period and (b) being willing to be assessed by trainers. Residents were divided into different postgraduate year (PGY) groups according to their rotation year in July 2020. The demographic information was collected.

Response process

Trainers rated each resident according to their previous rotated subspecialties. These trainers were, therefore, the raters throughout this article. A series of tutorials on the EPAs' concept was delivered to the trainers to minimize the inter-rater difference.

The rating processes were performed through an online survey platform (http://www.wjx.cn/). The trainers could complete the ratings by either computer or mobile devices. Each form contained 15 items of CR-EPAs (Appendix 3). A link containing CR-EPA supervision rating and the list of trainees to be assessed was sent to each trainer every 6 months. For each trainee, multiple times of ratings would be conducted by different trainers according to their previous rotation and performance. To avoid missing data, the survey could only be submitted after all EPAs of a target trainee were fully observed. The raters were allowed to select "unable to rate" certain EPAs if they felt inadequate supervision/observation opportunities or insufficient qualifications. The time consumed for each rating was automatically recorded. For each resident, overall performance was the average of multiple trainers' ratings.

After completing the rating, we compared EPAs across PGYs and assessment periods. A focus interview with eight raters was conducted to document comments and thoughts about using CR-EPAs in practice, ensuring the completeness of the response process investigation. All interviewees' questions were open-ended: "how do you feel when you were using CR-EPAs in practice."

Internal structure

The internal structure was investigated through (1) associations between any pairs of EPAs via Spearman correlation analysis, (2) discrimination of each EPA via Spearman correlation analysis, and (3) variance and reliability estimation via generalizability theory (G-theory) (18). Specifically, G-theory was used to decompose variance components of the assessment, and the estimation was achieved by using restricted maximum likelihood (REML) (19). As psychometrics theory indicates, the correlation between items (e.g., EPAs in our context) provides evidence for validity: they are expected to have a moderate-to-high correlation to show a good measurement structure. The correlation between an item (again an EPA in our context) and its sum/mean (as an overall performance for the entire assessment) is essentially "discrimination."

Many performance-based assessments are investigated through Cronbach's α, inter-rater reliability, inter-rater agreement, or concordance that all belong to classical test theory (CTT) (20–22). This study, however, utilized G-theory as it is more proper for the setting of our CR-EPAs. The reasons for using G-theory instead of others are listed below:

1. Instigating qualities of education assessment (i.e., validity) also most always involves measurement theories and their quantifying frameworks, including CTT, G-theory, and item response theory (23). Therefore, G-theory is a candidate for the study.
2. Compared with CTT that simply assumes that observed performance consists of true ability effect and error effect (i.e.,

the well-known $X = T + E$ and each effect correspond to variance such that $\sigma^2(X) = \sigma^2(T) + \sigma^2(E)$), G-theory is compatible with designs with *multiple facets* such as raters, items, groups, and occasions (24, 25), each of which is an effect affecting the observed scores. For instance, in performance assessment where a is the $p \times i \times r$ design present (each person p is graded by every rater r on each task/item i), G-theory can decompose observed response data as $X_{pri} = \mu + v_p + v_i + v_r + v_{pi} + v_{ir} + v_{pr} + \epsilon_{pri}$, where an observed score, X_{pri}, for person p on item i rated by rater r is made of the grand mean μ, person effect v_p, item effect v_i, rater effect v_r, interaction terms of any two random effects, and error effect ϵ_{pri}. Each of these effects involves variance as CTT does, and their values can indicate the proportion of an effect contributing to the data. To illustrate, the proportion of rater and item effects count for 80 and 10% of the total variance of the data and then intuitively one would consider the inconsistency between raters is high, while the items are more homogenous.

3. IRT is used more in large-scale standardized (multiple-choice) assessment (26), where the sample sizes are generally large. In certain simplified scenarios, such as scoring with the rating scale, IRT as G-theory can be used interchangeably (27). However, when *multiple facets* are available and non-large-scale scenarios are present, G-theory makes a more appropriate and reliable choice, especially when the designs are complex such as random-distributed and/or nested structures (28).
4. Competence/performance-related investigations through G-theory in the field of medical education have been seen more in the literature (24, 25) also conveying that our methodological adoption is a strong fit for the present study, which involves different EPAs, raters, and randomly crossed structure between raters and residents.

Variance estimates of G-theory allow calculating the level of (1) dependability (criterion- or domain-referenced) and (2) generalizability (e.g., norm-referenced interpretations of test scores), which are akin to reliability in CTT. G-theory enables researchers to make decisions on how to alter the reliability coefficient to a specific level. For instance, if G-theory shows a large variance in the rater effect implying a lack of consistency among themselves, a decision study (namely, D-study) will be informative to the prediction: how many raters are demanded to reach a specific coefficient level. In our study, the effects of raters, items (i.e., EPAs), residents, and their interactions were considered. Their estimation was achieved via the R software (29).

Consequence

Finally, consequence analysis was defined to investigate the potential use of EPA scores in future competency screening. In practice, administrators and raters tend to use an observed (mean or sum) score to evaluate if a resident meets the minimal requirements of the competency assessment. This implementation involves setting a cutoff score that theoretically consists of the least measurement errors or makes the highest sense through scientific reasoning. In this study, we aligned the observed (mean) EPA scores of each resident with true scores (i.e., the ability estimates from G-theory modeling after excluding other noises such as rater effect and item effect), and the scores' uncertainty/errors yielded from the aforementioned G-theory analysis. Ideally, the cutoff observed score should correspond to the true score level with the lowest uncertainty/errors, namely, the most reliable threshold setting from a data-driven perspective (30).

Results

Descriptive statistics

Thirty-eight pediatric residents were enrolled in this study; one was excluded due to incomplete rotation. The demographics of 37 residents are shown in Table 3. In total, 23 raters (trainers) participated in the assessment, and their demographics are shown in Table 4.

In total, 111 and 99 ratings were received for the two investigation periods, respectively. Each resident received 3.0 ± 1.2 ratings in Fall 2020 and 2.7 ± 0.7 in Spring 2021 from trainers, respectively. Since each EPA needs to be completed before submission, no data for the EPA assessment was missing. The supervision rating results of each EPA through PGY1 to PGY3 in Fall 2020 and Spring 2021 are shown in Figure 1.

Response process

All the raters (trainers) fulfilled the supervision rating within 2 weeks of the assignment. None reported "unable to rate." The rating data were

TABLE 3 Demographic of 37 participating pediatric residents.

Demographic	No. (%), except where noted
Gender	
Female	10 (27)
Male	27 (73)
Age, average ± SD	26.8 ± 3.1
Level of training	
PGY-1 resident	13 (35)
PGY-2 resident	11 (30)
PGY-3 resident	13 (35)
Number of ratings of each resident in fall 2020, average ± SD	3.0 ± 1.2
1	3 (8)
2	12 (32)
3	9 (24)
4	8 (22)
5	5 (14)
Number of ratings of each resident in in spring 2021, average ± SD	2.7 ± 0.7
1	2 (5)
2	12 (33)
3	19 (51)
4	4 (11)

PGY, postgraduate year.

TABLE 4 Dermographics of 23 trainers (raters).

Demographic	No. (%), except where noted
Gender	
Female	18 (78.2)
Male	5 (21.8)
Age, median (range)	33 (29–47)
Degree	
Medical doctors	21 (91.3)
Master's degree	3 (8.7)
Year enagaged in teaching	
<1 year	4 (17.5)
1 to <2 years	7 (30.4)
2 to <3 years	5 (21.7)
≥3 years	7 (30.4)
Subspecialty	
General pediatric	1 (4.3)
Respiratory	2 (8.6)
Pediatric intensive care	2 (8.6)
Neurology	4 (17.2)
Nephrology	3 (13.0)
Cardiology	2 (8.6)
Neonatology	4 (17.2)
Hematology	2 (8.6)
Neonatal intensive care	3 (13.0)

analyzed, and the results were reviewed with the raters (Figure A2 in Appendix 2). The emergent theme of both strengths and limitations was listed during the focus interview in Table 5. All the raters considered CR-EPAs to be highly operational and convenient. The conclusion is consistent with the time consumed to complete one rating—the minimum time is 37 s, while the maximum is 1700 s, with a median of 143 s. The raters believed that the proposed CR-EPA supervision rating was consistent with their clinical observations of a specific resident and a realistic reflection of the resident's clinical competence. If using traditional assessment tools (such as 360° assessment), raters often overestimate residents' "actual behavior" and cannot genuinely differentiate students' levels. However, it would be more mutual and objective when using supervision decision-making as the measurement scale, thus achieving good consistency among different raters.

Internal structure

In all ratings, individual EPAs correlate with total EPA moderately, with Spearman correlation coefficients spanning from 0.805 to 0.919, recorded in Figure 2, indicating that, overall, items nested within the target assessment possess good power in distinguishing residents' competency. Spearman correlation coefficient between all EPA pairs ranged from 0.541 to 0.926, with a median of 0.759 (Q1 0.697, Q3 0.827), recorded in Table A1 in Appendix 2. None of the EPA pairs' correlation was below 0.3. In total, 20 out of 105 (19%) individual EPA pairs' correlation coefficient was above 0.85. Among those EPA pairs, EPA 2 (select and interpret the auxiliary examinations), EPA 7 (identify and manage the general clinical conditions), EPA 6 (provide an oral presentation of a case or a clinical encounter), and EPA 5 (prepare and complete medical documents) were the ones that significantly correlated with other counterparts.

The results of generalizability theory modeling were presented in Table 6, showing the estimates of the variance components for residents, raters, EPAs, the interactions between residents and EPAs, the interactions between raters and EPAs, the interactions between raters and EPAs, as well as the residuals. Variability due to residents is the highest (nearly 78.5%), leading to a large size of the reliability estimates (i.e., G-Coefficient and Φ-Coefficient estimates are both higher than 0.75). Two interaction terms—the one between residents and EPAs and the other between raters and residents—are lower than 1%, implying that these "noisy signals" are barely influential to the assessment. On the other hand, the interaction between raters and residents, although not high in a relative sense, shows the total variability related to raters is 8.4% (i.e., 0.099, 0.130, and 0.005). The contributions from EPAs are low and indicate a high consistency between the item levels.

Consequences

At each given observed mean score (i.e., overall performance), bootstrapping the G-theory yielded a set of true score estimates allowing the construction of an uncertainty range, which reflects the estimation precision. The matching results are contained in Figure 3, indicating that the lowest error is located at 5.933. On the other hand, when the overall performance is 2.700, the errors become the largest—1.069.

Discussion

To the best of our knowledge, this is the first study in China to implement EPAs in the pediatric residency program. In our study, rating data sets on CR-EPAs during 1 academic year were employed to verify their reliability and validity, emphasizing the educational and clinical outcome of CR-EPA-based assessment in China's 3-year standardized pediatric residency training.

Competency assessments require good reliability. The generalizability coefficients of CR-EPAs are 0.871, the Φ-coefficient of CR-EPAs is 0.785, and both coefficients are above 0.75, which indicates that the use of instruments in the given context is reliable. In comparison with other assessments of this kind, the reliability estimates are sufficiently high for performance-based tasks. For example, Meyer et al. (31) showed that the generalizability coefficients of a pilot preclinical entrustment assessment in undergraduate medical education fall between 0.66 and 0.52. The coefficients are decomposed into different sources, of which the resident effect dominates the variance. Surprisingly, the rater and the rater-related interaction effects consume a larger partition than others, which is usual because ratings are too subjective to be highly consistent among all raters. However, the proportions of the rater and the rater-related effects are still low, reflecting positive signs of the series of rater training prior to the present study.

Supervision decision-making is widely used in pediatrics throughout the world (32). PKUFH Pediatrics Department has a long

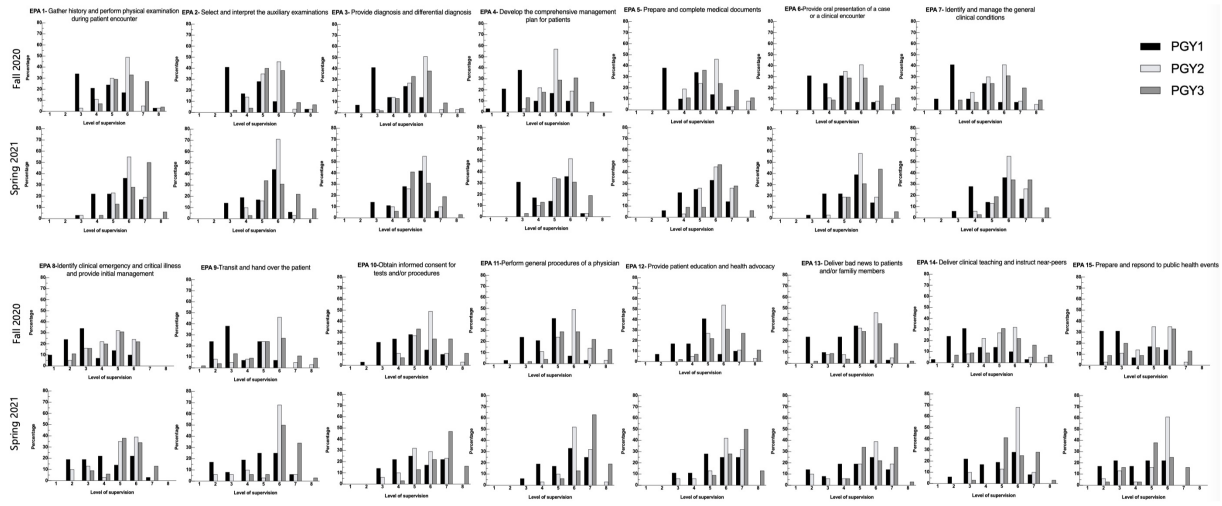

FIGURE 1
Distribution of the level of supervision assignments by Clinical Competency Committees for each of the CR-EPAs (see Table 1) using the scales (see Table 2). In each panel, bars represent the percentage of ratings for each level of supervision by postgraduate year (PGY). (Black bars= PGY1; Light gray bars= PGY2, dark gray bars= PGY3). For each EPA, data from July 2021 are displayed below those from Jan 2021.

TABLE 5 Aspects of the CR-EPAs supervision decision-making.

Emergent theme	Description
Favorable aspects	
Characteristics of CR-EPAs	CR-EPAs covered major generic clinical behavior and was a clinical-based, bed-side based assessment. Raters could easily make a supervision decision based on residents' clinical behavior, and CR-EPAs supervision level could reflect residents 'actual clinical competency.
Comparing to other assessment tools	CR-EPAs was a more mutual and objective assessment tool, compared with 360° assessment, and is clinical-based assessment compared with traditional structural case-interview. CR-EPAs illustrated more clinical competencies compared with mini-CEX and DOPS.
Areas to improve	
Assessment Platform	CR-EPAs should become a regular assessment with an interval of 2 to 3 months based on the rotation of residents. The assessment should have a specified electronic platform which is easy to review the previous results both for residents and raters and should have longitudinal data for certain residents and raters.
Lack of discriminations between PGY2 and PGY3 residents	Data were lack of discriminations between PGY residents. CR-EPAs was a generic clinical behavior. PGY-2 and PGY-3 residents shared similar responsibilities. The growth trajectory would be flat in the next 2 years. EPAs based on general pediatric training should be developed in future to fulfill the gap.

history of CBME. Hence, reliability could reach such a high level. Quoted for the focus review, supervisors describe CR-EPAs as a clinical-based, bed-side-based assessment tool, and supervisors could easily make a supervision decision based on clinical behavior. CR-EPAs were more reciprocal and objective when using supervision decision-making as the measurement scale, thus achieving good consistency among different raters.

In this study, CR-EPAs also showed relatively good validity evidence. The assessments made in Spring 2021 were higher than those made in Fall 2020 in most EPAs (Figure A2 in Appendix 2). These results were consistent with the expectation that residents require less supervision as their skills improve with more experience and teaching. The developmental trajectories are evident in aggregate data, and similar results were found in other studies based on pediatric fellows. However, there was no upward trajectory from Fall to Spring for EPA 15 (apply and respond to public health events) possibly due to a lack of practice and observation. It is a common problem the world is facing in the post-pandemic era. A specialized training course should be implemented to enhance the training. As for the internal structure validity evidence, individual EPAs moderately correlate with the EPA total score, indicating that items nested within the target assessment possess good power in distinguishing residents' competency. As for the inter-EPA correlation analysis, most EPA pairs were moderately correlated, while a few EPAs were significantly correlated with each other. Those EPAs are EPA 2 (select and interpret the auxiliary examinations), EPA 5 (prepare and complete medical documents), EPA 6 (provide an oral presentation of a case or a clinical encounter), and EPA 7 (identify and manage the general clinical conditions). Those EPAs were the most fundamental meta-EPAs and correlated with other EPAs significantly. Those EPAs included common clinical scenarios were that more observable for supervisors and, hence, more comfortable in judgment.

Although serving as an initial exploration in the present study, the consequence part provides insights into the decision-making use of EPAs. The data-driven result shows that supervision Level 6 (5.933) nearly corresponds to the lowest error for assigning residents to binary

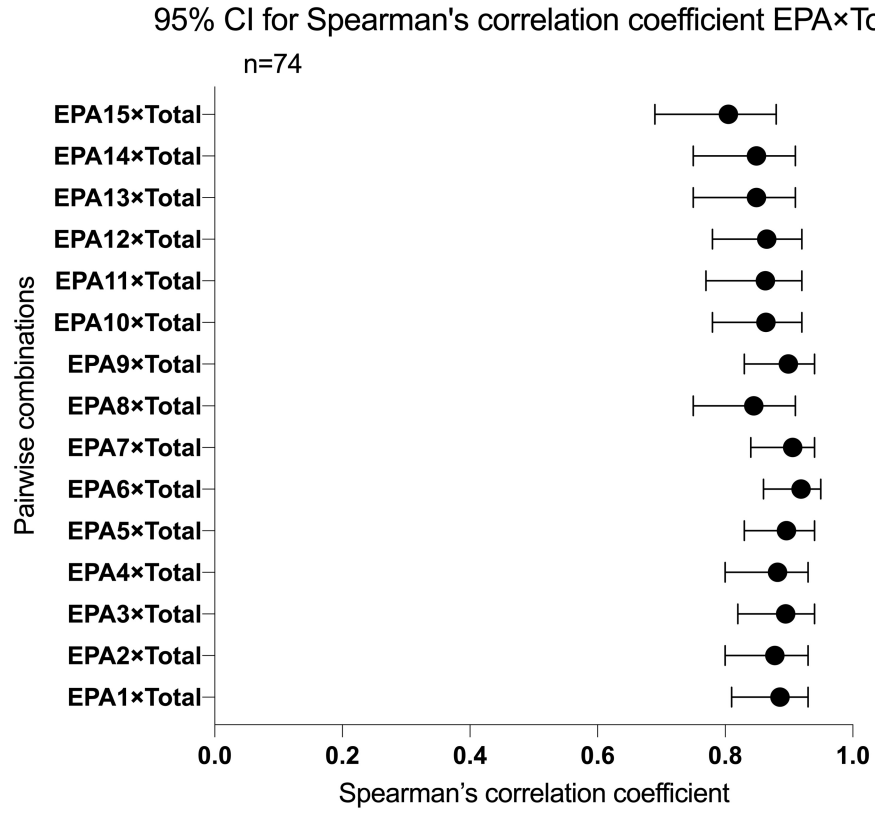

FIGURE 2
95% CI for Spearman's correlation coefficient EPA items with total score.

TABLE 6 Variance decomposition and reliability estimates via generalizability theory.

Effects	Variance component (VC)	% VC	*df*	G-Coefficient	Φ-Coefficient
Resident	0.925	78.5	1	0.871	0.785
Rater	0.099	8.4	3		
EPA	0.013	1.1	15		
Resident:EPA	0.000	0	15		
Rater:EPA	0.005	0.4	45		
Rater:Resident	0.130	11	3		
Residual	0.007	0.6	45		

classes, which are conventionally interpreted as "pass/fail," "competent/incompetent," and "qualified/unqualified." The cutoff score is well aligned with Chen (17) who claims that level 6 (Chen's Level 3c) should be the threshold when residents graduate from a program (the end of PGY-3 training). Hence, from the perspective of G-theory, Level 6 should be the cutoff value for supervision levels of CR-EPAs for residents.

Limitations

Our study has several limitations. It is a single-center, small sample-size study. The supervision rating timespan was half a year. It would be less likely to reflect a real-time improvement in the residents. The study was conducted only within 1 academic year in a single center. Furthermore, as the lack of an electronic platform specified for CR-EPAs ratings, our ratings were conducted on a survey platform, and all the EPAs were listed in a single survey; This may lead to a halo effect. Fortunately, an e-portfolio specified for CR-EPAs ratings will launch in our center soon, which can solve the problem in future.

Conclusion

We developed an eight-level supervision scale for CR-EPAs and implemented it in a pediatric residency training program of

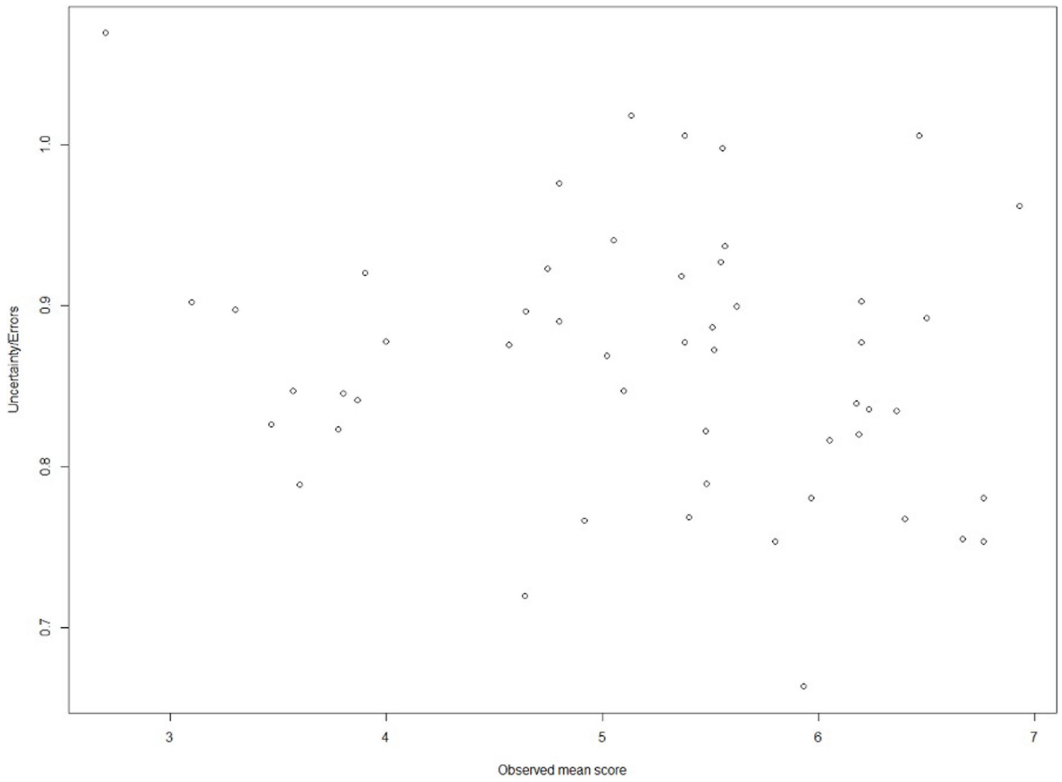

FIGURE 3
Relation between observed mean scores and corresponding uncertainty in a cut-off setting.

PKUFH. The ratings were reliable based on G-theory. CR-EPAs have a fine internal structure and the consequences of using them for binary decision shows reasonable utility. Our results indicate that CR-EPAs can serve as a robust assessment tool in workplace-based training in a carefully designed setting.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the institutional review board at Peking University First Hospital. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

SL: Formal analysis, Investigation, Project administration, Writing – original draft, Software. XQ: Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing. HL: Conceptualization, Resources, Visualization, Writing – review & editing. WZ: Formal analysis, Validation, Writing – original draft. ZJ: Data curation, Formal analysis, Methodology, Validation, Writing – review & editing. JQ: Conceptualization, Funding acquisition, Investigation, Project administration, Resources, Visualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

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Beyond mere respect: new perspectives on dignity for healthcare workplace learning

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Introduction: Although dignity in workplace learning in healthcare is gathering interest, we know little about stakeholders' conceptualizations in this area across professional groups. Dignity breaches in workplace learning are common, often with serious and long-lasting consequences for the affected. Conceptualizations shape behaviours and experiences. To prevent dignity violations in students' learning, it is thus important to understand stakeholders' understandings of the topic. This study therefore explores the dignity conceptualizations around workplace learning that students, placement educators and university staff hold across seven allied health professional groups.

Methods: Using a social constructionist perspective, we conducted individual and group narrative interviews (n = 51) with students, placement educators and university workplace learning staff from seven allied health professional groups. We used the 5-step Framework Analysis to explore and develop themes, identifying differences and similarities across stakeholder groups.

Results: We identified eight distinct, yet interrelated, dimensions of dignity from participants' narratives: dignity as respect, dignity as self-x (the various relationships we have with ourselves), dignity as feeling safe, dignity as understanding otherness, dignity as supporting others, dignity as equality, dignity as professionalism, and dignity as belonging. Dignity as respect was identified across all participants, although mutual respect and a culture of respect were only present in academic participants' talk. The remaining seven dimensions all present important factors extending our understanding of the construct of dignity.

Discussion: In line with existing research, our study identifies the absence of an unambiguous, positive conceptualization of dignity in workplace learning among stakeholders. It adds novelty in two ways: by identifying dignity dimensions that require informed action beyond respecting others, and by revealing a tension between dignity as professionalism and dignity as equality. We suggest revising existing dignity concepts in workplace learning to address this tension and to reinforce that active care, team integration and skilled support are all non-negotiable elements of dignified behaviour within workplace learning.

KEYWORDS

professional dignity, healthcare professions education, work-integrated learning, workplace learning, qualitative research, allied health, health sciences students, clinical educators

Introduction

The construct of dignity in the healthcare workplace is deemed core to good practice, being highlighted across numerous healthcare policies internationally, e.g., (1, 2). However, dignity is often confounded with *respect*. But it is not the same. Indeed, research has identified that the construct of dignity changes according to where and who is asked, e.g.,

(3–9). As such dignity is a sociocultural concept with antecedents, attributes and consequences (9). For example, achieving dignity in nursing is associated with empowerment for the persons involved, including enhancement of positive coping, well-being, self-esteem, integrity, hope, and control (9, 10). As a complex abstract construct, and in line with a social constructionist worldview, it is subject to individuals' contextual understanding being affected by "*environmental and structural factors and organizational relationships*" [(10), p. 2]. Accordingly, it has been recommended that researchers investigate the meaning of dignity in terms of differing contexts and population groups. This is especially important so we can develop nuanced understandings of how we might uphold dignity in the healthcare workplace, as dignity breaches can have serious negative consequences personally and organizationally (11). In this article we explore a range of stakeholders' explicit understandings of what dignity *in workplace learning* means to them, discuss the relationships and tensions between these dimensions, and propose how dignity can be usefully delineated from the concept of respect. Ultimately, we aim to make dignity a more accessible and useful concept for all stakeholders involved in healthcare workplace learning encounters.

Conceptualizing dignity

The concept of dignity has been extensively discussed and debated by scholars throughout centuries. In its basic form it has been described as "*being worthy of being appreciatively acknowledged as worthy*" [(12), p. 253]. Put differently, dignity means living in accordance with one's standards and values and respecting others' standards and values (13). Dignity thus includes both an outward and an inward looking perspective (14): that is, an "*ability to establish a sense of self-worth and self-respect, and to appreciate the respect of others*" (15). It also encapsulates a *right to* and a *responsibility for* dignified behavior, calling for both self-assertion and self-renunciation (12). In this way, dignity comprises a highly relational, context-dependent, and dynamic concept which is created, upheld or violated, as a result of self-image, social interaction and moral behaviors (10, 16, 17). It relates to every person and to all areas of social interaction. In sum, it has been argued that dignity can be associated with "*what we do… what we suffer*…and sometimes to *what we are*" [(18), p. 202]. Of course, these elements are interrelated. Historically, dignity has been associated as being a property of a human being: "the essential and unavoidable core of our *humanity*," [(19), p. 17] and this view has persisted, being embedded in societal values and laws. Following this supposition, it is logical that if we all have dignity, then we cannot treat people in any way that we please. We ought to treat others with the dignity they deserve.

This moral imperative is typically understood by banning two key types of behaviors: instrumentalization and degrading treatment/humiliation of others (18). And while the degrading treatment and humiliation of others are obvious behaviors to avoid (and we discuss this further in our section on dignity breaches during workplace learning), instrumentalization is less often discussed. Instrumentalization is linked to a lack of respect for the other and includes acts such as removing a person's autonomy, imposing our own goals on them, taking away their intrinsic value (18).

Conceptualising dignity in the workplace

The subjective elements of dignity at work (for example self-esteem, autonomy and meaningful work) have been the focus of many studies (20). Indeed, this aspect has recently focused on dignity breaches by peers and those in authority such as bullying and harassment (i.e., the degrading treatment and humiliation of others in the workplace), leading to dignity at work policies being developed across the world. Indeed, such dignity at work legislations commonly focus on the provision of safe working environments recognizing employees' rights to be treated with dignity and respect, free from bullying, harassment and sexual harassment (as such, tend to omit actions around instrumentalization as discussed above) (21, 22). However, this aspect of dignity is not forgotten. The construct of 'dignity in labor' focuses on the central role that work plays in human dignity, including: "the right to decent work" with opportunities for people to have access to safe working conditions with well-paid jobs and secure working contracts (20). Here the focus is on "the dignity of the process of organization" [(23), p. 2]. In other words, increasing our focus towards the dignity *of* work, as well as dignity *at* work (20, 23, 24).

Conceptualisations of dignity during healthcare workplace learning

In the context of healthcare learning, stakeholders comprise university staff, healthcare professionals, students, patients and their families: interacting in the often-overlapping areas of dignity at work, dignity while learning, and dignity while accessing professional healthcare (20, 23, 25, 26). While dignity at work and, more specifically, dignity in healthcare work, especially in nursing, has been extensively discussed (13, 16, 17, 25, 27–35), we know little about dignity in workplace *learning* in healthcare. However, due to growing concerns around professionalism breaches during workplace learning, and in particular around bullying and harassment [discussed further below (26, 36–45)], this topic is gathering interest in the research community. Although there are variations internationally, workplace learning typically comprises students learning with, on or about patients/clients; often in the presence of an educator who is a healthcare professional. A few studies have examined constructs and experiences of dignity in healthcare workplace learning (15, 30, 46–49).

For example, investigating students' and supervisors' conceptualizations of dignity in workplace learning across healthcare and non-healthcare disciplines (business, counselling, law, teaching, medicine, nursing) research has identified 23 distinct concepts through which participants defined dignity (47), with students being more likely than supervisors to express their conceptualizations in negative terms. Examining participants' workplace learning experiences, researchers identified nine narrated dignity types: verbal abuse, right for learning opportunities, care, inclusion, reasonable expectations, right for appropriate feedback, equality, trust, and right to be informed (46). Most of these dignity narratives centered around the student-supervisor relationship, fewer on environmental factors, with mainly individual characteristics being cited as contributing factors of dignity experiences (positive and negative). Frequently

mentioned supervisor characteristics included expectations of students and feedback competence; frequently mentioned student characteristics included showing initiative, enthusiasm and confidence.

Similarly, Sholl et al. (50) investigated understandings and experiences of hospital clinicians, medical educators and students and public representatives (including simulated patients and lay representatives) about the concepts of safety and dignity in healthcare workplace learning. They identified three types of dignity conceptualizations that interplay with their conceptualizations of safety: physical dignity, emotional and psychosocial dignity, and *other* types of dignity. All of these, except *other* types of dignity, related to respect of self or from others. Differences in understandings between stakeholder groups were not identified.

Dignity breaches during workplace learning

Research internationally has shed light onto a range of situations in which dignity in healthcare workplace learning is often compromised, including work undertaken within the constructs of *professionalism lapses, professionalism dilemmas* and interactional audio/video research on bedside teaching encounters (26, 39, 40, 42, 44, 45, 50–60). These situations include workplace bullying and harassment, talking to or about patients inappropriately, deliberately withholding information and students conducting examinations (sometimes intimate) on patients without valid consent. Indeed, this classification of professionalism lapses/dilemmas dovetails with the taxonomy of dignity violations identified by Mann (14): not being seen (including being ignored), being reduced to a member of a group category (rather than treated as an individual), violations of personal space, and humiliation. Such compromising of dignity within healthcare workplace learning sometimes happens knowingly, sometimes under duress, and sometimes due to a lack of understanding in how to protect or uphold the dignity of self and others (26, 56).

Workplace learning dignity breaches involve people from different social and professional groups (16, 61) often in unequal relationships with each other where one person is in a dependent, hence vulnerable, position with the other being in a position of power (13, 27, 34, 40, 42, 46, 52, 53). Indeed, unequal relationships exist between a range of groups interacting within the healthcare learning or 'placement' environment, including placement educators and students; healthcare professionals and patients; and university staff (who assign, educate, and monitor placement activities) and students. Thus, patients depend on the professionalism of clinicians; with students depending on the guidance, support and assessment of placement educators and university staff.

In addition, students expose their vulnerabilities in the learning process itself. This involves making mistakes as they engage in unfamiliar healthcare workplaces, often for the first time in their lives. In such an environment, dignity breaches can flourish (26); often going unnoticed by those not immediately affected (62, 63), and notoriously being underreported due to feelings of guilt, shame or fear of negative consequences on the side of the individuals whose dignity has been violated (64). As such, dignity breaches can breed further dignity breaches and, over time, erode organizational values and workplace culture, becoming 'normalized' or 'accepted' ways of behaving (26, 52, 65).

Consequences of dignity breaches during healthcare workplace learning

In addition to becoming a normalized part of a workplace culture, dignity breaches, especially if continued over time, can have disastrous effects for learners, healthcare professionals and patients. In terms of individual impacts, dignity breaches cause physical, mental and emotional harm (36, 40–43, 52, 55). Indeed, participants report experiencing moral and emotional distress, anxiety and depression, substance abuse, insomnia, physical illnesses, and reduced self-confidence (36, 41). Other consequences include withdrawal and avoidance behaviors, including avoiding perpetrators, avoiding seeking help, or failing to report incidences (41, 43, 52, 56, 66, 67).

Dignity breaches also compromise the wider team in which students and trainees learn alongside organizational performance and productivity, bringing secondary impacts on them (62, 63, 66, 68). For example, recipients of breaches report negative impacts on their job satisfaction, their organizational loyalty, and that they emotionally withdraw from work (30, 61–64).

If patients are on the receiving end, dignity breaches can lead to negative treatment outcomes. For example, patients may lose trust and withdraw from treatment when they hear a healthcare student being involved in disrespectful talking to them or another patient. Similarly, students witnessing or actively being involved in patient dignity breaches can also lead to an increased likelihood of students and/or healthcare professionals making mistakes, e.g., incompetent suturing, (26, 39, 40, 42, 43, 45, 46, 57).

In its essence, dignity is not merely about preventing dignity violations but rather about embracing intrinsic positive qualities and actions. For example, seeing others, acknowledging their individuality, respecting their personal space and honoring social norms (17). Moreover, research shows that many dignity violations in the healthcare workplace are subtle, covert and easily covered up (26), and therefore difficult to articulate. Yet, only an articulatable concept can be applied with confidence (31, 69, 70).

Study aims

Understanding the range of characteristics of dignity and their sociocultural nuances facilitates an awareness of how to uphold dignity for everyone by identifying what behaviors lead to its violations. Despite previous explorations of the concept of dignity within the workplace learning setting, research has primary focused on a small range of healthcare students' and placement educators' perspectives, specifically from medicine and nursing (30, 46, 47, 50). These studies do not account for the wider context in which workplace learning occurs. This context includes a wider range of student and placement educator groups from across allied healthcare settings, and the university staff who source, organize and support placements both educationally and organizationally for whom

dignity within workplace learning is a central concern. Indeed, when dignity breaches during workplace learning occur, it is this group (i.e., university staff) who may be required to mediate between students and placement educators and/or their managers, ensuring the welfare of students whilst maintaining overall relationships with the host learning organization.

Extending the range of stakeholders within the practice of healthcare workplace learning interactions therefore brings forth a broader consideration of the triadic interaction between students, placement educators and university workplace learning staff. This accounts for a more rounded understanding of the concept of dignity within workplace learning. Our study aims to fill these gaps in the literature by understanding how allied healthcare students, placement educators and university staff conceptualize the construct of dignity in workplace learning. In doing so we ask the following research questions (RQs): (RQ1) What are participants' conceptualizations of dignity during workplace learning encounters? (RQ2) How do these understandings differ (if at all) between participants' stakeholder groups?

Methods

We used a qualitative, narrative approach, with our underlying theoretical perspective being underpinned by social constructionism. Briefly, social constructionism recognizes that knowledge is created and co-created through talk and interaction. In other words, from an epistemological perspective, social constructionism acknowledges that we come to know our world through social interaction, and this is mediated across different contexts [for full details of the associated ontological, epistemological and axiological underpinnings see (71)]. Narrative approaches sit within the social constructionist world view and are exceptionally useful for uncovering detail and nuance of people's views and experiences (72). Aligned with this perspective, individual and group discussions were conducted with allied health students, placement educators and university staff whereby participants were asked to provide lived experiences to elucidate their responses. Our initial analysis comprised an inductive thematic approach, commensurate with narrative research undertaken within this genre (73). We received ethics approval from the University of Sydney Human Research Ethics Committee (Project ID 2019/841) and conducted our work according to the submitted protocol that included written and verbal informed consent, participants' anonymity and their right to withdraw at any time.

Study context

This study was conducted at a single university setting in Australia that offers allied health professional courses. Allied health disciplines included diagnostic radiography, exercise and sports science, exercise physiology, medical imaging science, occupational therapy, physiotherapy, speech pathology, and rehabilitation counselling. Student participants, who had completed at least one placement in an external placement site were drawn from across these disciplines. Placements, also termed professional practice or practice education, are an integral part of allied health courses, providing students with real-life learning opportunities set within authentic work-based settings Placements are mandated by the various health professions' regulatory authority professional accrediting bodies, with the aim of ensuring that on completion of their degrees, students are indeed work-ready.

The Work-Integrated Learning (WIL) team at the time of the study comprised both academic and professional staff supporting approximately 5,000 placements for students from allied health professional groups annually. Academic staff are responsible for the design and delivery of the subjects or 'units of study' that entirely or partially include a placement component. Unit coordination responsibilities include ensuring students' preparation for placement, academic support for both students and placement educators during placement, and for some disciplines, debriefing activities following placements. The professional staff members focus on the organizational aspects of the placement, for example, student vaccination verification requirements, student placement allocation, and all operationally-focused communication with placement providers and students. Placement educators comprise healthcare professionals (not employed by the university) whose primary priority is the delivery of healthcare services to members of the public. As part of their professional roles/obligations, these individuals also agree to host placements, supporting student learning and assessment of competency in their setting. Placement providers include publicly funded primary, secondary and tertiary health services, private practices, non-government organizations, and increasingly, large private companies providing services across the National Disability Insurance Scheme or vocational rehabilitation services. The providers are situated both within large metropolitan cities as well as throughout regional and rural areas, and are delivered across the community, accross people's homes, schools and workplaces, as well as in health settings.

Recruitment procedure

For placement educators, a stratified purposive sampling approach was employed: the population of placement educators who worked with the study context (> 1,200) was stratified into public, non-government and private organizations, across metropolitan, regional and rural locations with the assistance of a university WIL staff member. All university WIL staff were invited to participate via email from the research assistant (CK), within this invitation they were also asked to nominate a sub-set of up to 20 placement educators from across the stratification. Those nominated were emailed an invitation to participate. Thus, placement educator sampling was purposive in that university WIL staff were asked to select currently active placement educators who were known to them to have had positive and not so positive placement experiences. This ensured that only the most informative placement educators were approached for interviewing. Due to the relatively small number of WIL staff, this sub-sample was recruited using a convenience sampling approach (i.e., every WIL staff member who volunteered to participate was interviewed). The student sub-sample were emailed an invitation. This sub-group was selected purposively with the inclusion criteria that they had completed at least one external work placement during their degree.

TABLE 1 Overview of participants.

Characteristic	Student	Placement educator	University WIL staff^	
			Academic staff	Professional staff
Gender				
Female	17	11	12	5
Male	2	4	0	0
Age				
Range	21–48	26–54	31–61	40–56
Median	34.5	40.0	46	48
Discipline				
Diagnostic radiography	3	0	3	0
Exercise Physiology/Exercise and Sports Sciences	0	2	1	0
Occupational Therapy	3	5	1	0
Physiotherapy	0	4	3	0
Rehabilitation Counselling	0	1	*	0
Speech pathology	13	3	2	1
Cross disciplinary*	0	0	2	4
First language				
English	12	14	11	5
Non-English	7	1	1	0
Domestic student	14			
International student	5			
Totals ($n = 51$)	19	15	12	5

* Participants working across two or more disciplines are only counted in the 'Cross disciplinary' column. ^ 12 academic, 5 professional staff.

Participants

Fifty-one participants across the three stakeholder groups were interviewed: 19 students, 15 placement educators and 17 work-integrated learning staff (Table 1).

Procedure

We held 33 interview sessions: 11 group (comprising 2–4 participants) and 22 individual. All groups, except one, comprised homogeneous participants (i.e., one stakeholder group per session). The exception was one focus group comprising four participants, with two placement educators and two work-integrated learning professional staff located rurally. According to participants' convenience, we held 16 discussions face-to-face, 16 online (via Zoom) and one interview via the telephone.

Group discussions lasted between 70 and 150 min, the individual interviews between 45 and 100 min. Thirty-one discussion sessions were conducted by CK, two by ABe, neither had a prior relationship with any of participants they interviewed. The discussions were semi-structured with an interview guide beginning by asking participants to define the constructs under study (workplace learning quality and dignity) then moving on to enquire about their experiences of those domains. This study focuses on participants' responses to the opening question: "*What does the concept of dignity within workplace learning mean to you*?." When participants responded with an "I think…" answer, we often asked them if they could give us an example of a time when they encountered this as an issue (i.e., asking for a narrative to contextualize their opinions). All discussions were digitally audio-recorded and transcribed anonymously.

Data analysis

We used a team-based 5-step framework approach to determine content and process-related themes (74). Step 1: All authors read a subset of the transcripts (2–3 each, with each included transcript being read by two people). Step 2: We then discussed our ideas regarding themes identified within the data. Step 3: LVM and CK developed the initial framework document for coding with comments from the wider team. Step 4: The data were then coded by CK with feedback from LVM. Data were managed using the qualitative software ATLAS.ti 8. Three students from outside the study cohort joined the team to help coding the data under the supervision of LVM and CK (see Acknowledgement section). Step 5: LVM and CK further collaboratively developed the wider coding framework through individual coding and whole team discussions. This coding process enabled us to further explore and develop themes and concepts, identifying differences and similarities in understandings across and between the three participant groups.

Team reflexivity

While the team mainly comprised members of the same university faculty, the project officer CK was neutral in this respect. Team members came from a variety of disciplinary backgrounds, including psychology (LVM), hospital management (CK), higher education (ABe), occupational therapy (MP), physiotherapy (AD) and nutrition (GN). Amongst the team we have a range of expertise in qualitative research from those who have 10–18 years' experience (LVM, CK, ABe, MP, GN) to those who are relatively novice (AD). Furthermore, as a team we kept check on each other's interpretations, reminding ourselves of our philosophical framework and being mindful not to go beyond the status of the data.

Results

We present the explicit, narrated definitions that participants gave us in response to our interview question, "What does the concept of dignity in workplace learning mean to you?," explicitly addressing RQ1: What are participants' conceptualizations of dignity during workplace learning encounters? We identified eight explicit definitions of *dignity in workplace learning* and present them below in order of the frequency in which they occurred in the data, except for *dignity as self-x* which we describe immediately after *dignity as respect* where it fits conceptually, although it was mentioned less often (See Table 2, which also addresses RQ2: How do these understandings differ (if at all) between participants' stakeholder groups?).

We order our data pragmatically, making no claim to the relative importance of the concepts (75). Had we interviewed different participants, the frequency of mentions might have been different. When we refer to participants' talk, we capitalize their participant group name; when a group is referred using lower case, it means that they are the subject of participant's narrative, e.g., "a Student participant talked of how students on placement…." When we use the phrase "participants talked about *x*," we mean that an issue was discussed by the *majority* of participants. When we say, "*some* participants narrated *y*," we are indicating that y was narrated, but not commonly. In the following excerpts, we use a unique identifier denoting participants' gender (F/M), participant group (Student = ST, Placement Educator = PE, WIL Academic = WA, WIL professional = WP), and participant number.

Before we present the definitions identified, we note that a range of participants from all three stakeholder groups wavered when asked to articulate their conceptualizations of *dignity in workplace learning*. For example, one WIL Academic participant stated that the term "*confuses me a bit*" [F_WA_#6], another WIL Academic participant preferred to use the term *ethical practice* and some Student participants felt that dignity was such an inherent right that it should not need to be defined. Further, participants tended to define dignity from the point of what it is *not*, i.e., by talking about dignity breaches.

Dignity as respect

Respect was the most common aspect that all participant groups spontaneously associated with the concept of dignity. It was described across multiple dimensions: respect as a characteristic of individuals (respect of others), as a characteristic of interactions (mutual respect) and as a characteristic of the organization/workplace as a whole (culture of respect). It was also described as respect for oneself, but here respect was tightly associated with other qualities such as valuing, understanding and appreciating oneself. We therefore present this aspect under 'dignity as self-*x*'.

TABLE 2 Themes identified by participant group.

	Students (S)	Placement educators (PE)	University WIL staff	
			Academics (WA)	Professional staff (WP)
Dignity as respect				
Respect of others	✓	✓	✓	✓
Mutual respect			✓	
Culture of respect			✓	
Dignity as self-x*	✓	✓	✓	
Dignity as feeling safe	✓	✓	✓	✓
Dignity as understanding otherness	✓	✓	✓	
Dignity as supporting others	✓	✓	✓	
Dignity as equality	✓	✓	✓	✓
Dignity as professionalism	✓	✓	✓	✓
Dignity as belonging	✓	✓	✓	✓

*We use the term "Self-*X*" to refer to the multiple attributes (as commonly denoted by '*x*') of the self this theme comprises.

Dignity as respect of others

Dignity as respect was most frequently associated with a responsibility of individuals towards others. Respect *towards students* was understood by all participant groups as welcoming students to the site and valuing them as human beings, adult learners and temporary team members rather than judging them in terms of stereotyped demographic characteristics (e.g., perceived nationality based on their name):

> One of the negative things I've noticed … when you send to sites the names of students [who] are [to be] located to sites, sometimes they [the students] are judged based on their name and there've been placements cancelled because the name did not look like the name they expected. That's not dignity because this student if they're going there they … would have not been looked at or appreciated the same way they would appreciate others. I did have site cancelling on me placements just after I sent a list of [student] names which were the[type of] names they didn't expect. [F_WP_#3]

Respect *from students* was understood across multiple dimensions by all participant groups. Firstly, students respecting placement educators' and team members' roles and competencies. This includes students knowing their own place and how they fit in within the clinical team. Secondly, students respecting patients'/clients' needs, including respecting that patients' bodies are their own, irrespective of students' need to learn:

> That students respect the dignity of their clients or their patients and respect the professionalism of their educators. So I think that can sometimes particularly with graduate entry students be an issue because they may overstep their boundaries as students in terms of learning on placement [F_WP_#2]

Thirdly, in relation to the placement site, students' respect towards the organisation as a business venture was highlighted.

Dignity as mutual respect

Some participants understood respect as *mutual* respect. Here, respect was defined as a relational concept that is exhibited in an interaction, through verbal and non-verbal communication, where both stakeholders take joint responsibility for valuing one another, and treat each other humanely, irrespective of the other person's status or personal background:

> I really do believe [dignity] comes back a lot to communication, and how there is an interaction between the student and the placement educator, or anyone else in the workplace … there has to be a joint accountability and a joint responsibility there with dignity in the workplace. [F_WA_#2]

This understanding came predominately from WIL Academic Staff.

Dignity as a culture of respect

Some participants, especially in the WIL Academic Staff group, identified dignity as a *culture of respect* within the workplace. Here, respect was described as being exhibited by *all* members of the organization:

> *F_WA_#1: But [respect] has to be- it has to just be there throughout, so a respectful, dignified student going into an environment that —*
>
> *F_WA_#2: --So its almost dignified culture, like the culture already existing there—*
>
> *F_WA_#1: --The culture has to be, is right for the student to go in and be respectful and expect to be respected. [Group Discussion WA_#1]*

Dignity as self-*x*

This conceptualization was more commonly identified in WIL Academic Staff, Placement Educator and Student participants' talk and absent in WIL Professional Staff responses. Such an understanding of dignity focuses on the relationship we have with our '*self*': self-worth, self-respect, self-compassion and self-understanding, including an intention to protect one's sense of self and wellbeing and, in relation to others, an expectation to respect and support this endeavor:

> *Believing in yourself, respecting yourself and your position, not feeling like a little junior student out of place, feeling like you have every right to be there, and you belong there and you are doing a great job. That's the sort of thing that I think would make it dignified if I were a student and I went to a place for learning. [F_CE_#10].*

Dignity as feeling safe

This understanding of dignity is around physical, mental and emotional safety. All participant groups contributed to this dimension. Students talked about how they had been berated, bluntly being told they are wrong or had done something wrong. Thus, for Students, dignity was about *feeling* safe to learn: to be able to do something without ridicule or being made to feel bad. For Placement Educators and WIL staff it was mostly about *creating* that safe learning space, which was described as one which is free from negative behaviors such as bullying and discrimination, where students can express their wishes and concerns, make mistakes without being penalized and ask "*the dumbest question ever and not be shamed for it*" [F_WA_#8]. So here, the focus is around being mindful of students' vulnerability due to their status as learners.

Interestingly, one Placement Educator considered the learning process as being inherently unsafe in terms of potentially 'looking stupid':

> *Well dignity is not something that I would normally attach to a learning process. I think if you maintain- if you, as a student, want to maintain your dignity to a high standard you're probably not going to learn very well because you're not prepared to put it out there and give it a go. If I take it away from speech pathology and say learning to do a cartwheel* [a sideways rotary spinning of your body]*, if I'm not prepared to look stupid the first time I do a cartwheel, I am not going to get better [F_PE_#4]*

WIL staff additionally mentioned their own safety and that of placement educators:

> People feeling safe and secure and unthreatened and supported in a workplace setting… students and staff… WIL staff yeah, and staff on placement as well, like educators… because we all work together… I see that we work in a triangle [F_WA_#6]

Interestingly, none of the participants linked their explicit understandings of 'dignity as feeling safe' to patients.

Dignity as understanding otherness

Here, all participant groups, except WIL Professional Staff, described dignity in terms of understanding other people's differences, their individuality, or, in social terms, understanding diversity. This goes beyond respect. It includes giving others space and time to explain their perspective, suspending judgement, and listening deeply to learn from others and to understand them better. Otherness embraces an understanding that people have individual learning needs:

> I'm an international student, I come in with different views and different perceptions of what we do in healthcare. So the way that we do stuff might not be the same as compared to what they do over here… Kind of also letting us explain our side of why we perceive it this way, or why we did this, or why we did that [F_ST_#14]

Dignity as supporting others

Student groups, Placement Educators and WIL Academics highlighted this element. Here, the emphasis is on placement educators supporting their students and giving them opportunities to learn and grow. Several Student and Placement Educator participants spontaneously elaborated on the construct of *dignified feedback* beyond the issue of feeling safe. Placement Educators talked about how they approach feedback in a dignified manner: including making feedback inspiring, empowering, tangible, digestible, keeping it constructive, understanding the intricacies of different students and knowing how to deliver feedback so that it fits individual learners' needs:

> Dignity is about, for students, being able to deliver feedback that's tailored to the situation and the person when you see how they're reacting. Not just giving them feedback that's meaningless. Making sure that you show them what you mean. I always jump in sessions and do stuff with them, not berating them but just giving sensible and specific feedback, no personal comments. Giving them a chance to fix it and rewarding anything that they do fix [F_PE_#4]

Dignity as supporting others also includes students' abilities to accept constructive feedback. It also relates to providing students access to tools, resources and structures that facilitate their learning and undertaking work:

> If you don't give students everything that they need then you're not giving them the dignity and respect that they deserve and nor are you giving the clients the outcome who you are actually providing services to … students I think can sometimes, if the right structures aren't in place and the right resources aren't there, then they can easily be not shown the dignity that they deserve to be able to perform and learn. [F_PE_#11]

This dignity dimension builds on dignity as respect and dignity as understanding otherness in that respect and understanding are now applied practically in deliberate supportive action. Dignity as supporting others also goes beyond merely adhering to professional standards and practice (see *dignity as professionalism*).

Dignity as equality

The dimension of dignity as equality was highly prevalent in Student participants' talk, but also common in Placement Educators participants' talk. It was not mentioned by WIL Professional Staff participants. In this conceptualization, dignity in workplace learning is understood as treating everyone with the *same* level of attention and respect, irrespective of disciplinary or professional hierarchies. Here, the concept of hierarchies and power is often cited by participants, with multiple references across our data to people who are the 'highest' and the 'lowest' treating each other, and also of being treated as 'equal.' Such equality is around the recognition that everyone has a place and relevance in the workspace and is deserving of being respected in that space:

> [Dignity] means treatment of their colleagues, respectful communication both verbal, non-verbal, a little bit of a historical thing would be a breakdown of the hierarchy in terms of disciplines or professions. So an EN [Enrolled Nurse] working on the floor with no high level qualifications or someone who is working as a cleaner and/or a ward orderly is given the same level of respect as the highest doctor in your medical team. [M_PE_#2]

In terms of the educator–student relationship this means placement educators treating students as human beings like themselves, and affording all students with the same attention and judgement irrespective of personal preferences, and in turn being treated respectfully by students:

> Though everyone has different roles in the scenario, everyone is equal, and equally valued as human… it doesn't mean the student should not submit to authority when it's appropriate to do so… they're learning, and they should be respected as a person that is learning and not ridiculed. [F_WA_#10]

Dignity as professionalism

This dimension was identified in all participant groups' talk. Here, dignity was defined as professional behavior using terms such as *being*

in a privileged position, *ethics, standards*, *code of conduct, confidentiality, responsibilities*, and *accountability*:

> Intrinsically you are dealing with difficulties and so being mindful and respectful of how you approach these subjects so that's partly about confidentiality, for example, of the information that's exchanged… that information or anything that's in that relationship doesn't flow outside but also that's additional to all the interpersonal and human respect elements. So that confidentiality applies in organization levels and that recognition that you're… working from a service provider perspective as being in a privileged position of having access to that information. [F_WA_#5]

Participants also talked about clinicians' responsibility to communicate professionally, with placement educators and their teams role-modeling professional communication so that students can observe and emulate it. This includes aspects such as having discussions about ethics, patient dignity and putting patients/clients first to ensure the best possible outcomes for them:

> Then in a hospital it's really important to discuss- a lot of our clients are in very difficult stages of life, and it can be hard, and it can sometimes be good to have a discussion about ethics, dignity, how we go about treating these people who really need our help. [F_ST_#4]

> I think it's really around dignity for the client. I think particularly in a workplace in a disability space that we're putting the client first and really thinking about the supports around them. So I guess really instilling that in the students that come on placement is to see how they are doing in terms of their clinical approach or their therapeutic goal and outcome, how that's impacting on the person's overall functioning and their life. [F_PE_#9]

Dignity as belonging

This conceptualization (being identified across all participants groups) also expands on the concepts of 'dignity as respect' and 'dignity as understanding otherness' in that it focuses on actively including students in the placement team, involving them in activities and providing them with a sense of belonging:

> I think inclusiveness, as well, in the team… actually, it felt like being part of the team and they're not just an add-on for their department or their ward, and they're actually involved in all the activities. That's around that direct patient contact or clinical skill that they're here to do and that they're actually involved and valued in that wider team environment as well. [F_PE_#3]

Participants noted that belonging also brings with it a responsibility on the part of the student to work out how to fit in with the site's team culture, finding a balance between exhibiting professionalism and socializing in a team. In this way, this aspect of dignity also relates to the understanding of 'dignity as valuing oneself':

> especially within a team environment, knowing how to just be part of that workplace culture around, how to act and have some fun moments, but at the same time be fairly professional, and all of those things and also finding that right balance… So how we manage that as a workplace, but also how the student manages that within themselves. [F_PE_#9]

Discussion

We identified eight distinct but interrelated dimensions of dignity: dignity as respect, dignity as self-x, dignity as feeling safe, dignity as understanding otherness, dignity as supporting others, dignity as equality, dignity as professionalism, and dignity as belonging. These dimensions we identified in participants' narratives, combined with existing research around this topic, are invaluable pointers towards what a definition of the concept should entail. We therefore now delineate how our findings compare with existing research, drawing on both the theoretical (philosophical) and the empirical literature with a focus on dignity at work, dignity in healthcare and dignity in workplace learning where appropriate. We offer explanations on how the dimensions of dignity relate to each other; and we discuss implications for future research and practice.

In our data, narratives around *dignity as respect* (with its three sub-dimensions *respect of others*, *mutual respect* and *culture of respect*) and *dignity as self-x* featured prominently. Indeed, the phenomenon of associating dignity with *respect for others* relates to work examining dignity in students and supervisors across healthcare and non-healthcare workplace learning settings (47). However, our analysis takes this further, distinguishing between multiple inward and outward looking aspects of dignity. Such a distinction resonates with that found in the wider conceptual literature across nursing practice. Thus, Gallagher (76) distinguished between 'dignity as an other-regarding value' and 'dignity as a self-regarding value', referring to mutual respect for others' and one's own personal and professional dignity. Jacobson (28) talks about 'dignity-of-self' and 'dignity-in-relation', the former consisting of self-respect held by individuals but *created through* social interaction; the latter being upheld through a process of reflecting human worth *back* to others through words and actions. Scholars agree on a dialectic relationship between the two perspectives, an internal one ('how I see [or treat] myself') and an external one ('how others see [or treat] me'); both being interdependent, feeding from and into the other through fluid social interaction (34, 77). Our data reflect and extend this interdependent notion to the context of healthcare workplace learning. Thus, within this relational construct dignity arises through one's own self-respect and treatment of others, which in turn affords others' recognition of your self-worth and the expectation that you will be treated with similar dignity.

The dimensions of *dignity as feeling safe, dignity as understanding otherness* and *dignity as supporting others* therefore grow out of this interdependent self-otherness, extending beyond merely valuing and respecting others. They require *giving* things that flow from the role one assumes in the workplace: care, understanding and support, including during feedback. Thus, within the workplace learning space the delivering of feedback, often in front of patients/

clients, can easily become a context in which patient, student and even educator dignity is compromised with students sometimes left feeling particularly unsafe and vulnerable (56–58). Understanding the nuances around delivering feedback to students in front of patients or team members is key for placement educators' ability to maintain dignity for all.

So far we have focused on a person-centered, egalitarian perspective of dignity. However, our participants also talked about how different competency and hierarchy levels might call for different ways of behaving, levels of care, understanding and supporting of others. This is where *dignity as professionalism* comes in: described by our participants using attributes like confidentiality, responsibilities, role-modelling, communicating professionally, being in a privileged position, code of conduct, and standards. Indeed, the wider literature describes a similar concept, referring to it as *professional dignity* (16, 32, 78, 79). Thus, professional dignity embraces values such as accountability, excellence, duty, honor, and social identity (16). Professional dignity can be seen as *an achievement* (32) and even as "the sense of pride and accomplishment" associated with one's profession [(79), p. 41]. Professional dignity has also been associated with rank and status (28, 80) such as *dignity of merit* and *dignity of office* (27, 81, 82). As such, this construct relates to an Aristotelian virtue perspective where through our actions we become honorable and deserve dignity (76).

So, in both, our data and the literature, we find elements that relate to privilege (status, accomplishment, excellence, merit, honor) and elements that relate to responsibility (role-modeling, accountability, communicating professionally). Both sides of *dignity as professionalism*, suggest that one can (or must) *earn* a certain type of dignity at work. This further suggests that some have it and others do not, and that some can claim it and others cannot, depending on professional differences and hierarchies. This conditionality of dignity on instrumental differences between roles makes dignity in workplaces (and for that matter in workplace learning) vulnerable to being misused in that people with more privilege (higher status, competencies, achievements) can take advantage of the dignity of people with less privilege with reference to their privileges/status (15, 34). This usually happens in subtle and tacit ways. By the receiving person it is typically perceived as being looked down upon, being ignored or socially excluded, or by being restricted access to learning opportunities, feedback and resources (*dignity as supporting others*) (34, 37, 41, 42, 46, 47).

It could therefore be argued that a conception of *dignity as professionalism*, as being based on appreciating *differences* between self and others, clashes with the notion of *dignity as equality.* The latter postulates that everybody is of equal worth and that we ought to treat everyone with the same dignity regardless of achievement, skills, status or personal demographics (28). Striking a balance between *dignity as professionalism* and *dignity as equality* is therefore complex, requiring negotiation. As one of our participants commented, while everyone is equally valued, sometimes students do need to "*submit to authority.*" This also explains why our student participants mostly described their conceptualizations of dignity in work-integrated learning with terms that refer to *feeling safe*, *understanding otherness*, *supporting others*, *equality* and *belonging.* Indeed, these dignity dimensions are related predominantly to their relationships with placement educators and clinical team members: all people of higher privilege and status than themselves.

Methodological limitations and strengths

As with all research, our study has methodological limitations and strengths. Our data was collected using a range of sampling techniques, and we did not scrutinize participants' motivations to participate in the research before interviewing them. Thus, there are likely to be a range of motivations leading stakeholders to participate, motivations that are likely to be reflected in the data (e.g., after interviewing we note that some participants felt their dignity was breached during workplace learning and were motivated to address the issues through participation). However, this can also be considered as a strength, in that our participants include those with a lived experience of their dignity being compromised and are likely to be an informed sample. A second limitation is that data were collected with students, academic and professional staff at one institution and across six allied health disciplines. Additionally, participants were predominately female (note, there were no male University WIL staff at the time of the study). This limits our findings in terms of generalizability regarding healthcare profession and gender, and therefore our claims. However, the university is the largest in [Australian state] and all clinical educators came from a range of public and private healthcare providers. Furthermore, we recruited a large number of participants ($n = 51$) with a diverse range of workplace learning experiences, and for the first time, included the voices of university academic and professional staff. This range of new voices adds further depth to our findings. Although, we did not include patients'/clients' perspective into the study, some of our findings touch on dignity in healthcare providers' and students' relationships with them. Had we included the patient voice, we might have gleaned an understanding of how they perceive students' involvement in their care, potentially gaining further insights into how dignified care might be improved. To establish a more comprehensive picture of quality and dignity in work integrated learning, future investigations should include patient/client perspectives (53, 57, 58). The added benefit of an independent qualitative researcher (CK) outside of the university structure (who conducted 29 of the 31 interview sessions), meant that participants were able to discuss their experiences candidly and in complete anonymity. Finally, our team was able to work with several students (Pharmacy and Public Health) who brought fresh eyes and a student perspective to the study (see Acknowledgements).

4.1.1 Educational recommendations

Our research offers a number of suggestions for the promotion of dignity within workplace learning settings. Firstly, given that participants' understandings are wide-ranging and complex, diverging across workplace learning stakeholder groups, we suggest reviewing existing dignity concepts underpinning healthcare workplace learning curricula with a focus on ensuring three characteristics: (1) that it is communicated in a way that emphasizes positive actions, enabling stakeholders to understand, recognize and uphold dignity in workplace learning; (2) that it enables students, educators and sites to recognize, report and manage dignity violations; and (3) that it explicitly addresses any tension between dignity as professionalism

and as equality, offering solutions for all stakeholders to navigate this tension skillfully and appropriately. Importantly, understanding the interdependent nature of self and other dignity is key to this tension. This includes reinforcing with educators that making students feel welcome and safe, integrating them into workplace teams, accommodating to their capabilities, supporting them in their learning and granting them access to learning opportunities and resources, and constructive feedback are essential elements of dignity in workplace learning (46, 47) and duties arising from professionalism at work. Indeed, in terms of feedback, video ethnographic research examining interactional intricacies of feedback sequences has identified a range of strategies that serve to exclude the learner [e.g., overtly direct, very discrete or out of context: 84] whereby students might consider that their learning is being ignored [i.e., the indignity of not being seen: 14]. This research however also identifies a number of interactionally and educationally effective *embedded* strategies for the provision of timely feedback (83). These strategies uphold dignity through face-saving activities within the triadic clinician-student-patient/client encounter by fostering positive student participation, sensitively correcting and minimizing students' errors and developing self-esteem within specifically tailored learning opportunities. Indeed, it has been argued that "unequal power relations can be minimized and an aura of joint 'learning' experiences can be facilitated" though the use of embedded feedback with sensitive correction strategies [(83), p. 519].

We extend the promotion of dignity within workplace learning settings to the co-construction of student learning experiences that benefit all stakeholders: patients, students, service and education providers. Co-designing from a service delivery perspective, with an emphasis on how students can add value to the organization *through* participation (84) has potential to positively impact workplace dignity. In other words, students become a useful resource and in turn feel useful.

While there are no easy solutions, we further suggest providing all workplace learning stakeholders with suitable learning opportunities where they can practice applying the multi-dimensional dignity concept, collaboratively developing and strengthening a culture of dignity in workplace learning across healthcare settings. Through the development of this positive dignity culture, breaches can be reduced across healthcare workplace learning spaces, enabling students, educators and university staff to be equipped with more effective tools to embrace and live a dignified workplace learning culture.

Data availability statement

The datasets presented in this article are not readily available because ethics approval was contingent on data being stored on a secure university repository. We did not obtain permission for data sharing.

Ethics statement

The studies involving humans were approved by The University of Sydney Human Research Ethics Committee (Project ID 2019/841). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

CK: Formal analysis, Investigation, Software, Writing – original draft, Writing – review & editing. AD: Formal Analysis, Investigation, Writing – original draft, Writing – review & editing. AB: Formal analysis, Investigation, Writing – original draft, Writing – review & editing. GN: Formal analysis, Investigation, Writing – original draft, Writing – review & editing. MP: Formal analysis, Investigation, Writing – original draft, Writing – review & editing. LM: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Quality of life and quality of education among physiotherapy students in Europe

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Background: The study of physiotherapy is challenging and can affect the students' well-being and quality of life. The aim of this study was to describe and compare factors that could affect well-being among students across Europe.

Methods: In this descriptive cross-sectional study using an online questionnaire survey, students of bachelor's physiotherapy programs from 23 European faculties, from 8 countries, were interviewed on mental health and stress burden, sleep quality, dietary habits, and physical activity.

Results: Although 75% of students rated their quality of life positively and 47% were satisfied with their mental health, 65% showed higher levels of stress

and 51% described impaired sleep quality. The minimum physical activity of 150 min weekly was described by 79% of students, within which 67% engaged in strengthening twice a week. Students with a higher stress load/worse psychological health also showed worse sleep quality and lower amount of physical activity, women were significantly worse off. In terms of physical activity and sleep quality, students from Finland and Kosovo achieved the best results, while students from Italy, Greece, and Portugal achieved the worst. Students from Italy indicated the greatest dissatisfaction with the organisation of the study system and communication with teachers, while in Kosovo students rated the communication and study organisation the highest. All students had a problem with adhering to nutritional habits. Students from Italy and Spain, with the lowest body mass indexes and weight averages, were closest to the nutrition recommendations.

Conclusion: We demonstrated that physiotherapy students are burdened with stress, suffer from sleep disorders, and do not follow the recommendations regarding nutrition nor physical activity. There are significant differences between universities and countries in some aspects.

KEYWORDS

students, physiotherapy, stress, nutrition, sleep, physical activity

1 Introduction

Physiotherapy education varies worldwide, with some countries offering on-the-job training while others have bachelor's or master's degree programs. There are also differences in postgraduate education across Europe (1). Teaching techniques to future physiotherapists also present challenges due to variations in learning styles and attitudes towards clinical-practical teaching. National universities and their faculties can differ in various ways, and health systems and policies impact rehabilitation and physiotherapy methods, too. There is a limited number of empirical studies comparing the experience of physiotherapy students at different institutions (2–4), highlighting the variations in physiotherapy education worldwide (5, 6). In this study, we focused on the comparison of bachelor's degree programs in physiotherapy in Europe.

During the bachelor's study program, students learn, from a physiotherapeutic point of view, within the framework of complex rehabilitation treatment, to take an anamnesis, establish a differential diagnosis and prognosis (e.g., based on kinesiological analysis, examination of functional disorders of the musculoskeletal system, examination of clinical functions according to standardised and validated tests), design a short-term and long-term therapeutic plan and carry out effective therapy (e.g., treatment of functional disorders of the locomotor system, mobility, spasticity, pain, fatigue, improvement of physical and psychological condition, and quality of life). It is challenging because it requires: (1) extensive study of theoretical knowledge in preclinical and clinical fields of medicine, (2) development of manual, communicative and empathic skills in subjects specialised in acquiring professional expertise, and (3) understanding of scientific work in subjects focused on the preparation of a bachelor's thesis. To sum it up, such education needs good health and mental condition of the students.

Recently, great emphasis has been placed on well-being that encompasses the quality of life and the ability of people and societies to contribute to the world with a sense of meaning and purpose (7). Students' well-being could be influenced by many factors, e.g., physical and mental conditions, educational attainment, occupational status, leisure activities, leisure time, social affiliation, religious security, physical security or personal autonomy (8), university access, rigorous curricula, clinical practice obligations, financial pressures (9, 10), sleep patterns, diet, and physical activity (11), the impact of the pandemic or university background and study conditions (12). There were some studies presented by colleagues (13–15) that dealt with students' quality of life. However, these were mixed student populations or students from only one country.

That is why we carried out this descriptive cross-sectional study using an online questionnaire survey with the aim to describe and compare the current educational systems and physical and mental well-being of physiotherapy students in Europe. Physical and mental well-being were divided into the following subcategories: mental health and associated stress levels (2, 4, 16, 17), sleep quality and patterns (18, 19), dietary habits (20, 21), and physical activity levels (22, 23). These subcategories were analysed in relation to each other, highlighting their interconnectedness and importance within the broader framework of the quality of life (24–27).

2 Method

2.1 Description of the project

The overall project consisted of two phases. In the first phase, carried out in 2021, two survey questionnaires were developed. The first questionnaire aimed to systematically describe organisational

aspects of physiotherapy faculties by their representatives. The second questionnaire focused on describing the physiotherapy students' well-being. Moreover, a list of potential participating universities was prepared and the approvals of the ethics committees of participating faculties were obtained. In the second phase, carried out between February and December 2022, the data were collected.

2.2 Study design

A descriptive, cross-sectional online survey, using self-administered online questionnaires.

2.3 The survey questionnaire

The lead author (MS) developed an initial draft of the questionnaire that was agreed upon in five rounds of core group (MS, KŘ, MP, MA, JJ, JR) email communication. It was piloted with 60 students from three European universities in 2021. Based on pre-analyses, the core group agreed on the final questionnaire items and wording. Then, the internet version using the SURVIO.cz portal was developed.

2.3.1 The questionnaire for guarantors

The questionnaire for guarantors comprised 16 questions concerning organisational aspects of participating universities' programs: how many students undergo the bachelor program, what type of study program is offered (bachelor, master, doctoral), how many semesters students' study to reach bachelor's degree, what is the form of study (present, distant or combined), should students pay for the study, whether there is a possibility to reach scholarships, etc.

2.3.2 The questionnaire for students

The questionnaire for physiotherapy students consisted of 87 questions divided into three parts (Supplement 1).

The first part collected background information, such as gender, age, weight and height, university and semester of study, and subjective level of English.

The second part focused on the students' quality of life, covering:

2.3.2.1 Stress and mental health

These were analysed using the Undergraduate Sources of Stress questionnaire, USOS and the World Health Organization Quality of Life Questionnaire – short version, WHOQOL-BREF. USOS is a questionnaire specifically aimed at evaluating the degree of stress load among university students, evaluating 3 categories of potential stressors (academic, financial, and personal). The maximum number of points could be 72, which would be interpreted as maximally stressful.

Six questions were selected from the WHOQOL-BREF questionnaire assessing various aspects of quality of life, including overall life quality, mental health satisfaction, enjoyment of life, perception of life meaning, self-satisfaction, and sense of control. The maximum number of points could be 24, which would be interpreted as the worst subjective perception of quality of life.

2.3.2.2 Sleep quality

It was analysed based on the Pittsburgh Sleep Quality Index (28) and questions combining WHOQOL-BREF and the study (18). Pittsburgh Sleep Quality Index, PSQI, measures several different aspects of sleep as sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The maximum number of points could be 21, which would be interpreted as the worst quality of sleep. Impaired sleep quality is indicated by a score of 5 or more (29).

2.3.2.3 Dietary habits

We were interested in sufficient intake of fluids, fruit, vegetables, and alcohol intake per day (questions were formulated based on WHO recommendations (30, 31)). Nutritional habits were reflected in body weight, and therefore we assessed Body Mass Index (BMI). Moreover, the importance and satisfaction with current nutrition education were questioned.

2.3.2.4 Physical activity

Questions concerning physical activity were formulated based on the International Physical Activity Questionnaire – Short Form and the Food & Physical Activity Questionnaire (32) (in terms of the amount and duration of strengthening and relaxation/meditation exercises and the number of steps) and quantified using METs recommended by WHO (33). WHO recommends at least 150–300 min of moderate-intensity aerobic physical activity or at least 75–150 min of vigorous-intensity aerobic physical activity.

2.3.2.5 Employment

The third part was devoted to the satisfaction with the university background and study conditions.

2.4 Recruitment process

A total of 45 European universities were identified by the core team. Of these, representatives from 30 faculties confirmed their participation. They were regularly contacted every month to optimise the survey response rate. Seven of the faculties were excluded because they did not provide sufficient responses (0–1 response from students). Finally, 23 faculties from 20 universities from 8 countries participated. Representatives from each faculty co-ordinated the data collection individually – it was recommended to organise a lecture explaining the importance to participate and advertise to fill the questionnaire regularly.

2.5 Inclusion criteria

The first questionnaire was filled out by specialists in physiotherapy (guarantors of the study programmes or teachers at universities, who knew general information about the university and physiotherapy study programmes).

The criteria for respondents of the second questionnaire were: (a) a full-time student of physiotherapy, in the bachelor's study program, in the academic year 2021/2022 or 2022/2023; (b) demonstrating sufficient English language proficiency to comprehend the survey questions.

2.6 Data analysis

The data from the first questionnaire was processed to create an overview presented in Table 1. The data from the second questionnaire were analysed for the whole sample as well as

TABLE 1 Participating countries and universities, basic characteristics.

Country	Faculty, University, Town	Higher study levels		BSc. study program		Financial aspects		Number of students		
		MSc.	PhD.	Semesters	Form	Student fees	Scholarship available	Replied	Total number of PT students/ addressed	Response rate
Czech republic	2nd Medical Faculty, Charles University, Prague	✓	✓	6	Present	×	✓	25	60	41.7%
	3rd Medical Faculty, Charles University, Prague	×	✓	6	Present	×	✓	67	88	76.1%
	Faculty of Physical Education and Sport, Charles University, Prague	✓	×	6	Present	×	✓	12	150	8.0%
	Faculty of Physical Culture, Palacký University Olomouc	✓	×	6	Present	×	✓	51	93	54.8%
	Faculty of Biomedical Engineering, Czech Technical University in Kladno	✓	×	6	Present	×	✓	47	102	46.1%
Finland	Savonia University of Applied Sciences, Kuopio	×	×	7	Present	×	×	59	141	41.8%
	Satakunta University of Applied Sciences, Satakunta	×	×	7	Present	×	×	13	75	17.3%
	Tampere University of Applied Sciences, Tampere	×	×	7	Present	×	×	13	120	10.8%
	Oulu University of Applied Sciences, Oulu	×	×	7	Present	×	×	10	NA	–
Greece	University of Peloponnese	×	✓	8	Present	×	×	134	336	39.9%
	University of West Attica	✓	✓	6	Present	×	×	198	NA	–
	University of Thessaly	✓	✓	8	Present	×	×	46	465	9.9%
	University of Patras	✓	✓	8	Present	×	×	119	460	25.9%
Italy	University of Milan	✓	×	6	Present	✓	×	7	83	8.4%
	University of Sassari	×	×	6	Present	✓	✓	11	NA	–
Kosovo	Universum College, Pristina	×	×	6	Present	✓	✓	22	NA	–
Portugal	Politécnico de Leiria, Leiria	×	×	8	Present	✓	×	114	221	51.6%
Slovakia	Pavol Jozef Šafárik University in Košice	✓	✓	6	Combined	×	✓	18	45	40.0%
	University of Ss. Cyril and Methodius in Trnava	×	✓	6	Combined	✓	✓	36	510	7.1%
	Slovak Medical University in Bratislava	✓	×	6	Combined	×	×	41	70	58.6%
Spain	University of Salamanca, Salamanca	×	✓	8	Present	✓	✓	16	195	8.2%
	University of Valencia, Valencia	✓	✓	8	Present	✓	✓	25	NA	–
Total								1,084	3,214*	33.7%*

NA, not available (not provided by the university). *Total number includes available information only. Real response rate may be thus slightly lower.

separately for each of the countries. In this article, only the data comparing individual countries are presented; data in individual universities are mentioned only if notable differences occurred.

Continuous variables were summarised using the mean with standard deviation (SD) and/or the median with interquartile range (IQR). Absolute and/or relative frequencies were used to summarise categorical variables. Differences between groups (women vs. men, countries) were compared using χ^2-test in the case of categorical variables or the *t*-test/ANOVA *F*-test in the case of continuous variables. Pearson's correlation coefficient (*r*) was used to assess the relationship between various continuous or five-level ordered variables concerning stress and sleep quality. Similarly, χ^2-test was used to assess relationship between categorical variables. The level of statistical significance was set at the 0.05 level. The statistical environment and language used for analysing was R, version 4.0.2 (23).

3 Results

3.1 Organisation of physiotherapy studies across Europe

Management of 23 European faculties was described. Apart from bachelor's study program, 12 faculties offer also master and 11 faculties doctoral programs. Finnish universities offer a 7-semester undergraduate degree programme, while Greek, Portugal and Spanish an 8-semester. The remaining universities follow the standard 6-semester format. The largest universities by student enrolment are the University of Trnava in Slovakia (having a total of 510 students across all 3 years) and the University of Patras in Greece (having 460–540 students in all years). The smallest university is the University of Košice in Slovakia, with only 45 students for all three years. A combined form of study is available exclusively at universities in Slovakia. Tuition fees are required at six universities (Kosovo,

TABLE 2 Demographic and baseline characteristics of participants.

Country	Number	Gender (%)		Age [years] mean (SD)	Weight [kg] mean (SD)	Height [cm] mean (SD)	BMI mean (SD)
		Female	Male				
Czech Republic	202	80.2%	19.8%	21.3 (2.1)	66.7 (12.6)	171.8 (9)	22.5 (3.2)
Finland	95	76.3%	23.7%	25.7 (6.3)	69.6 (13.6)	169 (8.3)	24.3 (3.9)
Greece	492	57.3%	42.7%	21.3 (4.7)	68.7 (13.6)	171.8 (9.6)	23.2 (3.6)
Italy	16	56.2%	43.8%	23.6 (4.4)	62.7 (13)	170.2 (10.3)	21.4 (2.7)
Kosovo	22	63.6%	36.4%	19.8 (1.3)	70.5 (14.3)	173.6 (9.2)	23.2 (3.1)
Portugal	114	71.9%	28.1%	21.4 (4.1)	63.9 (11.6)	165.8 (8.4)	23.2 (3.5)
Slovakia	93	78.5%	21.5%	23.3 (5.8)	66.6 (16)	170.4 (9.5)	22.9 (5.1)
Spain	41	82.9%	17.1%	20.6 (2.5)	62.9 (10.2)	167.6 (7.4)	22.3 (2.7)
TOTAL	1,075	67.8%	32.2%	21.8 (4.6)	67.5 (13.4)	170.6 (9.4)	23.1 (3.7)

TABLE 3 Summary of stress, sleep, nutrition, physical activity, and employment across countries.

Country	USOS [range 0–72]	WHOQOL-BREF [range 0–24]	PSQI scores [range 0–21]	PSQI 5+	Liquid intakes [at least 1.5 L/day]	Alcohol intakes [at least 1 drink/week]	Physical activity [METs min/week]	HEPA	Paid employment
	Mean (SD)	Mean (SD)	Mean (SD)	%	%	%	Mean (SD)	%	%
Czech Republic	25.9 (8.9)	8.9 (3.9)	6.2 (3.0)	68%	73%	75%	2,118 (1439)	31%	49%
Finland	21.5 (8.7)	7.5 (4.1)	5.4 (2.6)	55%	75%	58%	2,152 (1362)	41%	41%
Greece	28.0 (11)	8.7 (4.1)	7.0 (3.4)	75%	73%	71%	1821 (1413)	29%	26%
Italy	31.8 (8.3)	10.7 (5.1)	6.1 (2.6)	69%	81%	81%	1791 (1180)	31%	25%
Kosovo	23.4 (13.6)	5.6 (4.5)	6.7 (3.6)	64%	86%	23%	1,668 (1603)	27%	41%
Portugal	29.9 (11.4)	8.6 (4.0)	6.9 (3.0)	75%	54%	55%	1,446 (1615)	23%	16%
Slovakia	25.2 (9.6)	7.5 (4.0)	6.4 (3.2)	69%	76%	58%	1994 (1519)	31%	58%
Spain	28.5 (10.0)	8.0 (3.3)	6.0 (3.0)	63%	68%	66%	2,160 (1446)	39%	17%
total	27.0 (10.6)	8.5 (4.1)	6.6 (3.2)	70.9%	71.5%	66.8%	1891 (1458)	30.5%	33.4%
Comparison between countries	$p < 0.001$*	$p < 0.001$*	$p < 0.001$*	$p = 0.004^{\#}$	$p = 0.003^{\#}$	$p < 0.001^{\#}$	$p = 0.002$*	$p < 0.001^{\#}$	$p < 0.001^{\#}$

*Differences between countries assessed using *F*-test in ANOVA model. #Differences between countries assessed using Pearson's χ^2-test.

Salamanca, Trnava, Milan, Sassari and Leiria) with considerable variation both between and within institutions (Table 1).

3.2 Well-being of physiotherapy students

Out of the 3,214 students who were contacted by representatives from each participating universities, 1,084 responded, resulting in a response rate of 33.7%. Nine of them were students of the master program, so they were excluded. Data from 1,075 students were analysed. 67.8% of respondents were women with an average age 21.8 ± 4.6 years (the youngest students are from Kosovo, while the oldest from Finland) (Table 2).

3.2.1 Stress and mental health

On average, the students achieved a score of 27.0 ± 10.6 points on the USOS questionnaire, with statistically significantly higher scores recorded by women compared to men (27.7 vs. 25.6, $p = 0.005$). Furthermore, 56.6% of the students referred to were experiencing high levels of distress. It is worthy to note that this condition was observed more often amongst women ($p = 0.01$) and those from Italy (94%, $p < 0.001$), but less frequently in students from Finland. Although over 50% of the students reported high stress levels, 75.3% objectively evaluated their quality of life as "good" or "very good", and 47% reported being "satisfied" or "very satisfied" with their mental state (Table 3).

Only 37.5% of students used physical exercise as a means of coping with high levels of stress, with a higher incidence among men compared to women (47.4% versus 32.7%), while only 5% of students practised yoga, breathing exercises, or meditation as a coping strategy, with a higher incidence among women (10.9% versus 8.4%). Other coping mechanisms included spending time with family or friends (17.7% of students), spending time in solitude (16.7%), and going for walks (10.3%). Only two students reported seeking professional help from a psychologist or psychotherapist. Three students mentioned smoking and drinking alcohol as coping mechanisms, while the

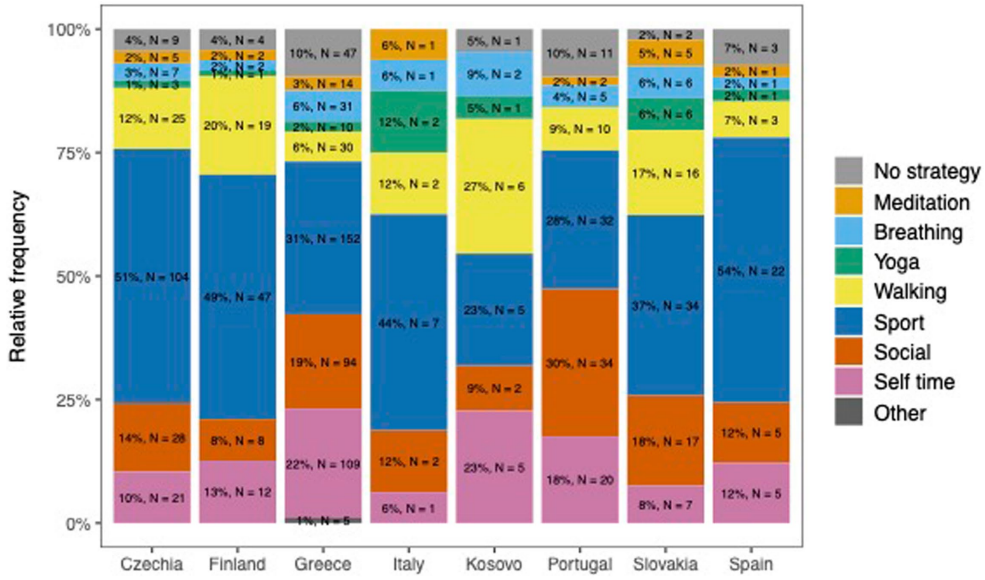

FIGURE 1
Students coping strategies among states.

majority did not use any specific strategy. Significant findings indicate that compared to other countries, students in Kosovo do not use physical activity as an important coping strategy ($p < 0.001$), but they do use walking and spending time alone. Italy had the highest usage of yoga as a coping strategy, while Portugal and Greece had the highest number of students reporting no coping mechanisms (Figure 1).

3.2.2 Sleep quality

A total of 44.9% of students reported that they sleep 7 or more hours per night, with 51.2% rating the quality of their sleep as "good" or "very good". The mean PSQI score was 6.6 ± 3.2 points. Furthermore, 70.9% of the students scored more than 5 points (5+). The gender differences were not significant. Finnish students significantly revealed the best sleep quality, while students from Greece and Portugal the lowest (Table 3). Additionally, 13.2% of students admit taking sleeping pills. 50.3% of all students experience daytime tiredness at least 3 times a week. Meanwhile, 19.7% of students (women significantly more frequently) mention concentration difficulties, and 16.2% claim a lack of energy.

Significant differences between countries were found for fatigue ($p = 0.001$), concentration problems ($p = 0.007$), and lack of energy ($p < 0.001$). Students from Kosovo seem to suffer the least concentration problems (5%), whilst displaying the highest energy levels (45%). Conversely, Italian students reported the highest incidence of concentration problems (25%) and lack of energy (25%).

PSQI score significantly correlates with USOS score ($r = 0.39$, $p < 0.001$), with no significant differences by gender or country. Moreover, a strong positive correlation between concentration problems and the lack of energy ($r = 0.44$, $p < 0.001$), as well as between the lack of energy and fatigue ($r = 0.47$, $p < 0.001$); concentration problems and fatigue ($r = 0.29$, $p < 0.001$); and PSQI scores and fatigue ($r = 0.34$, $p < 0.001$) were confirmed, regardless of gender, country, or university.

3.2.3 Dietary habits

In total, 71.5% of students comply with the recommendation of consumption of at least 1.5 L of water/day (34), men significantly more often than women (84% vs. 66%; $p < 0.001$). Water drinking significantly ($p = 0.003$) differs between countries: students from Portugal consumed less (54%), on the contrary students from Kosovo (86%) significantly more often meet the minimum of 1.5 litters of water/day.

The recommended amount (at least 2 or more) of servings of fruit per day were consumed on average by 31.8% of students (33% of women vs. 30% of men). Students from Spain (71%) and Italy (50%) eat significantly ($p = 0.001$) more fruit than students from Greece or Slovakia (22%). Three or more portions of vegetables per day were consumed by only 14.4% students (16% of women vs. 11% of men), the most by Italian and Spanish students (31 and 29%) and the least students from Kosovo (9%).

A positive correlation between BMI and fruit and vegetable intake was statistically significant. Surprisingly, 43% of obese students consumed 2 or more servings of fruit per day, compared to only 31% of students with a normal BMI. Similarly, the consumption of 3 or more servings of vegetables per day was consumed by 30% of obese vs. 13% of students with a normal BMI.

A third of students claimed that they do not consume alcohol (33.2%), of the remaining most students consume less than 3 drinks (44.5%) per week. Men consume significantly more drinks per week than women ($p = 0.028$). Significantly more students from Kosovo do not consume any alcohol (77%; 17; $p < 0.001$). In contrast, most students consuming one or more drinks/week are from Italy (82%; 13).

The education in the field of nutrition is considered important by 97.2% (1,045) of students. However, they evaluate its quality rather negatively on average (−0.44 points on −2 to +2 scale, SD 1.94). Only 19% (204) of students do not see any problem in nutrition education at their school. For 34.5% of students, both the quality and quantity of

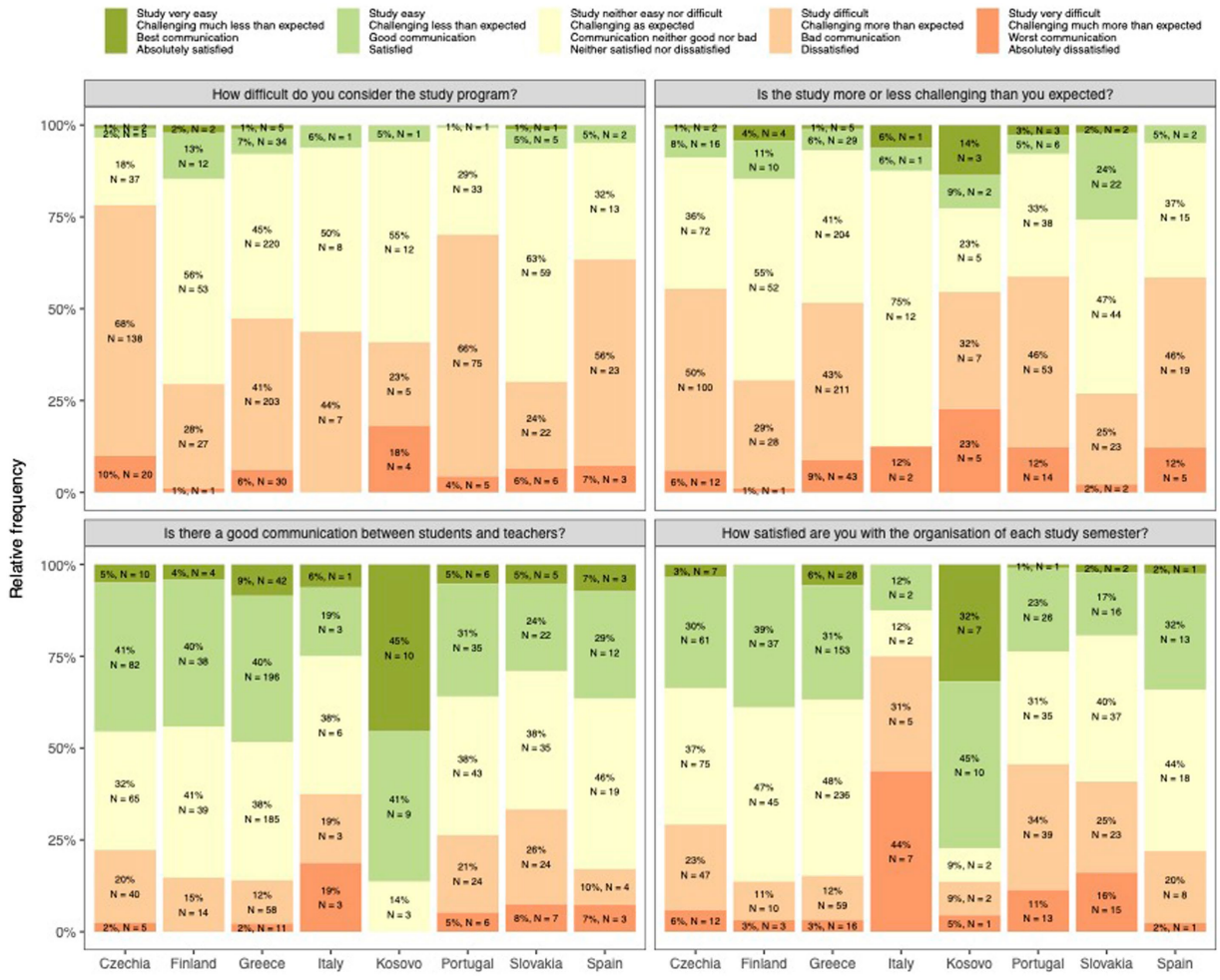

FIGURE 2
Summary of students satisfaction with study programme.

the education they receive is insufficient, while for 21.1% only quality and for 22.9% only quantity is insufficient.

3.2.4 Physical activity

On average, students reported 1,891 ± 1,458 METs-min/week based on IPAQ (vigorous, moderate, and walking). It means that only 30.5% reached the recommended level of health enhancing physical activity (HEPA), moreover 16.1% were classified as "inactive", even though 96.7% of students believed that physical activity affected their mental health. Men were significantly more active and classified as HEPA than women (2,107 ± 1,522 METs-min/week; vs. 1,782 ± 1,414 METs-min/week, $p < 0.001$). The highest rate of inactivity was found in Portuguese students (39%) and the lowest in the Czech Republic (8%). Conversely, the most active (HEPA category) students were found in Finland (41%), but none of the students at the University of Oulu met the HEPA.

Contrary to WHO recommendation, only 26% of students met 150+ min/week of moderate physical activity, and only 8% met more than 300 min/week. The150 min threshold for moderate activity and walking (combined) was met by 78.9% of students, and over 300 min by 51%. About 47% of students met 75 min/week of vigorous activity, with 29% reaching 150+ min/week. A total of 67% of students did strengthening exercises 2 or more times a week (Table 3).

Higher physical activity (METs-min/week) was associated with better quality of life (USOS score) ($r = -0.19$, $p < 0.001$) in men. Increasing the amount of METs-min/week had a significant effect on WHOQOL-BREF ($r = -0.1$, $p < 0.001$) and psychological health ($r = -0.1$, $p < 0.001$) in men.

3.2.5 Paid employment

A third (33.4%) of students, regardless of gender, have paid employment (on average 4.6 ± 8.0 h per week), 40.1% of them work in their field of study. Significant differences were found between countries ($p < 0.001$). The largest number of students work at Slovak universities (58%), the least in Portugal (16%), and Spain (17%). No relationship between time spent at work and quality of life (USOS) was found.

3.2.6 University background and study conditions

Students' assessment of their studies is exactly in line with their expectations (average 0, maximum −2/+2). They are neither satisfied nor dissatisfied with the communication with teachers and the organisation of the study programme. There were no gender differences ($p > 0.05$). However, students differed between countries in all four aspects ($p < 0.001$, Figure 2).

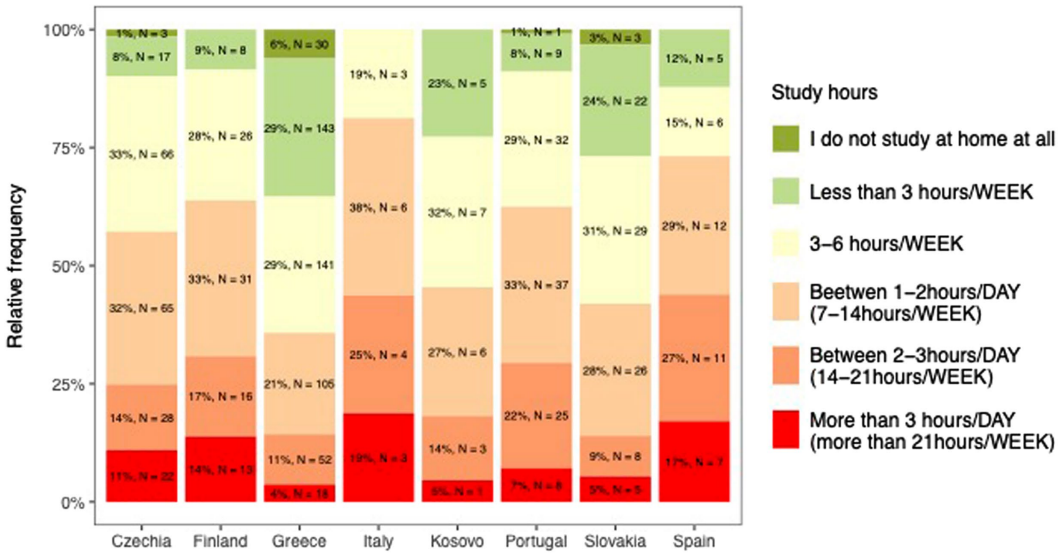

FIGURE 3
Amount of study hours among students.

Students from the Czech Republic, Portugal, and Spain found studying more difficult than other students. Students from the Czech Republic, Greece, Kosovo, Portugal, and Spain found studying more challenging. Students from Kosovo significantly reported the best communication and study organisation and were most satisfied with the materials provided ($p < 0.001$, Figure 2). Students from Italy reported the worst communication, organisation and inadequate materials provided (in the latter case together with Slovak students). Students for whom studying is more difficult than they expected also showed higher USOS scores ($p < 0.001$ and $r = 0.22$), more so for men ($r = 0.31$ vs. $r = 0.15$).

Overall, 11% considered the information received during lessons sufficient to pass the exam without studying external materials, while 48.1% must study from external materials received from teachers and even 32.2% must find external materials independently. Only 8.5% felt that there was not enough information for their exam.

On average, students' study 8.6 ± 6.0 h per week, with women studying significantly more (9 ± 6.1 h vs. 7.9 ± 5.9, $p = 0.004$). Only 3.5% of students do not study at home at all, 19.6% study less than 3 h/week, 29% study 3–6 h/week, 27% study 1–2 h/day, 13.8% study 2–3 h/day and 7.2% study more than 3 h/day. Men study significantly less at home and if they do, they study less than 3 h/day. Italian students study significantly the most (Figure 3), while students from Greece and Slovakia study the least ($p < 0.001$). Those who spend more time studying also report that their studies are more demanding than they expected ($p < 0.001$ and $r = 0.1$). No association was found between the number of study hours and stress levels (USOS questionnaire, $p = 0.87$), sleep quality (PSQI, $p = 0.42$) or physical activity (METs r, $p = 0.32$).

4 Discussion

4.1 Stress and mental health

Although most of the students in this study are satisfied with their mental health, 21.5% perceive it as neutral to poor (WHOQOL-BREF) and even 65.6% show higher levels of distress (USOS). It is in accordance with findings in medical students (17), students of social and health sciences (35), and students of physiotherapy and dentistry (36).

Our work and the previous studies (2, 4, 16, 37–40) suggest differences in levels of stress and quality of mental health, with women generally more vulnerable, although one study reported no relationship between stress and gender (41). The most stressful are academic factors (2, 3, 16, 38, 42) such as the amount of material students must learn, the overall stress load at school, the "vastness" of the school curriculum and frequent tests (43). Our students also showed an association between higher levels of stress and subjective quality of life, as did the review (44).

4.2 Sleep quality

Sleep problems were reported by 70.5% of our students, aligning with findings in previous studies (24, 25, 27, 45–47). However, this contrasts with results from studies (19, 48, 49) that did not utilize the PSQI. Notably, while sleep problems are more frequently reported by women in some studies (19, 46), this trend was not observed in our study.

A total of 45% of our students sleep the recommended number of hours (more than 7), which is a lower percentage than in study (25) which indicates 64.8%, and higher than in authors (24) who reported only 20% (50, 51). In our case, 13.2% of students take sleep medication, mostly less than once a week. It is a higher percentage in comparison to other studies that indicate its use in 9–10% (25, 48) or only 6–4% (47, 49).

Our work confirmed relationship between the quality of sleep (PSQI) and the degree of perceived stress (USOS), similarly to studies (27, 52, 53); as well as between PSQI and quality of life, similarly to authors (8, 44, 47).

4.3 Dietary habits

Nutrition plays a crucial role in maintaining good health and preventing chronic diseases (54). However, studies show that many students in health professions do not follow dietary recommendations, putting themselves at risk of disease.

Our students did not meet the recommendations in consuming the recommended amount of liquids, fruit, and vegetables. From this point of view, they had a worse quality of diet on average, other studies showed the same result (45, 55, 56).

A total of 44.5% of students in our study consume alcohol less than three times a week, 22.3% consume three or more drinks a week. In a study of Hungarian university students, 35.4% of students consumed one drink per week, and students who consumed 3–7 drinks (10%) consumed them mostly at one time (57).

In our case, 97% of students believe that education in the field of nutrition is important, the same result we can find in (58), where 92% of students think this, and in their case, 30% of respondents consider current education in the field of nutrition as sufficient, in our case this is shared by 21.5% of students, the rest are dissatisfied with the quality and/or quantity of education in nutrition. It is crucial for future health professionals to be well-versed in nutrition, however the results are unsatisfactory and do not show any particular healthy lifestyle of these students (21, 55).

4.4 Physical activity

Surprisingly, our expectation that students of physiotherapy are more active than is recommended by WHO (1,200–3,000 METs-min/week) was not confirmed. On the other hand, they are in accordance with these recommendations, similarly to previous studies (18, 59).

If we consider the question whether students meet the recommended level of health enhancing physical activity (HEPA) by the IPAQ score, only 30.5% met the level, similarly to authors (60). On the other hand, our students are more active than in studies (18, 61), where only 16–20% of highly active students are found, and in study (62) where, similarly to our study, only 16% of them are inactive.

The relationship between good mental health/lower stress and higher physical activity has been confirmed by our as well as other studies (26, 63, 64). In our case, the relationship between (1) USOS/physical activity and (2) subjective assessment of mental health/physical activity in men was confirmed. No association was found between PSQI and physical activity, which only adds to the confusion about the association between the two categories (65).

4.5 University background and study conditions

Universities offer great access to information and knowledge, teach how to study, acquaint students with the social reality, show different perspectives of the present society and culture, and allow the possibility to discuss serious issues and their social repercussions (66). On the other hand, universities can be a source of stress caused by academic obligations and constant assessment both by teachers and by students themselves.

Our study confirmed that each university has different conditions and offers different support (or it may be perceived differently by students), which can be reflected in the level of stress perception. We were surprised that students from Kosovo have the best perception of their university, which we explain by the fact that in the context of war they perceive everything more positively. The most dissatisfied students are from Italy and Slovakia.

5 Conclusion to discussion

In line with other studies, students in this study suffered from (1) higher stress levels (17, 35, 36, 43), with women being more susceptible (2, 4, 16, 38–40), (2) sleep problems (24, 25, 27, 45–47) that were not related to gender, which is in contrast to some studies (19, 48, 49), (3) poor dietary habits (45, 46, 56), and (4) met WHO recommendations for physical activity of 1,200–3,000 METs-min/week (18, 59) but only 30.5% were in compliance with health-enhancing physical activity (HEPA) (18, 61). Academic factors were the most stressful (2, 3, 42, 43). Stress, as in review (44), and quality of sleep, as in studies (8, 44, 47), was associated with subjective assessment of quality of life. An association between physical activity and sleep quality was found, contrary to studies (65). Almost all students (97%) thought that nutrition education was important but not sufficient (58). For more detailed results see Table 4.

5.1 Limitations

The inhomogeneous distribution of students within universities and countries is the main limitation of the study. Some faculties obtained a very small sample of students, which can significantly distort the results of the study. In addition, in the first place, the timing of the data collection was not planned to coincide with the transition between two semesters and two academic years. However, some universities did not manage to obtain the necessary permissions from the ethics commission, or they did not manage to organise the data collection before the start of the summer examination period, and thus the data collection was extended into the winter semester. This is a reason why differences between semesters were not included in the analysis, although this was the primary intention. Also, the English in which the questionnaires were written may have limited some students from participating. As well as language, the length of the questionnaire could affect the response rate, as it took approximately half an hour to complete.

Differences in COVID restrictions between countries and institutions during the pandemics may have influenced the results. This issue was not specifically addressed in the questionnaire since the data were collected after the acute phase of COVID pandemic and the involved countries no longer had any specific restrictions on physical presence in the classroom. It is true that the previous different effects of COVID-related in the various countries may have influenced students' attitudes. Nevertheless, we consider the study a success given its important information on health-related quality of life in physiotherapy students over a large number of countries.

TABLE 4 Comparison with other studies results.

Authors	Year	Participants	Results
Wassif et al.	2019	390 medical students, all years	66.1% of students reported higher stress levels
Aslan et al.	2020	358 social and health science students from 14 universities	71% of students reported higher level of perceived stress, 52% presented anxiety symptoms and 62% depression symptoms
Owczarek et al.	2020	105 physiotherapy and dentistry students	Mean results in both groups indicated a high level of perceived stress in both groups
Tucker et al.	2006	434 physiotherapy students	Female students reported higher academic stress than male, academic factors were the most stressful
Hodselmans et al.	2018	116 physiotherapy students	Female students were more vulnerable to stress
Moutinho et al.	2017	761 medical students	47.1% of students reported stress symptoms, women were more vulnerable to stress
Eller et al.	2006	413 medical students	21.9% of students reported anxiety symptoms, 30.6% reported depression symptoms – both higher in females
Volken et al.	2021	3,571 students +2,328 swiss national population	Female students had higher prevalence of depressive symptoms, than matching female population
Pacheco et al.	2017	Meta-analysis of 59 studies (on medical students)	Female gender was significantly associated with depression, anxiety and stress
Cetinkaya et al.	2022	219 nursing students	Female students reported higher anxiety scale scores
Akgun et al.	2003	141 university students	No relationship found between stress and gender
Jacob et al.	2013	312 physiotherapy, communication disorder and nutrition sciences students	Academic factors were the most stressful, perceived stress correlated with grading stress factors
Lavoie-Tremblay et al.	2022	26 nursing students	Academic sources of stress were the most stressful
Ghrouz et al.	2019	617 college students	30% of students reported anxiety and 18% depression 51% reported low physical levels, 51% poor sleep quality, correlation between higher physical activity and lower anxiety and depression was found. Poor quality was significantly positively associated with anxiety and depression
Chowdhury et al.	2017	460 university students	46.3% of students reported higher stress levels, most stressful were academic factors (vastness of the school curriculum and frequent tests)
Ribeiro et al.	2018	Review	Found association between higher levels of stress and subjective QoL, connection found between PSQI and QoL
Pagnin et al.	2014	127 medical students	65% of students reported sleeping problems, only 20% of students slept 7+ hours/day
Džaferović et al.	2023	125 medical students	75.8% of students suffered from poor sleep quality, 64.8% of students slept more than 7 h, 10.4% of students used sleep medication
Carpi et al.	2022	1,279 university students	65% of students reported poor sleep quality
Rafidah et al.	2009	141 technology university students	Students reported sleeping problems, bad quality of diet
Sk et al.	2017	576 medical students	70.4% of students reported sleeping problems (more in female)
Preišegolavičiūtė et al.	2010	450 medical, law, business and economy students	59.4% of students reported sleeping problems (more in female), 5.9% used sleeping medication, connection between QoL and quality of sleep was found
Rathi et al.	2018	166 university students	Only 32.5% of students reported sleeping problems, poor sleep was more frequent among females
Corrêa et al.	2017	450 medical students	Only 39.5% of students reported sleeping problems, 8.6% used sleep medications
Zailinawati et al.	2009	555 medical students	Only 16.1% of students reported bad sleep quality, 3.9% used sleeping medication
Taylor et al.	2013	1,074 college students	Connection between worse quality of sleep and higher reported stress was found
Alyoubi et al.	2021	582 university students	Higher level of insomnia was associated with higher levels of stress
Ramón-Arbués et al.	2022	868 university students	Higher satisfaction with sleep and diet quality were associated with higher QoL
Bernal-Orozco et al.	2020	276 medical, nutrition and dentistry	Students reported poor quality of diet
Hilger et al.	2017	689 university students	Students reported poor quality of diet
Breitenbach et al.	2016	5,174 university students	35.4% of students consumed one alcoholic drink/week

(Continued)

TABLE 4 (Continued)

Authors	Year	Participants	Results
Mogre et al.	2018	207 medical students	Education in nutrition is important for 92% of students, 70% of theme were dissatisfied with their education
Szypowska et al.	2020	165 cosmetology and physiotherapy students	Students reported poor quality of diet
Ranasinghe et al.	2018	115 physiotherapy students	Only 16% of students were HEPA and 48.7% were inactive
Rodríguez-Larrad et al.	2021	13,756 university students	Students are in accordance with WHO recommendations to 1,200–3,000 METS-min/week
Kgokong et al.	2020	296 physiotherapy students	Only 37.5% of students engaged in high physical activity
Zalewska et al.	2021	141 physiotherapy students	Only 19.9% of students fulfilled HEPA, and 40.4% had low physical activity, more physical activity had positive effect on mental health
Dąbrowska-Galas	2021	308 medical students	Only 19% of students were inactive
Kowalska et al.	2021	110 physiotherapy students	Relationship between good mental health/lower stress and higher physical activity has been confirmed
Chew et al.	2019	633 medical students	For 94.8% of students' physical activity can lead to preventing diseases and to 70.9% it can treat diseases
Pacheco Salles et al.	2022	218 physiotherapy students	Relationship between good mental health/lower stress and higher physical activity has been confirmed
Memon et al.	2021	Meta-analysis of 29 studies	No connection between physical activity and quality of sleep

6 Conclusion

In this study, we demonstrated that physiotherapy students, whose future profession requires good physical condition, are burdened with stress, and suffer from sleep disorders. Although they are educated in the field focused on the deterioration of health, they do not follow the recommendations regarding nutrition. Although the emphasis of their education is focused on physical fitness and quality of movement, their own physical activity is sometimes insufficient.

Further, there are significant differences in experienced stress, subjective assessment of mental health, quality of sleep, dietary habits, and amount of physical activity between universities. It would be advisable to take an example from universities that offer study conditions that students perceive as comfortable, and therefore prepare them well for their profession.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethic Committee, Charles University, Third Medical Faculty, Ruská 87, Praha 10, 100 00. The studies were conducted in accordance with the local legislation and institutional requirements. The ethics committee/institutional review board waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because the study was an online questionnaire that was distributed via online link and before starting to fill in the questionnaire, the students agreed that the provided data will be used for analytical processing.

Author contributions

MS: Conceptualization, Investigation, Methodology, Project administration, Writing – original draft. KŘ: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. JJ: Investigation, Methodology, Writing – original draft, Writing – review & editing. MP: Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. JR: Investigation, Methodology, Writing – original draft, Writing – review & editing. MÄ: Investigation, Methodology, Writing – original draft, Writing – review & editing. MŠ: Investigation, Writing – review & editing. AK: Investigation, Writing – review & editing. EŽ: Investigation, Writing – review & editing. TK: Investigation, Writing – review & editing. DP: Investigation, Writing – review & editing. BB-G: Investigation, Writing – review & editing. DB: Investigation, Writing – review & editing. EB: Investigation, Writing – review & editing. PG: Investigation, Writing – review & editing. JA-G: Investigation, Writing – review & editing. NS: Investigation, Writing – review & editing. AP: Investigation, Writing – review & editing. MK-Y: Investigation, Writing – review & editing. M-LL: Investigation, Writing – review & editing. JK: Investigation, Writing – review & editing. GB: Investigation, Writing – review & editing. MH: Investigation, Writing – review & editing. AA: Investigation, Writing – review & editing. SC-A: Investigation, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2024.1344028/full#supplementary-material

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One decade of "English as a medium of instruction" (EMI) in healthcare education

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Introduction: This paper analyzes published healthcare studies about "English as a medium of instruction" (EMI), indexed in the Scopus database from 2013 to 2022.

Methods: The author used published criteria of systematic reviews and limited the findings to healthcare education using several key terms; this returned 137 articles. The author then downloaded and carefully read the articles. The majority of articles (102) were deleted because they did not meet the selection criteria discussed in the methods section, thus the final list comprised 35 research studies. Next, the author analyzed the articles' bibliometric indexes, such as author, funding information, context, research instruments, years of publication, place of publication, and citations. In addition, the key findings and recommendations of these studies were presented.

Results and discussion: Most of the studies assessed were conducted in the last five years in Arabic speaking countries by non-language specialists, and the language of instruction was not the main focus of the studies. The studies were most often about attitudes of students, and used quantitative methods such as questionnaires. The results show diverse and conflicted results such as positive impacts and positive attitudes in some cases, negative impacts and attitudes in others, and preferences for either monolingual or bilingual approaches. The findings demonstrate the need for experimental and rigorous mixed methods studies that involve different stakeholders and are conducted by both applied linguists and healthcare education specialists. Future research should move beyond student attitudes and utilize rigorous mixed methods involving researchers from both linguistics and healthcare education to deepen our understanding of EMI's complex impact in diverse contexts.

KEYWORDS

healthcare education, English as a medium of instruction (EMI), medical education, language of instruction, higher education

Introduction

The English as a medium of instruction (EMI) policy has dominated healthcare education because English is the lingua franca of science (1). Macaro (2) defines EMI as "the use of the English language to teach academic subjects other than English itself in countries or jurisdictions where the first language of the majority of the population is not English" (p. 19). We refer to this definition in the selection criteria presented later

in this study. The impact of EMI policy is a concern for researchers and policymakers in healthcare departments. The literature shows a diversity of conflicting results, as we will explore later in this study. There is therefore a need to conduct a systematic review in order to understand the outcomes of EMI research in healthcare colleges. The need to conduct more EMI research in order to determine patterns and trends has been emphasized by several researchers and international organizations (3). Many developing countries face policy challenges in deciding the language of instruction (4). There is a strong need to examine the influence of EMI in healthcare education.

The field of education research has firmly recognized EMI across both higher and secondary education levels (5). Researchers [e.g., (6)] stressed the need for further research in EMI, include the impact of EMI on content learning, specifically objective student outcomes, which remains understudied (7–9). There's a need for high-quality research to inform stakeholders to what extent EMI affects learning through a second language (2). Macaro and Rose (6) highlight the need for research that examine the effect of EMI on student English proficiency, especially the type of linguistic knowledge that improves, balancing this against any potential negative impact on content learning. Research should clarify the specific language skills enhanced by EMI compared to general English learning (6). Additionally, there's a need to understand the strategies EMI students use to navigate the challenges of tertiary education (10–12). Researchers [e.g., (6)] encourage contributions from underrepresented countries in EMI research.

The main objective of this study was to analyze the findings of research on EMI policy in healthcare education through a systematic review of the literature from the past decade. As far as we are aware, such a comprehensive review has not yet been conducted, and it will offer fresh insights to the body of existing literature. It will delineate the principal findings, chart the progression of EMI research themes, and forecast directions for subsequent scholarly endeavors, thereby informing policy development in healthcare education. This study will serve as an extensive resource for researchers, policymakers, and stakeholders vested in the integration of EMI within healthcare education. It will also provide international educationists with critical perspectives on language policy in the context of healthcare learning environments. The study will also propose areas necessitating further investigation, like the influence of EMI on the academic outcomes of healthcare students. By suggesting new research pathways, it will contribute to a more thorough exploration of EMI's broader educational impact. Also, the study will project recommendations for healthcare education policymakers.

Literature review

English as a medium of instruction in healthcare education has been a focus of diverse research, addressing its implementation, challenges, and outcomes. This literature review categorizes the extensive body of research into seven major themes, providing a comprehensive understanding of EMI's complexities, diverse perspectives, and impacts across various contexts.

The studies in first theme focus on the perceptions, attitudes, and perspectives of students and instructors in different countries such as Saudi Arabia [e.g., (13, 14)], Korea [e.g., (15)], South Africa, [e.g., (16, 17)]; and Hong Kong (18). Research across various regions has assessed stakeholders' perceptions of EMI in healthcare education. Alrajhi et al. (13) and Horwood et al. (19) found favorable views of EMI, noting its role in global connectivity and career development. In contrast, Al-Zubi et al. (20) and Saha et al. (21) identified a preference for native language instruction due to EMI's linguistic challenges and resource scarcity. Alfakhry et al. (22) explored attitudes toward language translation in educational content, while Al-Zubi et al. (20) assessed the reception of Arabicized medical terminology. Dube and Mlotshwa (23) provided insights into nursing students' perceptions in South Africa, adding depth to the discourse on EMI's impact on learning environments. Negative perceptions of EMI have been shown to affect student behavior and outcomes, with peer influence also shaping engagement (24).

The second thematic cluster of studies within healthcare education centers on the multifaceted challenges posed by EMI. Al Zumor (25) explored the specific hurdles faced in scientific disciplines in Saudi Arabia, shedding light on student perceptions related to understanding lectures, communication, and pedagogical efficacy. Echoing this, Pomat et al. (26) explored the complex needs and obstacles encountered by nursing students and educators in Thailand, where instruction occurs in English, Thai, or a combination of both. Yang et al. (27) further expanded this discourse by examining the adaptive strategies employed by teachers and students within a Chinese EMI medical education context to overcome similar issues. Although Al Zumor (25) and Pomat et al. (26) emphasize the considerable challenges, such as student anxiety and insufficient teaching resources, Yang et al. (27) provide a counterbalance, suggesting that strategic adaptations and resource enhancement can effectively address these concerns.

The third theme in EMI healthcare education studies emphasizes textual and policy analysis. Alhamami and Almelhi (28) assessed the EMI policy's effectiveness by evaluating Saudi Arabian healthcare college alumni's academic records and experiences. Law et al. (29) scrutinized the mutual recognition arrangements among ASEAN nations, relating them to the professional mobility of health personnel in Cambodia. Additionally, Alsuliman et al. (30) scrutinized bilingual medical texts for Arabic-speaking students, assessing their educational efficacy. Addressing the adaptation of medical terminology, Lazer-Pankiv and Pysmenna (31) investigated how Latin terms are phonetically and orthographically adapted for EMI, analyzing the impact on foreign medical students' terminological competence. Otomo (32) focused on Japanese healthcare licensure applicants, exploring how language training policies affect their career prospects in Japan. Mayberry (33) tracked the trajectory of Chinese medical graduates studying in English, highlighting implications for the UK medical field. They doing an English parallel course through a Freedom of Information search of the current UK medical register. These studies suggest that English proficiency is required for academic success (28, 29), yet Lazer-Pankiv and Pysmenna (31) and Otomo (32) caution against the complexities of EMI policy implementation in contexts where English is not the dominant language.

The fourth thematic area in EMI healthcare education research addresses pedagogy and curriculum support. Hijji (34) critically assessed the design of multiple-choice questions in nursing exams at Middle Eastern universities, applying a set of 22 principles to

gauge their effectiveness. Kumar et al. (35) surveyed preferences for teaching methods among North Indian dental and medical faculties and students, aiming to optimize lecture strategies and educational tools. In the field of pharmacy education, Khan (36) examined the integration of technology as a pedagogical tool, assessing its impact on learning outcomes. Together, these studies underscore a demand for enhanced teaching approaches within EMI settings, with Hijji (34) identifying gaps in test construction, and Khan (36) advocating for technological advancements. Kumar et al. (35) complement these findings by advocating for teaching aids tailored to the specific needs of the local educational context.

The fifth theme in EMI healthcare education research focuses on the impact of student diversity and linguistic backgrounds. Mustonen and Strömmer (37) explored the growing presence of migrant students in Finland's vocational education and their unique linguistic assets, suggesting a need for further studies on leveraging their multilingualism through translanguaging practices. Roshini et al. (38) examined the perceptions of dental students taught in multilingual settings, noting that non-English backgrounds could affect academic performance and self-assessment, with perceptions evolving throughout their studies. Ndawo (39) provided insights into nurse educators' experiences with EMI, revealing a generally positive stance despite challenges like the shortage of skilled EMI instructors. These studies collectively reveal the influence of linguistic backgrounds on EMI adaptability and propose a more inclusive educational approach that values students' language skills (37, 38).

The sixth thematic strand within EMI healthcare education research investigates stakeholder experiences. Møller (40) provided an account of Inuit nursing students grappling with language and cultural hurdles within a healthcare system influenced by Euro-Canadian and Danish norms. The study found that the Inuit students faced a number of challenges, such as language barriers, cultural differences, and a lack of support from their families and communities. Waterval et al. (41) explored the dynamics of international medical curriculum partnerships, noting the potential risks such as subpar curriculum execution and insufficient preparation for clinical practice in host nations. They underscore the necessity for further exploration into students' perspectives on these transnational educational experiences. Salamonson et al. (42) examined the implications of a globalized student body in nursing programs, emphasizing the success tied to early language assistance. Together, these studies illustrate the complex interplay between EMI, cultural identity, and academic achievement, suggesting that while EMI presents certain challenges like cultural discord and language obstacles, it also offers significant benefits for educational development and global research competencies.

The final thematic focus lies on the interplay between students' language proficiency and their academic understanding. Tenney et al. (43) established a significant link between English proficiency and overall academic achievement in a Hong Kong pharmacy program, surpassing the influence of scores in other subjects such as mathematics, chemistry, or Chinese. Schoepp (44) reinforced this by demonstrating how proficiency test results, like IELTS and TOEFL scores, align with GPA indicators, providing a predictive measure of academic success. Mann et al. (45) explored this further by linking verbal working memory, a key component for academic performance, with English language proficiency. Their findings suggest that even students with high English proficiency may encounter academic difficulties if they are non-native speakers, pointing to nuanced challenges in language acquisition that extend beyond test scores. These studies collectively underscore the critical role of language proficiency in EMI contexts, while also acknowledging the nuanced academic hurdles faced by non-native speakers (43–45).

The literature review reveals a nuanced landscape shaped by varied perceptions, systemic challenges, and the interplay of language proficiency with academic achievement. The favorable views of EMI, noted by Alrajhi et al. (13) and Horwood et al. (19), reflect its potential in globalizing healthcare education and broadening career prospects. However, the preference for native language instruction, as found by Al-Zubi et al. (20) and Saha et al. (21), indicates the need for a balanced approach that considers linguistic barriers and resource limitations. Challenges highlighted by Al Zumor (25) and Pomat et al. (26) emphasize the anxiety and resource inadequacies faced by students and faculty, while Yang et al. (27) propose adaptive strategies as a remedy. Policy and textual analyses by Alhamami and Almelhi (28) and Law et al. (29) support the benefits of EMI when English proficiency is robust, yet they also caution against the complexities involved in non-English dominant regions, as discussed by Lazer-Pankiv and Pysmenna (31) and Otomo (32).

The necessity for improved pedagogy is clear from the critiques of Hijji (34) and the technological integration suggested by Khan (36). The diverse backgrounds of students, explored by Mustonen and Strömmer (37) and Roshini et al. (38), call for an inclusive, multilingual approach to education, recognizing and utilizing the linguistic assets of students. Stakeholder experiences, particularly of groups like the Inuit studied by Møller (40) and international students in curriculum partnerships examined by Waterval et al. (41), reveal cultural and linguistic hurdles, yet also highlight the transformative potential of EMI in fostering global competencies. Finally, the critical role of language proficiency in academic success, as seen in the findings of Tenney et al. (43) and Schoepp (44), reinforces the need for language support in EMI programs. While EMI holds the promise of enhancing healthcare education by offering a global perspective, this review underscores the importance of addressing the linguistic, cultural, and pedagogical challenges that accompany its implementation. Ensuring students' linguistic capabilities, fostering an inclusive environment, and providing effective teaching strategies are paramount for harnessing the full potential of EMI in healthcare education.

Methodology

We used the Scopus database (accessed on 9 January 2023), a widely utilized and reliable source of data for literature reviews (46). PubMed and Medline (Ovid) content are a subset of Scopus. PubMed indexes around 6,000 journals, Scopus indexes around an additional 17,000 (total around 24,000) journals including most, but not all, of the content of the Embase database (47). Vitta and Al-Hoorie (48) reported that faculty members in Asia could be rewarded approximately three times more for publishing in a Scopus-indexed journal than in a locally indexed journal. Scopus is considered one of the main indexes of prestige within academia

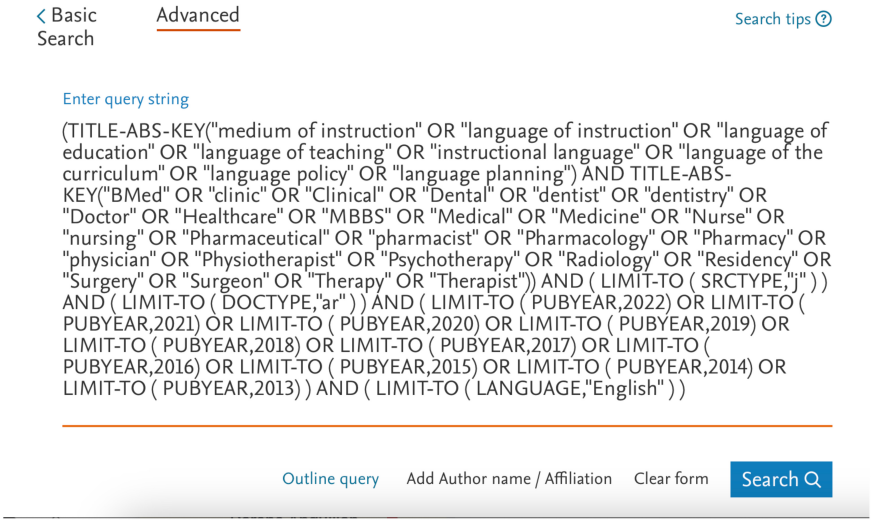

FIGURE 1
Researched keywords.

(49). Researchers have recommended the use of Scopus to analyze data because Scopus is broader than the other databases, and many good papers are indexed there (50).

To conduct a systematic review of previous research, we established a set of inclusion and exclusion criteria following the review protocols developed by Macaro et al. (51) in their systematic review and their definition of EMI. First, we included all articles available within the database in the "final" or "in press" publication stage from 1 January 2013 to 31 December 2022. We used particular keywords that appeared in the article title, abstract, and keywords, adapted from Macaro et al. (51): "medium of instruction" OR "language of instruction" OR "English Medium of Instruction" OR "English as a Medium of Instruction" OR "Content and Language Integrated Learning." In healthcare education, we adapted the following keywords from systematic reviews on healthcare education [e.g., (52–54)]: ("language policy" OR "language planning") AND TITLE-ABS-KEY ("BMed" OR "clinic" OR "Clinical" OR "Dental" OR "dentist" OR "dentistry" OR "Doctor" OR "Healthcare" OR "MBBS" OR "Medical" OR "Medicine" OR "Nurse" OR "nursing" OR "Pharmaceutical" OR "pharmacist" OR "Pharmacology" OR "Pharmacy" OR "physician" OR "Physiotherapist" OR "Psychotherapy" OR "Radiology" OR "Residency" OR "Surgery" OR "Surgeon" OR "Therapy" OR "Therapist"). We limited the results to the last decade (the last ten years), 2013–2022, and to journal articles that were published in the English language (see **Figure 1**).

The results yielded 137 documents. Next, we exported the data to an Excel spreadsheet. The spreadsheet contained the following information: Authors, Author full names, Author IDs, Articles titles, Year of publication, Journal name, Article DOI, Article cited by, Article link, Authors, Affiliations, Article, Abstract, Indexed keywords, Author keywords, Funding details, Funding texts, Article references, Correspondence address, ISSN, Language of original document, Abbreviated source title, Document type, Publication stage, and Open access.

Next, the author downloaded the full manuscripts of these 137 articles and read the titles and abstracts of each paper to verify the relevance of the document to the scope of the study. If the main focus of the abstract did not explicitly reflect the language of the instruction, full articles were consulted to verify the relevance of the document to the study objectives. The following inclusion and exclusion criteria were adopted to narrow the selection of studies: (1) took place in instructional settings where the majority of the population was healthcare students such as nursing; (2) focused on contexts in which the participants spoke the instructional language as a foreign language; (3) recruited participants currently studying medical subjects, not English proficiency courses; (4) took place in higher education. Students in high school and secondary education contexts were excluded; (5) adopted empirical methods of data collection (e.g., interviews, questionnaires, observations, tests); and (6) one of the main objectives of the study or its findings involved discussion of the language of instruction. We also excluded conference proceedings, book reviews, Master's dissertations, and Ph.D. theses, which meant that only peer-reviewed journal articles were included in the review.

The selected articles (n = 35) were then analyzed with the above information having been downloaded automatically from the database, the researchers having added other columns to insert information after reading each article carefully: location of the study, educational level, participant description, focus of the study, research methods and instruments, and key findings (see online **Supplementary materials**, for full list of the articles).

Here is a summarized description of the systematic review process. This summary provides an overview of the systematic review methodology, highlighting the main points from identification to the analysis of selected articles. For a full list of included articles and detailed information, refer to the online **Supplementary materials**. **Table 1** illustrates the procedures and inclusion and exclusion criteria.

While the current study employs a rigorous methodology that effectively reaches its defined objectives, its scope necessitates acknowledging certain limitations that future research could address to further enrich our understanding of the field. First,

focusing solely on English-language publications restricts the data's richness and diversity, particularly in the context of language instruction. Significant research often emerges in the local languages of the study setting, potentially offering valuable insights. Future studies could significantly benefit from expanding the language scope to capture this valuable knowledge. Also, limiting the analysis to one decade offers a valuable snapshot, but a broader historical perspective could reveal fascinating trends and transformations in language instruction practices and theories. Extending the timeframe of future studies to include earlier research would illuminate the evolution of this dynamic field. In addition, peer-reviewed journals form the cornerstone of academic exploration, but valuable contributions also appear in conference proceedings, dissertations, and theses. These sources may harbor innovative ideas not yet formally published. To gain a more comprehensive understanding of the current research landscape, future studies could consider incorporating these additional avenues.

TABLE 1 Systematic review procedures summary.

1. Database and time frame:	Searched the Scopus database on 9 January 2023.
	Articles from 1 January 2013, to 31 December 2022, considered.
2. Criteria for consideration:	Included empirical studies in the final or in-press stage.
	Excluded conference proceedings, book reviews, dissertations, and theses.
	Limited to articles published in English.
3. Keyword search:	For the EMI field, terms from Macaro et al. (51):
	For healthcare education, keywords from systematic reviews [e.g., (52–54)]
4. Initial results and data management:	Obtained 137 documents initially.
	Exported details to an Excel spreadsheet, including bibliometric information and article specifics.
5. Screening and eligibility:	Downloaded and reviewed the full manuscripts based on titles and abstracts.
	Applied inclusion and exclusion criteria focusing on: • Instructional settings with healthcare students. • Contexts where the instructional language is a foreign language. • Participants studying medical subjects, excluding English courses. • Studies conducted in higher education settings. • Empirical data collection methods. • Studies with a primary focus on the language of instruction.
6. Selection of studies:	After the screening, 102 articles were excluded.
	35 articles met all criteria and were included for in-depth analysis.
7. Further analysis and documentation:	For the selected 35 articles, additional information such as the study location, educational level, participant description, study focus, research methods, and key findings was documented.

Results

Years of publication

Figure 2 shows that the EMI policy in healthcare has started to gain the increased attention of researchers in the last five years, with the number of relevant studies increasing. Unfortunately, the number of studies published decreased in 2020, possibly due to the COVID-19 pandemic. These findings support other researchers' views that EMI research in higher education is presently "trending" (2, 55). These findings also indicate that the effects of EMI policy have drawn the attention of healthcare education policy makers. However, research on EMI is in its infancy (56), and more research is needed to understand the EMI phenomenon.

Locations of the studies

Table 2 presents the countries for which studies into EMI in healthcare education were conducted. Most EMI studies were undertaken in Saudi Arabia (7 out of 35), followed by South Africa (4) and India (3). From Table 2, we can infer that most of the studies were conducted in Asia and Africa, while there is a lack of EMI in healthcare education studies in South America countries, such as Brazil, Argentina, and Colombia. There is a need for collaborative research among researchers in different countries, which will return more generalizable findings and explore different country characteristics. Orduna-Nocito and Sánchez-García (3) stressed the need for more EMI research to determine patterns and trends emphasized by several researchers and international organizations. Table 2 supports UNESCO (4) recommendation that many developing countries should examine the language of instruction policy. Several Asian and African countries face EMI policy challenges that have not been examined by educational researchers and policymakers.

Author's affiliation and funding information

Using online tools, we determined whether there were any author Scopus ID numbers repeated more than once in the 35 articles. All of the researchers associated with these articles participated in publishing just one of the studies, except the following researchers who participated in two studies: Wilang, Jeffrey Dawala; Alshareef, Musab; Alrajhi, Ziyad; Alhamdan, Ali; Hamad, Bashir. This observation perhaps indicates that researchers are not continuing to instigate EMI policies in healthcare.

Funding: Ten studies were funded by the following organizations:

1. King Khalid University, Saudi Arabia
2. Taif University, Saudi Arabia
3. Japan Society for the Promotion of Science, Japan
4. King Abdulaziz University, Saudi Arabia
5. Asia Pacific Observatory of the World Health Organization, Cambodia

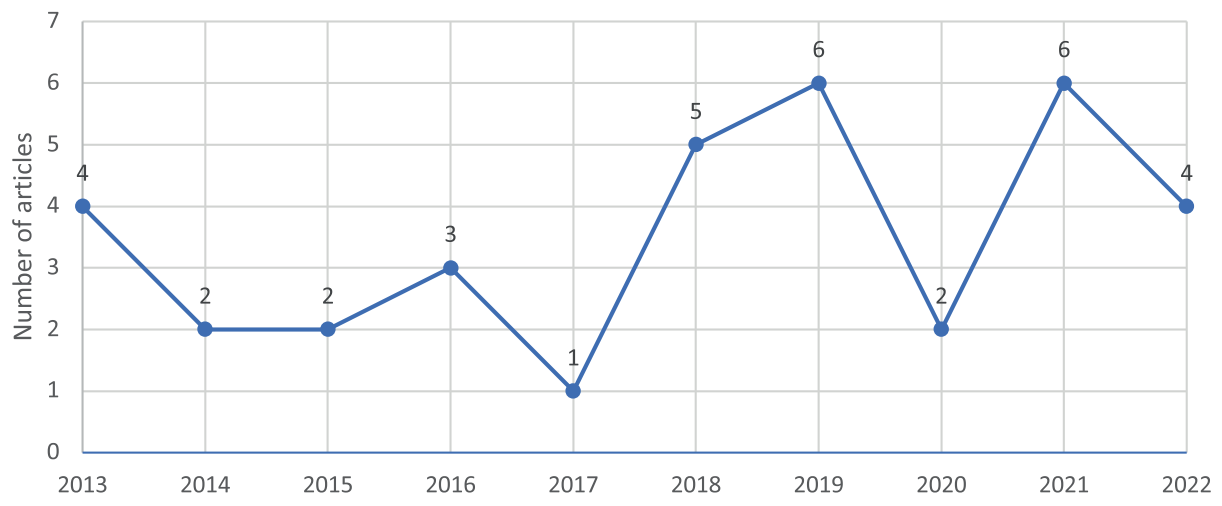

FIGURE 2
Number of articles retrieved by year of publication.

6. Suranaree University of Technology, Thailand
7. Norwegian Agency for Development Cooperation (Norad), Norway
8. King Abdullah International Medical Research Center, Saudi Arabia
9. Academy of Finland, Finland
10. Ministry of Education Humanities and Social Science Project, China

This list indicates that Saudi universities have the highest percentage of author affiliations (4). We found a relationship between the number of published studies and funding information. Interestingly, half of the published papers were funded by Saudi organizations, which shows that policymakers have gained an interest in EMI policy in a Saudi context. There is a need to fund projects in other countries such as African countries and South American countries. Supporting EMI research in other contexts will lead to more analyses of the phenomenon and more informative decisions by healthcare education policymakers.

TABLE 2 Locations of the studies.

Region	Counts
Saudi Arabia	7
South Africa	4
India	3
Australia, Japan, Syria, and Thailand	2
Bahrain, Cambodia, China, Congo, Finland, Hong Kong, Jordan, Korea, and Ukraine	1
Combination of more than one country, a study in UK and China; a study in Nunavut and Greenland' and a study in Netherlands, Saudi Arabia, United Kingdom, Egypt, United States, and Qatar. One study has no specified context	1

Studies in Australia, UK, and USA target non-English speaking students who study healthcare programs.

Journals and citations

The articles assessed here were published in several journals. The BMC Medical Education Journal published the highest number of these articles (4), followed by Asia-Pacific Education Researcher, Eastern Mediterranean Health, Health Professions Education, and Theory and Practice in Language Studies–each of these journals publishing two articles. The remaining journals published only one relevant article each (see online **Supplementary materials**).

In terms of citations in the Scopus database (databases such as Google Scholar have a different number of citations), the article by Joe and Lee (15) has the highest number of citations (64), followed by Dube and Mlotshwa (23) (19), Seabi et al. (16) (17), Alsuliman et al. (30) (13), Al Zumor (25) and Yang et al. (27) (12 each), and Mann et al. (45) (11). The remaining articles had fewer than 10 citations each. Eight articles had no citations.

Sample of participants

Table 3 summarizes the findings of participant characteristics. Most often the participants were all students (in 20 articles), with the next most common participant cohort being students and instructors (8). Most of the studies involved only healthcare related majors ($n = 32$). Three studies involved participants from computer science, engineering, and social work in addition to healthcare participants.

Instruments and methodological designs

Analysis of the research instruments that have been used in these studies shows that most of the researchers used solely a questionnaire ($n = 10$). The second most used tool is the test analysis, and the comprehension and analysis of policy

documents, together (n = 5). Other studies used a questionnaires and interviews together (n = 3). Three studies used only interviews. Two studies used two questionnaires–one for students and another for instructors. The rest of the studies used one type of instrument or a combination of instruments, as we can see in Table 4.

Figure 3 shows that analysis procedures. Most of the studies used quantitative analysis (n = 16) followed by mixed methods analysis (n = 10). Only nine studies used qualitative analysis to analysis the findings.

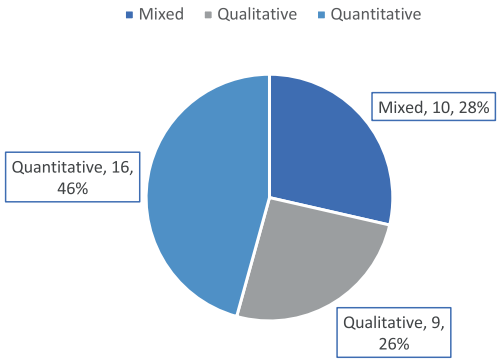

FIGURE 3
Preponderance of different research method designs.

Main findings

The findings of 35 studies have revealed a spectrum of outcomes that reflect the complex interplay of factors influencing English medium instruction (EMI) in healthcare education. We will group them into five major themes.

Theme 1: Learning and performance implications of EMI

1.1. Negative impacts: Al Zumor (25), Mann et al. (45), and Ndawo (39) present compelling evidence of the challenges posed by EMI. Al Zumor (25) reports that EMI adversely affects the comprehension of scientific content and overall student assessment, leading to negative emotions and suboptimal educational outcomes. Mann et al. (45) contribute to this narrative by demonstrating that medical undergraduates who learned English at a later age experience difficulties in speech discrimination amid background noise, a factor that is compounded by stress and is indicative of international students' struggles. This contrasted with local students, who learned English earlier and exhibited better speech-noise ratio results.

TABLE 3 Description of the participants.

Level	Counts
Students	20
Students and teachers	8
Analysis of text	3
Educators and policymakers (decision makers)	2
Students, teachers, and administrators	2

TABLE 4 Other types of research instruments.

Level	Counts
Three questionnaires	1
Two questionnaires (one for teachers and one for students) and alumni records	1
Two questionnaires (one for teachers and one for students) and interviews	1
A survey, two discussion forums, and a workshop	1
A document and policy review, and key informant interviews with 16 agency representatives	1
Ethnographic observations, interviews, and audio-recorded interactions	1
A focus group and interviews	1
Interviews and questionnaires, observations, participant observations, reviews of news reports, government documents and report	1
Pre and posttest, and questionnaire	1
Questionnaire and focus group	1
Questionnaire and test	1
Two questionnaires and audiometry testing	1

1.2. Neutral impact: Joe and Lee (15) and Yang et al. (27) offer a different perspective by suggesting that EMI does not necessarily impede comprehension or academic success. Joe and Lee (15) note that students' general English proficiency had no correlation with their understanding of lectures, indicating that other variables may be at play. Yang et al. (27) support this by highlighting the lack of significant differences in test scores between EMI and non-EMI students, although they identify four key challenges within EMI programs, including inadequate teaching materials and methods, which are mitigated by employing adaptive strategies such as using supplementary textbooks and enhancing self-learning skills, sometimes incorporating the Chinese language as a support tool.

1.3. Positive outcomes: Contrasting with the concerns about EMI, Alhamami and Almelhi (28) find that English fluency is a strong predictor of academic success, as evidenced by the higher cumulative GPA of English-speaking healthcare alumni in Saudi universities. Furthermore, Waterval et al. (41) observe that while the overall reception of EMI is positive, there are complexities in its practical application, especially for students who lack proficiency in the language of the patient population, complicating their workplace-based learning and interaction. These findings illustrate a complex landscape where EMI's impact on healthcare education can vary widely. Factors such as the timing of English language acquisition, the proficiency of the learners, and the quality of instructional materials all play pivotal roles in determining the efficacy of EMI. It is clear from the diverse outcomes that a one-size-fits-all approach to EMI may not be feasible, and a nuanced understanding of the contextual factors at play is necessary to maximize the benefits of EMI while mitigating its potential drawbacks.

Theme 2: Student and faculty attitudes toward EMI

2.1 Positive attitudes: Alfakhry et al. (22) and Horwood et al. (19) document a favorable disposition toward EMI among students and faculty, attributing this preference to the enhanced access to academic resources and potential for career progression that EMI offers. Alfakhry et al. (22) specifically found a consistent preference for EMI despite challenges stemming from insufficient Arabic medical translations. Horwood et al. (19) echoed these sentiments, noting that EMI provided significant opportunities for engagement with the wider scientific community and career development. However, they also pointed out the challenge of inadequate English competency among students, which could hinder the full realization of these benefits. Additionally, Pomat et al. (26) observed that both students and teachers acknowledge the necessity to improve their English skills to fully leverage the advantages of EMI.

2.2. Negative attitudes and preference for mother tongue: In contrast to the positive views, Al-Zubi et al. (20) and Alhamami and Almelhi (28) discovered a predilection for instruction in the mother tongue, driven by the barriers presented by EMI. Al-Zubi et al. (20) reported that while there was a general acceptance of Arabicized medical terms among students, the prevalent use of English for teaching and assessments, and the lack of comprehensive medical resources in Arabic, were significant obstacles. Alhamami and Almelhi (28) found a majority preference among students for receiving healthcare education in Arabic. Complementing these findings, Saha et al. (21) provided insights into the linguistic preferences of students from rural areas, with a substantial portion favoring Bengali, their mother tongue, as the medium of instruction. The studies collectively suggest that the debate on the efficacy of EMI versus mother tongue instruction in healthcare education remains unresolved, signaling a need for more context-specific research to determine the most effective language of instruction.

2.3 Mixed attitudes: Alshareef et al. (14) and Matthews and Van Wyk (17) present a more nuanced perspective, recognizing the dual nature of EMI's impact. Alshareef et al. (14) found general support for EMI among decision-makers due to its global applicability, yet there was also an expressed interest in developing an Arabic curriculum for future use. Matthews and Van Wyk (17) observed an enhancement in communicative competence in students, but they also identified an ongoing need for additional linguistic support. Tayem et al. (57) reported varied responses related to the perceived language barrier in medical studies; while many students did not view language as an obstacle, there was a clear distinction between those proficient in English and those who were not. Interestingly, a significant majority of students were unsure of medical terms in Arabic, yet confident in their ability to communicate with patients in Arabic, revealing a dichotomy in language use and preference. The findings indicate a split in attitudes toward EMI, suggesting that while it has its proponents, there is considerable support for a bilingual approach that incorporates both English and Arabic. The analysis of attitudes toward EMI uncovers a complex interplay of factors, including resource availability, linguistic proficiency, and cultural considerations, that influence perceptions. These diverse perspectives highlight the importance of a tailored approach to EMI implementation that takes into account the unique linguistic and educational needs of healthcare students and professionals.

Theme 3: Language proficiency and educational effectiveness

3.1 Impact of language proficiency: The critical link between language proficiency and educational effectiveness is elucidated in the research by Mann et al. (45) and Ndawo (39). Mann et al. (45) discovered significant disparities in speech-noise ratio performances among medical undergraduates based on the age at which they learned English. Those who acquired English later were disadvantaged in auditory processing in noisy environments, a challenge more pronounced among international students. This contrasted with local students who had learned English early and consequently had better auditory discrimination abilities.

Ndawo (39) extends this discussion by indicating that insufficient English proficiency undermines learner confidence, impedes the development of critical and reflective thinking, and complicates the comprehension of complex material. The study also notes that the effectiveness of nurse educators who are not proficient in EMI is significantly reduced, affecting the quality of instruction.

3.2 Advantages of bilingual or hybrid instruction: Alenezi and Kebble (58) and Alsuliman et al. (30) present a strong case for bilingual or hybrid instruction. Alenezi and Kebble (58) report that students showed a marked preference for code-switching, finding it more effective than a monolingual approach. Alsuliman et al. (30) reinforce this preference by showing that students performed better and responded faster when engaging with hybrid texts, which integrate both English and Arabic, compared to texts in only one language. Such bilingual strategies, as Mustonen and Strömmer (37) suggest, not only enhance comprehension of specific content but also allow students to utilize and develop their multilingual capabilities more strategically.

Yousif et al. (59) add to this narrative by demonstrating that a significant majority of students favored a combination of English and Arabic as the medium of instruction. Similarly, Kumar et al. (35) found a strong preference among students for instruction that incorporates both English and their native language, in this case, Hindi. These studies suggest that while EMI can present challenges, particularly for those with lower English proficiency, the integration of students' first languages within the educational framework can lead to improved outcomes. The flexibility to switch between languages or to use a hybrid model can cater to the diverse needs of students, enhancing not only their understanding of the subject matter but also their overall academic performance.

Theme 4: Factors influencing EMI effectiveness

4.1 Instructor and student English proficiency: The proficiency of instructors and students in English critically affects the effectiveness of EMI, as evidenced by Hijji (34) and Alrajhi et al. (13). Hijji (34) identified a lack of English language

proficiency among healthcare instructors, manifesting in errors within exam questions and highlighting the necessity for adequate language skills among educators for reliable and valid assessments. Conversely, Alrajhi et al. (13) found that both students and faculty recognized the benefits of English proficiency, including improved access to medical information and enhanced job prospects, suggesting that a higher level of English competence can contribute positively to educational outcomes.

4.2 Resource availability and support systems: The accessibility of resources and support systems is paramount for the success of EMI, as indicated by Salamonson et al. (42) and Law et al. (29). Salamonson et al. (42) emphasized that factors such as age, enrollment status, and the primary language spoken at home can influence educational experiences in healthcare settings. Law et al. (29) noted the requirement for increased English proficiency among Cambodian medical professionals, advocating for more comprehensive English training to facilitate their participation in the ASEAN community. Dube and Mlotshwa (23) recognized that external factors, including parental involvement and technological resources, contribute to improved academic performance, while socioeconomic challenges and negative peer influences can be detrimental.

4.3 Curriculum design and implementation challenges: Roshini et al. (38), Khan (36), and Wilang and Nupong (60) discuss the complexities of curriculum design in the context of EMI. Roshini et al. (38) observed that dental students faced educational challenges when English was not the primary language of instruction, pointing to the need for curricula that accommodate diverse language backgrounds. Khan (36) argued for the inclusion of English for specific purposes (ESP) in higher education to address the needs of students who do not use English as a daily medium of communication. Wilang and Nupong (60) highlighted the variance in EMI experiences based on student and program characteristics, suggesting the need for curricular adjustments that consider English proficiency, student motivations, and the provision of additional language support. Overall, the effectiveness of EMI in healthcare education is influenced by a constellation of factors, encompassing language proficiency, resource allocation, and curriculum design. A nuanced approach that considers these variables is essential for the development of effective EMI strategies. Ensuring educators are well-versed in English, providing adequate resources and support, and designing curricula that address the specific linguistic and educational needs of the student body are critical steps toward optimizing the use of EMI in healthcare education.

Theme 5: EMI policy and educational strategy

5.1 Challenges and solutions in implementing EMI: The implementation of EMI in higher education, particularly in healthcare and paramedical fields, comes with its own set of challenges and potential solutions, as discussed by Khan (36) and Alhamami and Almelhi (28). Khan (36) stresses the importance of a well-structured English curriculum tailored to the specific needs of learners who do not regularly use English outside the classroom. The study advocates for the integration of English for specific purposes (ESP) into the curriculum, suggesting that such an inclusion could significantly enhance the learning experience by aligning with the specific vocabulary and contexts students will encounter in their professional lives.

Alhamami and Almelhi (28) contribute to the discourse by analyzing alumni data, revealing that early grades in intensive English programs can be predictive of overall academic success. Their findings indicate that the perspectives of both students and instructors point to challenges in using EMI, particularly when students do not possess sufficient English fluency, resulting in potential hindrances to their academic achievement. This underscores the critical nature of English proficiency for both educators and learners and the need for robust support systems to facilitate effective EMI delivery.

Overall, these insights suggest that the success of EMI policies within healthcare education is contingent upon several interrelated factors. A concerted effort must be made to ensure that both students and instructors have the necessary proficiency in English. This includes providing access to resources such as specialized language courses and technological tools that support language learning and curriculum development. Additionally, the educational strategies employed must be thoughtfully designed to address and integrate the linguistic abilities of the learners to foster an environment where EMI can be a catalyst for educational advancement rather than a barrier.

Recommendations

Based on the analysis of the selected studies, several strategies and solutions have been proposed to improve the quality of education in EMI policy healthcare programs.

Al Zumor (25) advocacy for "additive bilingual education" underscores the importance of solid English instruction in foundational years. This approach posits a tiered language program that begins with basic English education and methodically progresses to include specialized medical terminology. The challenge lies in implementing this without displacing the students' native language, thus maintaining linguistic diversity while fostering English proficiency. A conducive environment for the use of Arabicized medical terms has been suggested by Al-Zubi et al. (20) to alleviate comprehension barriers. To operationalize this, the development of bilingual medical glossaries is necessary, requiring collaboration with native speakers in curriculum design and the rigorous vetting of such glossaries to ensure terminological accuracy across various Arabic dialects and contexts.

The reevaluation of language policies is another significant consideration, with Alenezi and Kebble (58) highlighting the pedagogical benefits of code-switching. The practical implementation of this would involve organizing training sessions for faculty to proficiently employ code-switching strategies in the classroom. Overcoming the potential resistance from teachers who are entrenched in traditional monolingual methods represents a significant hurdle. In areas where English is not the lingua franca, like Syria, the absence of professional medical translators in educational settings hampers learning. Al-Fakri et al. (22) have emphasized the urgent need to establish translation units within medical schools to support non-English-speaking students. This solution necessitates the recruitment and development of translators well-versed in medical terminology and language

education, which may prove challenging given the required level of expertise.

Enhancing English proficiency across health programs has been stressed by Alhamami and Almelhi (28), pointing to the need for continuous English learning opportunities. The integration of English language modules tailored to healthcare into the curriculum would serve this purpose. However, the challenge arises in providing consistent and contextual language support to students throughout their education. The preference for EMI in medical education, as noted by Alrajhi et al. (13), suggests a future pursuit of Arabic for teaching medicine, alongside English, to enrich the learning environment. This dual-language approach would require the support of national educational and governmental bodies to overcome the significant challenge of aligning policy changes at a national level with the practical realities of medical education.

Alsuliman et al. (30) propose the use of simplified bilingual terminology to support learning among Arabic-speaking populations. This approach necessitates the development of educational materials that incorporate simplified terms in both languages, with the primary challenge being the maintenance of medical accuracy alongside linguistic simplification. The advocacy for the selection of well-qualified nursing students and the modernization of training facilities by Dube and Mlotshwa (23) points to the necessity for a rigorous student selection process and significant investments in infrastructure. However, securing the required funding and resources for such enhancements remains a daunting task. Concerns about the proficiency of instructors in test writing and item analysis raised by Hijji (34) have led to the recommendation for universities to offer workshops on these skills. The successful implementation of this recommendation hinges on the development of comprehensive faculty training programs and ensuring their participation and application of the training.

Horwood et al. (19) recognize EMI as a vehicle for overcoming language barriers in research partnerships, especially in low-income countries. They advocate for extensive support to develop English skills, aligning with the United Nations Sustainable Development Goals. The actionable step here involves forming partnerships with English training providers to offer language support for both staff and students, with the challenge being the integration of language training within the demanding schedule of research activities. Joe and Lee (15) have provided evidence supporting the efficacy of EMI in Korean higher education, asserting that EMI does not adversely affect student learning when the lectures are specialized and incorporate medical subjects, provided that the students' general English proficiency is adequate. Kumar et al. (35) noted that the educational needs of Indian students differ from Western students, necessitating tailored didactic lectures to enhance comprehension. This suggests that traditional teaching methods, such as using chalkboards, may be more effective than modern technology like PowerPoint presentations in certain contexts. Lazer-Pankiv and Pysmenna (31) suggested the development and implementation of uniform standards for phonetic and orthographic adaptations of medical terminology in English. This comprehensive approach would require the preservation of etymological principles and the careful selection of terminology to maintain medical precision.

Matthews and Van Wyk (17) shed light on the disconnect between language learning and practical communication skills. Their study of learners in an isiZulu language program demonstrated improved language knowledge and attitudes but did not extend to effective patient communication. This gap underscores the necessity for communicative language teaching methods to be honed, ensuring that learners are not only proficient in the language but are also capable of practical communication with patients, which is crucial in healthcare settings. Møller (40) draws attention to the critical demand for Inuit nurses who are versed in the Arctic health system. The lived experiences and insights of Inuit nurses are invaluable, he argues, in shaping education and health systems that are responsive to the unique needs of Arctic communities. Here, the support for and retention of nursing students and practitioners in the Arctic become imperative, demanding both educational and systemic interventions that acknowledge and build upon the distinct knowledge and skills pertinent to the region. Pun (18) offers a perspective on the educational bridge between veterinary studies and clinical practice in bilingual contexts. He posits that the development of multimodal teaching and learning materials that are culturally contextual can address the communication challenges that arise from language discrepancies in such settings. This approach recognizes the necessity of a pedagogical strategy that is flexible and responsive to the linguistic and cultural nuances of veterinary education.

Roshini et al. (38) emphasized the integration of language skills, communication abilities, and behavioral sciences in dental education. They argue that the incorporation of these elements is fundamental to the smooth transition from school to dental college, enabling students to not only excel academically but also to effectively serve their patients upon entering the professional field. Seabi et al. (16) offered a counter-narrative to the perceived linguistic privilege of native English speakers in multilingual educational contexts. They observe that Caucasian students in South Africa, lacking proficiency in indigenous African languages, experienced limitations in their ability to serve clients effectively. This finding challenges the assumption that native English speakers inherently hold an advantage in multilingual settings, suggesting that a multilingual proficiency is an asset in the diverse linguistic landscape of professional healthcare programs. Yang et al. (27) highlight the complexities inherent in initiating EMI programs, which necessitate extensive faculty development, organizational backing, and the implementation of successful learning strategies for students and groups. They note that adaptive strategies deployed by both educators and students can serve as invaluable blueprints for enhancing the efficacy of EMI programs across diverse educational landscapes.

Yousif et al. (59) provide pragmatic suggestions aimed at augmenting the teaching methods for Saudi pharmacy students. They advocate for the adoption of interactive teaching methodologies and the employment of bilingual educational media to reinforce knowledge transfer and elicit active student engagement. Such approaches have the potential to not only enrich the learning experience but also to ensure a deeper comprehension of the subject matter. Waterval et al. (41) document the unique academic opportunities that medical curriculum partnerships offer to students. They argue for the adaptation of home curricula to

the health systems of host countries, a strategy that not only provides students with a comprehensive international healthcare perspective but also maintains the relevance and accreditation of the curriculum globally. These recommendations represent a composite vision for advancing healthcare education through EMI, each with actionable steps and challenges that must be navigated. Successful application of these recommendations would involve not only strategic planning and resource allocation but also an openness to pedagogical innovation and cultural sensitivity.

Conclusion

English as a medium of instruction research in healthcare education has gained more attention in the last five years, but the published studies do not provide sufficient evidence about its impact. The language of instruction was not the main topic of the analyzed studies, but was instead discussed as a sub-topic or a marginalized factor within other main factors. Future research should focus on the language of instruction in healthcare education. Most of the authors of the present study are not language specialists and do not have a background in applied linguistics topics. There is a need for collaboration between language specialists and healthcare educationalists in order to conduct more thorough research about EMI in healthcare. Most of the studies we examined were conducted in Arabic speaking countries. There is a need to explore South American and African contexts. Future studies should collaborate between researchers from different countries to provide more comprehensive outcomes of current EMI policy. The same authors of the studies assessed in the present report always published just one of those studies. This might show a lack of support from institutions in terms of investigating EMI within healthcare education. Healthcare education institutions should provide more funds for research into studies about EMI in healthcare education. EMI is an interdisciplinary topic that interests healthcare journals and applied linguistics journals. EMI research was published in both healthcare journals and language journals. We recommend having a special issue about EMI within the context of healthcare in one of these journals. The main repeated topic in the analyzed studies was stakeholders' perceptions and attitudes. Most of the studies focus on students as participants, and attitude as a topic. There is a need for more experimental studies and empirical studies that examine the influence of EMI on students' achievements in healthcare education. Future studies should also include different stakeholders' views in one investigation. Most of the studies are quantitative and used closed-ended questionnaires. There is a need for mixed methods research. Future studies should adapt rigorous components of a mixed methods research design to achieve data integration. The findings of the current studies show conflicted results, and the use of well-designed studies will resolve several concerns about learning processes within the EMI context.

Data availability statement

The original contributions presented in this study are included in this article/**Supplementary material**, further inquiries can be directed to the corresponding author.

Author contributions

MA: Writing – original draft, Writing – review & editing.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2024.1296563/full#supplementary-material

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Bioethical knowledge in students and health professionals: a systematic review

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Introduction: Bioethics training is essential for healthcare professionals as it enables them to address ethical dilemmas in their clinical practice. However, there is still a lack of rigorous teaching programs, and assessing bioethical knowledge poses challenges.

Methodology: Systematic review using the PRISMA method.

Results: Analysis of 27 studies reveals a lack of ethical knowledge and skills among healthcare professionals and students. Specific training in bioethics is effective in developing bioethical competencies. Different approaches have been employed, including integrated training in academic curricula and intensive or ongoing programs. The results demonstrate improvements in knowledge, attitudes, and ethical values, although regularly updating these courses is recommended.

Conclusion: Specific training, institutional support, and considering regional and disciplinary differences are necessary to enhance ethics in the practice of healthcare professionals.

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KEYWORDS

bioethics, training, assessment, healthcare professionals, ethical skill, bioethical competencies

Introduction

The training of healthcare professionals is usually focused on the study and acquisition of knowledge aimed at developing diagnostic and treatment competencies. Likewise, it should also be linked to the development of humanistic skills that allow these professionals to practice their profession with a balance between the technical and the human aspects (1–4). This is highlighted by Striedinger (5) who argues that a framework of scientific and technical skills needs to be combined with a human dimension to address possible bioethical dilemmas that may arise in healthcare professions.

Training in bioethical aspects is a central and indispensable element that is progressively being included in the curricula of all health-related degrees. However, the training received is still inconsistent (5–7). This is mainly due to the need to approach the interactions between healthcare professionals and patients from a balanced technical and human perspective. While this may seem logical, evident, and indispensable nowadays, this reality is a recent consensus and has not always been a constant in health disciplines (8–10).

All of this is supported by Reich (11), who describes the process of evolution and development undergone by Bioethics, indicating that, from its early stages, it has drawn on moral, medical, and theological philosophy (11–13), enabling it to achieve the unified and scientific vision presented in Potter (14) work "Bioethics: The science of survival."

Through literature, the consolidation of Bioethics as an independent discipline is evidenced by the use of scientific methods inspired by those used in the humanities and social sciences (14–18). With the development of bioethics, an empirical approach based on "principlism" has been adopted, such as the Belmont Report (autonomy, beneficence, non-maleficence, justice) (19), and other more inductive logics (20). While the consolidation of this discipline is already a fact, there is still progress to be made regarding the transfer of bioethical knowledge to healthcare professionals (21–24).

Given the tensions that exist between humanity and the practice of healthcare professionals regarding patients (25–28), coupled with uncertainties arising from modifications in healthcare systems (29, 30) and the impersonal advancement of new techniques, reflected in the substantial decrease, on the part of healthcare professionals, in the altruistic commitment to helping others (28–30), the importance of education in bioethics becomes evident in order to provide an optimal response in those moments when healthcare personnel may face ethical dilemmas (28, 31–33).

The humanization of healthcare services is directly related to the ethics, moral values, and professional deontology of healthcare agents toward the patient (34–36). Thus, bioethics seeks to combine humanism with the development of scientific knowledge, considering the patient not merely as a body or a medical process, but as a vulnerable human being facing illness (37–39).

The constant dissatisfactions of patients, who demand respect for their vulnerability in the face of illness, pose a challenge for healthcare institutions (34, 40–42). These institutions see bioethics as the link between health and humanization, reconciling clinical practice and the doctor-patient relational attitudes with ethical and moral reflection (43, 44). Therefore, knowledge and education in bioethics are essential to acquire more humane competencies and improve care while safeguarding the dignity and quality of life of patients, especially in situations of vulnerability (34, 45–47).

Similarly, bioethics is applicable in the administrative field of healthcare centers, aiming to provide patient care with greater quality and humanism (41, 48–50). This includes the establishment of an Assisting Ethics Committee in each healthcare sector, based in the reference hospital of the sector (Article 28 of BOE-A-2011-8403, Law 10/2011, of March 24, on the rights and guarantees of the dignity of the person in the process of dying and death).

In recent years, there has been a growing interest among the scientific and professional community in improving the education received by professionals in this aspect (51, 52). This is evidenced by the increasing, albeit limited, body of literature that points to the lack of rigorous teaching programs within university and professional contexts (6, 53–56), and that encourages the creation of specialized curricula in this area (56–62), in order to progressively develop the capacity to face ethical conflicts through simulated and real environments (6, 7, 53). On the other hand, experts recommend problem-based learning (PBL), which allows students to acquire not only theoretical content and knowledge (knowing and understanding), but also reflective and evaluative abilities (knowing how to act) and the necessary competencies to resolve different situations related to the profession (54, 63–66).

Espinoza Freire and Calva Nagua (67) and Carrera et al. (68) emphasize the need for this ethical education to start with the ethical training of academics since only through teacher education can the necessary knowledge be transmitted. This can be achieved through the implementation and design of new strategies that help mitigate the constant ethical dilemmas that arise in clinical practice and their consequences.

According to Culver (69), Bioethics education programs should not directly teach attitudes but rather focus on the identification of ethical conflicts that arise in clinical practice. Students should internalize the process for a rational response.

Couceiro-Vidal (54) highlights two main misconceptions regarding ethics education in healthcare. Firstly, the denial of freedom of conscience, and secondly, the presence of conflicts in the values due to the clinical relationship between healthcare professionals and patients and the paternalistic model that has been followed since ancient times.

Curriculum plans should take into account that moral development requires the development of schemas and different mental structures across six stages (obedience and punishment, individualism and exchange, interpersonal relationships, social order, social contract, and universal principles), which form three levels (pre-conventional, conventional, and post-conventional), as specified by León et al. (70), based on previous studies by Kohlberg (71). The latter two levels are where individuals seek the good for social and community wellbeing, understand that there are certain rules to be followed to live in a community, and use those norms to guide their actions in pursuit of the common good of their social group (71–73). At this level, individuals are capable of evolving toward full maturity of thought, establishing their own moral autonomy from which they can make absolute judgments of justice (70, 74–76).

In general, the academic and scientific community proposes a "common" model of aspects that would improve the method of teaching bioethics, subdividing it into "competencies to be achieved," "knowledge," and "skills" (54). It is suggested that in the preclinical period, basic bioethics should be taught, introducing students to the fundamental theoretical content. Then, in the clinical period, bioethics should be clinical, enabling students to learn skills to resolve specific conflicts that may arise in their clinical practice (66, 77–79).

Assessment of bioethical knowledge

The assessment of competencies, attitudes, and behaviors that align with the values being conveyed in academic content remains challenging due to the novelty of the discipline and the multitude of application contexts (80, 81). In an effort to address this challenge, the academic and scientific community has sought to develop and implement existing examinations, such as the objective structured clinical examination (OSCE), as an evaluation methodology (82–84). The OSCE allows for the measurement of knowledge and the ability to ethically act in clinical situations (81, 85), but it is unable to assess learning in other areas, such as behaviors based on acquired ethical values (81, 86).

In this line, Couceiro-Vidal (54, 87), along with his proposal of problem-based learning (PBL), suggests a new evaluative method that allows for the objective assessment of bioethics learning in the clinical professional's practice, acknowledging the complexity of the entire process and following a similar curriculum design structure as other subjects taught.

Vera Carrasco (88) explains that, for a proper evaluation of bioethics learning, it should be conducted in three specific periods. Firstly, a diagnostic assessment is conducted at the beginning of the course to determine the subject's theoretical foundation. Secondly, during the course, there is a formative phase in which strengths and weaknesses in teaching should be identified. Lastly, a summative phase takes place at the end of the academic year, during which the instructor quantifies and grades the subject's acquired knowledge. This third phase is crucial as it allows for the identification of weaknesses and enables the instructor and the evaluated individual to engage in self-assessment.

Of the available scales for this purpose, the Hirsch (89), Hirsch (90) for the evaluation of attitudes toward professional ethics is worth highlighting. It is based on research conducted by Escámez Sánchez (91, 92); Escámez Sánchez et al. (93), drawing from the ideas of Fishbein and Ajzens (94) "Theory of Reasoned Action" (1980), which conceives individuals as rational beings capable of judgment and evaluating situations (95, 96). This scale consists of 55 items that are responded to using a 5-point Likert scale (1–completely disagree; 5–completely agree) and allows for the assessment of cognitive competencies, social competencies, ethical competencies, and affective-emotional competencies. Another relevant scale is the "Problem Identification Test" developed by Hebert et al. (97), which aims to evaluate ethical knowledge in students, defining it as "the ability of a person to recognize the existence of a moral problem" (98–100). This instrument uses 4 clinical cases to semi-quantitatively assess the recognition of three fundamental principles of bioethics (Autonomy, Beneficence, and Justice).

However, most studies measuring theoretical and applied bioethical knowledge rely on ad-hoc scales with questions specific to each author (90, 101–104). In general, the design of questionnaires aimed at evaluating bioethical knowledge arises from professional experience and the needs faced by each teacher and/or area in bioethics (90, 105, 106). Hence, the importance of the teacher's attitude in creating evaluative methods focused on resolving ethical dilemmas encountered in their professional practice.

Therefore, this research aims to demonstrate the level of knowledge in bioethical aspects among students and healthcare faculty, as well as promote critical reflection on bioethical education for improved practice.

Materials and methods

Study design

The methodological process was based on the recommendations presented by the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) statement (107–110). All review phases were conducted in duplicate. The protocol for this study was registered in PROSPERO (International Prospective Register of Systematic Reviews) under the ID: CRD42023437146.

Research strategy

The literature review was conducted between October and December 2022. To conduct the systematic review, a SPIDER framework (111) was employed. Within this framework, S (Sample) encompassed both students and healthcare professionals, PI (Phenomenon of Interest) focused on bioethical knowledge, D (Design) comprised descriptive or scale validation studies, E (Evaluation) centered on questionnaire outcomes, and R (Research type) encompassed quantitative studies.

The databases used were Web of Science, PubMed, PEDro, Lilacs, and Scopus. Additionally, specialized journals such as Bioethics in Health Sciences, Revista española de Bioética, Perspectivas Bioéticas, Revista latinoamericana de Bioética, Revista colombiana de Bioética, Revista Apuntes de Bioética, BioScientis, Bioética&Debate, Revista de Bioética y Derecho, Cuadernos de Bioética, Empirical Bioethics, Journal of Bioethics, Medicine and Bioethics, American Journal of Bioethics, and Journal of Medical Ethics were included. The following search terms were used in both English and Spanish: (bioethics OR deontology OR medical ethics OR ethics AND scale OR questionnaire OR validation OR evaluation AND health).

Inclusion and exclusion criteria

To be included, studies had to meet the following criteria: (1) be published after 2019; (2) be written in English or Spanish; (3) provide previously unpublished original results; (4) aim to evaluate bioethical knowledge in the healthcare population or in training. Therefore, this work excluded literature reviews, systematic reviews, meta-analyses, books, general journals, editorials, comments on works, and articles that did not propose any intervention program and/or proposed it but not for the evaluation of bioethical knowledge in the healthcare population.

Selection process

After completing the search in all sources, a total of two reviewers screened the abstracts of the obtained results, using the Rayyan support tool for the initial exclusion criteria. In cases where there were doubts, an independent professional expert in bioethics was consulted. The data collected from the accepted articles were grouped into a database for synthesis and further discussion in this document. The following data were extracted from the accepted articles: (1) primary authorship, (2) year of publication, (3) methodology used, categorized as qualitative or quantitative methods, (4) sample used, including age and origin of the sample if available, (5) type of evaluation or intervention, indicating the type of resource used, name, items, and questionnaire administration time if applicable, (6) overall assessment of bias risk, and (7) main study results.

Regarding the reduction of bias risk, this review proposes different strategies, including (1) addressing biases from the accepted studies in the review, (2) managing biases in the synthesis of the collected information, (3) addressing biases from articles that should have been included in the review but were not, and (4) addressing biases caused by conflicts of interest and/or authorship funding. To reduce the bias risk arising from the analysis, synthesis, and reflections generated by the authors of this document, maximum transparency has been provided in the selection method, coding, bias analysis, and information synthesis, allowing future replication by other professionals and promoting inter-rater validity. In order to reduce the bias risk associated with not admitting articles that could have been accepted for various reasons (e.g., not being published in an indexed journal, language barriers, gray literature), a comprehensive search strategy has been designed, including specialized journals.

Results

Figure 1 shows the flowchart of the systematic review process. The literature search in databases yielded a total of 11,274 articles, out of which 6,460 were excluded for being published before 2019 or not being written in English or Spanish. Among the 4,814 identified articles, a total of 1,926 articles were discarded as duplicates. A total of 2,819 articles were rejected based on the title and abstract information; none of them were inaccessible, and the inter-rater consensus process was blinded. Therefore, a total of 69 articles were read in-depth and assessed for eligibility. Out of these, 42 articles were excluded from this study as their objective was not the evaluation of bioethical knowledge in the healthcare population. Finally, 27 articles were included in the present review.

Main findings

Study characteristics

The main findings are summarized in Table 1. Out of the 27 reviewed articles, the majority were descriptive, specifically 15 had a cross-sectional descriptive design (5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 26) and 2 had a longitudinal descriptive design (1, 23). On the other hand, 7 studies had a quasi-experimental design without a control group (2, 10, 24, 27) or with mixed methods (3, 4, 22). The remaining studies were experimental with a control group (9, 25) and validation of a scale (19).

Regarding the countries/geographical areas represented in the review, the samples were mainly composed of residents from the United States (1, 2, 12, 21, 23, 27) and Europe (11, 13, 14, 20, 3, 10), followed by samples from Pakistan (4, 16, 19), Turkey (7, 9, 13), India (15, 18, 26), Iran (24, 25), Ethiopia (5), Bangladesh (6), Malawi (8), Tanzania (13), Saudi Arabia (17), and Australia (22). Except for the study led by Paşalak et al. (112), which explores a cross-cultural analysis of professional ethical values among nursing counterparts from Turkey, Spain, and Tanzania, the rest of the studies had samples from a single country.

The fields of study in the healthcare domain were diverse. 89% of the studies included nursing professionals (3, 4, 7, 8, 9, 11, 12, 13, 14, 15, 17, 23, 25) and medical professionals (1, 2, 3, 4, 5, 6, 15, 16, 18, 20, 21, 24, 26, 27), while 11% involved professionals from other healthcare disciplines such as dentistry (1, 10, 11, 19, 26), physiotherapy (1, 11, 22, 26), pharmacy (1), psychology (3), speech therapy, and sports sciences (22). Additionally, 26% of the studies included multiple healthcare disciplines (1, 3, 4, 11, 15, 22, 26).

To quantify knowledge in bioethics and related outcomes, ad-hoc questionnaires were used in 60% of cases (1, 2, 3, 5, 6, 10, 11, 15, 16, 17, 18, 21, 23, 25, 26, 27). Among studies that employed standardized (113) scales, the Nursing Professional Values Scale-Revised (NPVS-R) was used in three studies, specifically designed to measure altruism, autonomy, knowledge, ethics, integrity, and justice in nursing professionals (12, 13, 14). The Kirkpatrick protocol was used in conjunction with the Semantic Differential Scale (22) or the TEKNeo (27) in two studies. One study combined the Objective Structural Clinical Examination (OSCE) with Self Reflection and Insight (SRIS) (24). Another study used the Social Justice Advocacy Scale and Moral Sensitivity Questionnaire together (9). The Nursing Dilemma Test and Moral Development Scale for Professionals were used together in another study (7). Similarly, the Defining Issue Test and Problem Identification Test by Hebert were used in conjunction in one study (20). Additionally, the Dental Ethical Sensitivity Scale (19), The Moral Competence Scale for Home Care Nurses (MCSHCN) (8), and semi-structured interviews (3, 10) were found.

The objectives outlined in the studies were diverse. Nearly half of the reviewed articles (2, 4, 9, 15, 20, 21, 22, 23, 24, 25, 27) aimed to evaluate the effectiveness of bioethics education through curriculum implementation or specific training. On the other hand, six studies focused on assessing knowledge in ethics, as well as individuals' attitudes and competencies related to it (1, 5, 8, 17, 18, and 26). The study by Maluwa et al. (114) went further by attempting to identify determinants of adequate ethical competence. Four studies sought to analyze the reflection process associated with decision-making in ethical dilemmas present in healthcare practice (6, 7, 10, 11). Furthermore, three studies aimed to explore differences in professional values among different training programs or geographical locations (112, 115, 116).

Bioethical knowledge

The analysis of the studies demonstrates that, in general, there is insufficient knowledge in the field of medical ethics and/or skills for resolving ethical conflicts among healthcare professionals and students. There is also a perceived lack of support from universities and workplaces, and there is consensus on the need to incorporate mandatory training in professional ethics (6, 7, 8, 10). However, it is observed that work experience and level of education completed are associated with an improvement in knowledge and ethical values (13, 14, 17, 20).

Despite this, in terms of ethical competence or knowledge, there do not seem to be significant differences based on gender or professional role (4, 7, 8, 11, 13, 19). However, it is important to note that, regarding the selected outcome variable, these results are not consistent across all studies. Some studies show that women have higher postconventional moral reasoning (17, 20), which is associated with a higher level of ethical competence in professional practice. There are also cases where dental professionals have lower ethical knowledge compared to their counterparts in nursing, medicine, or physiotherapy (11, 26).

On the other hand, significant differences exist in terms of bioethical knowledge, attitudes, values, or professionalism based on

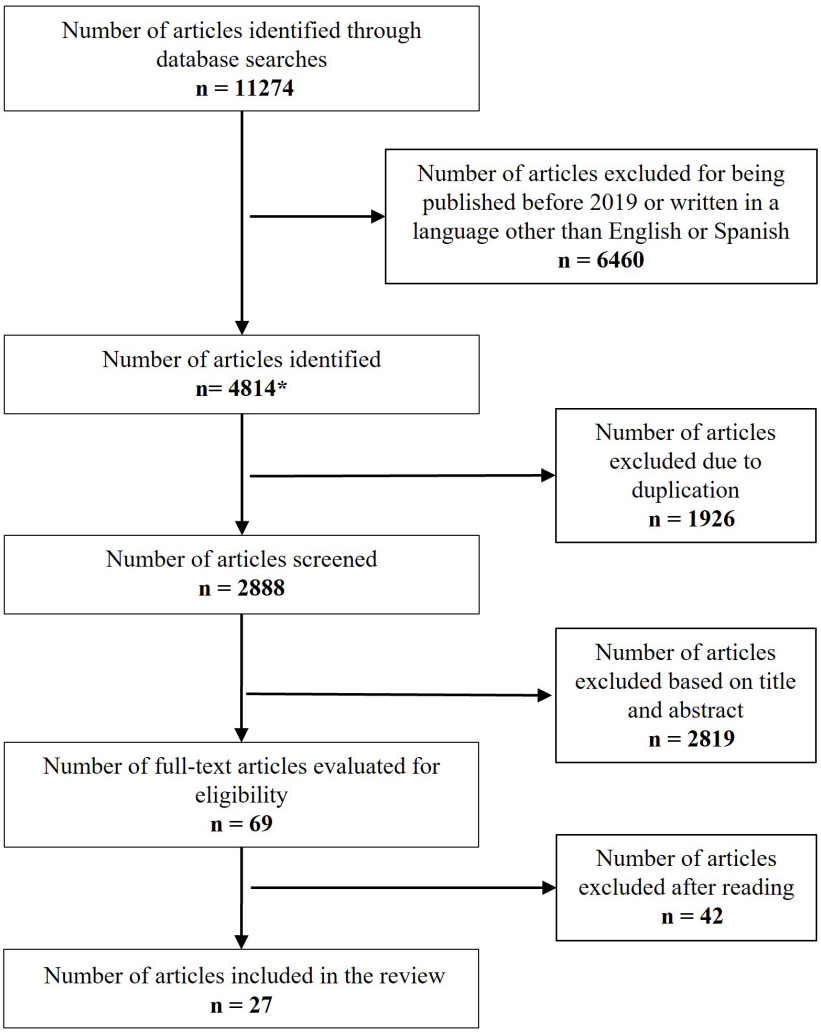

FIGURE 1
Flowchart. * = WOS (*n* = 1,825); PubMed (*n* = 906); Lilacs (*n* = 12); PedRo (*n* = 0); Scopus (*n* = 2,059); Rev. Colombiana de Bioética (*n* = 3); EIDON (*n* = 1); Rev. Latinoamericana de bioética (*n* = 2); Rev. Apuntes de bioética (*n* = 2); Rev. Bioética y derecho (*n* = 1); Theorical Medicine and bioethics (*n* = 2); Journal of Medical Ethics (*n* = 1).

the geographical region of reference. Developed regions, such as the United States, tend to show higher scores than less developed regions like Malawi or Ethiopia (6, 12, 13). The same applies when comparing education in public and private universities, where students from private universities tend to achieve higher scores in ethical knowledge (16).

Characteristics and effectiveness of training

Out of the 27 articles analyzed, 16 included bioethics training as an independent variable, and the majority of them demonstrated that specific bioethics training is effective in developing bioethical knowledge, attitudes, values, or competencies for professional practice. These bioethics trainings showed significant heterogeneity in terms of their format and duration.

In the case of undergraduate student training, 4 studies proposed integrated training programs within academic curricula (2, 9, 20, 24), while 6 studies presented complementary programs external to the curriculum (1, 4, 9, 11, 15, 21, 22). In the case of integrated training within the curriculum, the training combined theory and practice, utilizing clinical cases, vignettes, discussion forums, simulation scenarios, among others. For trainings outside the academic curriculum, the proposed programs had a shorter duration (between 3 and 16 sessions) and were characterized by experiential learning through didactic tools such as problem-based learning (PBL and CBL), case dramatization, lectures delivered by renowned professionals, problem-solving in complex simulation scenarios, or the use of mobile applications.

Training programs for practicing professionals exhibit a variety of structures, but all of them are equally effective. It is possible to distinguish between intensive proposals and ongoing proposals over time.

Among the ongoing proposals, an example is the training program called "Teach for Ethics in Palliative Care" (T4EPC) proposed by De Panfilis et al. (117). This program consists of 28 h of training distributed over several weeks. During this time, professionals receive theoretical training (8 h), practical training (10 h), and individual mentoring (10 h). This training approach has proven to be effective in improving the professional

practice of physicians, nurses, and psychologists who have completed the program.

On the other hand, the program developed by Geis et al. (118) consists of 13 ethics modules targeted at neonatology fellows. This program has been effectively tested in three academic institutions using a flipped classroom approach. The modules cover a wide range of topics in bioethics, such as principles of bioethics, maternal-fetal decision-making, professionalism and communication, prenatal counseling, withholding or withdrawing life-sustaining treatment, cultural sensitivity, genetic screening, palliative care, social justice and resource allocation, law and ethics, moral dilemma and physician awareness, disclosure of medical errors, and research ethics.

Intensive programs have also proven to be effective in developing ethical competencies. Sinha et al. (119) proposes a theoretical seminar that addresses knowledge, beliefs, and attitudes related to principles and clinical practice. This approach successfully improves the knowledge of participating medical professionals who underwent the program.

On the other hand, Wall (120) suggests a 74-min didactic seminar targeted at oncology nurses. Techniques such as storytelling, role-playing, and simulation are used in this seminar. The presented stories illustrate the role of oncology nurses in protecting and advocating for vulnerable patients, respecting and adapting to cultural differences, and increasing self-awareness of personal values that may influence decisions. According to the findings, there is a significant short- and medium-term improvement in the ethical competencies of nurses. However, it is suggested that these trainings need to be regularly renewed and updated as a stagnation in long-term improvement has been observed.

Furthermore, Momennasab et al. (121) propose bioethics training for nurses through independent reading of cases that present various ethical conflicts in relation to the professional code of ethics, followed by group reflection. This approach shows improvement in attitude and ability to resolve ethical conflicts, although no significant improvement is observed in ethical knowledge.

Discussion

This review summarizes the findings of studies that address the analysis of bioethical knowledge in healthcare students and professionals, as well as the perception of knowledge and ethical competencies in healthcare professionals and students. Twenty-seven studies were systematically reviewed, all of which demonstrate the reality of existing bioethical knowledge and education in healthcare settings. To distinguish between the reviewed studies and other evidence, the reviewed studies will be cited using the assigned numbers in **Table 1**.

Findings on bioethical knowledge and education in the field of healthcare

Overall, the evidence from the reviewed studies suggests that education in ethics and bioethics in the healthcare field is a topic of increasing interest, both in academic and professional contexts. This is because healthcare professionals constantly face complex ethical situations in their daily practice.

Drawing conclusions regarding the competence of healthcare students and professionals in terms of knowledge and skills to address bioethical dilemmas is challenging, as the analysis of the studies presents conflicting results. On one hand, there are studies that reveal a lack of sufficient knowledge in the field of medical ethics and skills for ethical conflict resolution among healthcare professionals and students (6, 7, 10), while others conclude adequate levels of knowledge in this population (8, 16). These results are consistent with what has been pointed out by Bellver Capella (122), Suárez Alba and Artiles Chaviano (123), and they confirm the ongoing difficulty in drawing solid conclusions due to the disparity of theoretical conceptualizations and procedures employed in different studies, as well as the limited representation of healthcare professions other than medicine or nursing.

Despite the existing deficiencies, it is observed that work experience and the level of completed education appear to be associated with an improvement in knowledge and ethical values (13, 14, 17). This indicates that time and exposure to ethical situations in professional practice can contribute to the development of ethical competencies (124–126). Additionally, there is evidence of a perceived lack of support from universities and workplaces in the development of ethical competencies. This deficiency is reflected in the consensus on the need to incorporate mandatory training in professional ethics (28, 31–33).

When analyzing differences based on gender and professional role, heterogeneous results have been found. In some studies, no significant differences have been identified in terms of ethical competence or knowledge (4, 7, 8, 11, 13), following the findings of authors such as Coffin-Cabrera et al. (127) or Sanz Ponce and Hirsch Adler (128). However, in other cases, it has been observed that women exhibit higher postconventional moral reasoning, which has been associated with a higher level of ethical competence in professional practice (17, 20), as stated by Barba (129) and Barba and Romo (130). On the other hand, it has been observed that dental professionals show a lower level of ethical knowledge compared to their nursing, medical, or physiotherapy counterparts (11, 26). These differences may be influenced by specific contextual and educational factors of each profession, as similarly asserted by García-Vilanova and Pérez (6), Nicoletti et al. (7), and Striedinger (5).

Another relevant aspect identified in the conducted review is the influence of geographical region and university type on ethical knowledge and competencies. Studies indicate that more developed regions, such as the United States, demonstrate higher scores in professional ethics compared to less developed regions like Tanzania or Ethiopia (6, 13). Additionally, it has been found that students studying at private universities achieve higher scores in ethical knowledge compared to those studying at public universities (16). These differences may be related to the availability of resources and the educational approach adopted in each context (130–133).

TABLE 1 Summary of the reviewed studies.

Article number	References	Country	Objective	Sample	Design	Instruments	Results
1	Madigosky et al. (137)	USA	Demonstrate knowledge, skills, and behaviors of teamwork/collaboration, values/ethics, and quality/safety as a member of the interprofessional team. Demonstrate collaboration, teamwork skills, and behaviors as an interprofessional team. Identify the unique roles and responsibilities of each healthcare professional within the interprofessional team. Articulate a shared and interprofessional identity as a healthcare professional.	Students in initial-level programs of anesthesiology assistant, dentistry, medicine, nursing bachelor's, pharmacy, physiotherapy, medical assisting, and public health programs. (2014)592-(2015)637-(2016)620	Longitudinal descriptive	Teaching method for bioethics in a transdisciplinary manner through group work. 16 sessions (8 at the end of the first semester + 8 at the end of the second). In the first 15 sessions, three aspects are addressed (collaboration, ethics, quality), and the 16th session involves applying everything previously discussed. An *ad hoc* questionnaire is administered at the beginning, middle, and end of the course. It consists of 34 Likert-scale questions and 3 open-ended questions.	Improvement of learning and skills both at the group and individual levels.
2	Perkins and Stoff (138)	USA	Describe the development and implementation of a specific pilot curriculum for pathology in bioethics.	$N = 29$ students in medical pathology (F? M?)	Longitudinal quasi-experimental study without a control group.	An *ad hoc* pre- and post-intervention survey was conducted. Five-hour sessions were held over the course of 14 months. Within the core curriculum, there was one introductory didactic session and three sessions focused on specific topics and case-based discussions. An additional second introductory session was conducted between sessions 2 and 3 to ensure that new medical pathology graduates from Emory were fully oriented to the curriculum objectives. The introductory sessions consisted of a 45-min to 1-h didactic presentation, which described the need for ethical education for pathology learners, basic terms and concepts, and the structure and objectives of the curriculum.	Most of the sample found the curriculum useful and learned something new after completing it. They also believed that a basic understanding and application of ethics and professionalism are essential to their current and future pathology practice.
3	De Panfilis et al. (117)	Italy	Develop a new specialized training program in medical ethics dedicated to a hospital's UCP (Unit of Clinical Practice) along with its evaluation. Evaluate both quantitatively and qualitatively the impact of the training on students in terms of enhancing their ethical skills	$N = 8$ (F? M?) The participants of the training program are employees of the Public Hospital for Oncological Research in Reggio Emilia. The group consists of 3 doctors, 2 nurses, and 3 psychologists.	A mixed-methods design with pre- and post-intervention evaluation	The training program has been named "Teach for Ethics in Palliative Care" (T4EPC). It involves 28 h of training conducted over 36 weeks. The training focuses on a theoretical session (8 h in three meetings), a theoretical-empirical session (10 h in three meetings), and a session centered on individual ethical consultation upon request (10 h in 5 meetings). The assessment of learning follows the Moore model, ranging from Attendance (Level 1) to Change in Practical Performance (Level 5). Data were collected through semi-structured interviews (participant expectations), an ethical skills portfolio, and an analysis of an ethical case.	The results highlight those participants developed deeper ethical knowledge and awareness. They also felt more confident and motivated to widely apply ethical reflections and reasoning in their daily practice.

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TABLE 1 (Continued)

Article number	References	Country	Objective	Sample	Design	Instruments	Results
4	Naseem et al. (139)	Pakistan	To test the effectiveness and feasibility of a mobile learning app (EthAKUL) for teaching bioethics in a university in Pakistan using the M-JiTL (Mobile-Just-in-Time Learning) method.	*N* = 67 (pre-intervention) (F = 48; M = 19) *N* = 29 (post-intervention) (F = 17; M = 12) The average age is 25 years.	A mixed-methods design with pre- and post-intervention evaluation	A knowledge test was designed and administered before and after the intervention to assess changes in students' bioethics knowledge. The pre-test was completed by students during orientation workshops, while the post-test link was emailed to them one week after the intervention had concluded.	Changes in bioethics knowledge were measured by comparing the pre- and post-test results. A significant change ($p = 0.012$) was observed in the overall mean score of the pre-intervention bioethics knowledge test for the students (9.34 ± 2.37), and the post-intervention mean score (10.38 ± 1.98), indicating an increase in the students' knowledge scores. No significant changes in mean scores were found based on gender.
5	Tekleab and Lantos (140)	Ethiopia	Explore the ethical knowledge, attitudes, and experiences of physicians in a pediatric referral hospital in Addis Ababa, Ethiopia, a resource-limited setting.	*N* = 59 participants completed the questionnaire (F = 36; M = 23) Mean age 30.7 years.	Descriptive correlational study.	An *ad hoc* questionnaire was designed to address the following characteristics of the respondents: demographic characteristics, knowledge about certain domains of pediatric bioethics (maximum score of 23, +19 indicating good knowledge), attitudes, and experiences of ethical dilemmas encountered by clinicians during their practice (9 Likert-scale questions, maximum score of 45).	The findings indicated that the respondents had poor knowledge of many important ethical principles. The average knowledge score of the respondents (12.3) was lower than that reported for pediatricians in the United States, where the average knowledge score was 17.3. This suggests that modern bioethical principles may conflict with traditional practices in certain countries. It also suggests that education is likely to be effective in changing knowledge, beliefs, and attitudes
6	Jahan and Flora (141)	Bangladesh	Evaluate the attitude of newly graduated medical students toward medical ethics and professionalism.	*N* = 308 (F = 144; M = 164) Mean age = 24.2 years	Descriptive correlational study.	An *ad hoc* questionnaire using a 5-point Likert scale was administered.	51.6% of the respondents emphasized the importance of ethical conduct and patient autonomy, but there still exists a significant paternalistic attitude (88.6%). The mean scores for the maximum statements were around 3, indicating that individuals may not express themselves as confidently as expected. The majority of the respondents (85.4%) favored the inclusion of a mandatory module on medical ethics and professionalism for the improvement of their practice and knowledge.

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TABLE 1 (Continued)

Article number	References	Country	Objective	Sample	Design	Instruments	Results
7	Arslan et al. (142)	Turkey	Analyze the relationships between moral development and ethical decision-making in nurses.	*N* = 227 nurses (F = 187; M = 40). Ages ranging from 20 to 50 years.	Descriptive correlational study	The Nursing Dilemma Test, sociodemographic form, and the Scale of Moral Development for Professionals were used. The Scale of Moral Development consists of three factors: pre-conventional level, conventional level, and post-conventional level. It includes 12 items and is measured using a Likert-type scale. The scale's minimum score is 12, and the maximum score is 60. Higher scores indicate a higher level of moral development. The scale scores are categorized as follows: 12–27 indicates pre-conventional level, 28–44 indicates conventional level, and 45–60 indicates post-conventional level.	In this study, it was found that nurses were at the post-conventional level according to Kohlberg's theory of moral development. Sociodemographic and work-related characteristics did not affect their scores in moral development level and scores in nursing-based principle thinking, practical consideration, and familiarity ($p > 0.05$). Nurses pay attention to moral principles during decision-making, although not at a desirable level, and they are relatively influenced by environmental factors.
8	Maluwa et al. (114)	Malawi	Analyze the level of ethical competence among clinical nurses working in selected hospitals in Malawi; Identify the determinants of high-level ethical competence; Describe the indicators/characteristics of ethical competence.	*N* = 271 (235 responded) (F = 180, M = 55) Age range between 21 and 40 years.	Descriptive cross-sectional	The questionnaire consisted of three parts: Demographic data Level of competence in ethics (The Moral Competence Scale for Home Care Nurses–MCSHCN). This scale consists of 45 items based on five theoretical components of moral competence, which are moral/ethical sensitivity, moral/ethical judgment, moral/ethical motivation, moral/ethical character, and implementation of moral/ethical decisions. Characteristics of ethical competences. This question allows for open-ended responses to express themselves accurately in their own words.	The results showed that there was no significant difference ($p > 0.05$) between demographic characteristics and the level of ethical competence. This study has confirmed that the MCSHCN is a reliable instrument for measuring ethical competence among nurses and midwives in resource-limited countries like Malawi. The scores of clinical nurses in this study ranged from 3.16 to 5, indicating that all clinical nurses were ethically competent.
9	Nesime and Belgin (143)	Turkey	Evaluate the effectiveness of the nursing education curriculum in providing knowledge, attitudes, behaviors, and ethical sensitivity in advocating for, developing, protecting, and maintaining health.	*N* = 80 nursing students (2 groups of 40) F = 36, M = 4 Mean age = 21.3 years	The study is a pre-test, post-test, parallel group, randomized controlled study (RCT).	Social Justice Advocacy Scale (SJAS) The Moral Sensitivity Questionnaire (MSQ)	On the Ethical Sensitivity Scale, the pretest scores of the experimental group and the control group were similar ($p > 0.05$). The posttest score of the experimental group was significantly higher than their pretest score and the posttest score of the control group ($p < 0.001$).
10	Hertrampf et al. (144)	Germany	Evaluate the attitudes toward ethical issues affecting dental students at the School of Dentistry in Kiel during patient treatment.	*N* = 23 (F = 18 M = 5)	Qualitative study	Standardized semi-structured interviews were conducted.	None of the students exhibited relevant theoretical knowledge in the field of medical ethics or skills for ethical conflict resolution.

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TABLE 1 (Continued)

Article number	References	Country	Objective	Sample	Design	Instruments	Results
11	Macpherson et al. (145)	Spain	Evaluate ethical decision-making during the early stages of student training.	*N* = 294 students (F = 184, M = 112)	A mixed-methods study using narrative responses to a case with ethical implications in the field of gender-based violence.	A procedure was developed through Case-Based Learning (CBL) in 30 h of seminars. An *ad hoc* questionnaire was used to assess knowledge.	The results indicate significant differences in responses between specialties based on scores on ethical knowledge tests. No significant differences were found between the responses provided by men and women. Instead, four categories of responses were identified because of combining personal conversation, reporting to legal authority, or seeking assistance from other teams. The most common option among dentists is only conversation, while physiotherapists include assistance from other teams. In nursing, a balance between both possibilities is observed.
12	Feller et al. (115)	USA	Identify if there are differences in nursing professional values based on program type and/or geographic location.	*N* = 417 nursing students	A descriptive cross-sectional study.	The Nursing Professional Value Scale-Revised (NPVS-R) is a scale consisting of 26 descriptive statements reflecting a particular disposition of the code of ethics, including its interpretation found in the ANA Code of Ethics (2001). It uses a five-point Likert scale generating scores ranging from 26 to 130; higher scores represent a greater assimilation of strong professional values.	The results indicate that pre-licensure nursing students are educated with values integrated into the nurses' code of ethics. Significant differences ($p < 0.05$) were found when comparing geographic locations, program types, and scores on the factors of the Revised Nursing Professional Value Scale.
13	Paşalak et al. (112)	Turkey, Tanzania, & Spain	Analyze the professional values of nursing students from different countries.	*N* = 305 (F = 221, M = 84) Mean age = 23.4 years	Comparative descriptive study.	Nurses' Professional Values Scale–Revised.	The levels of ethical values and professionalism among Turkish and Spanish students were similar but higher than those of Tanzanian students. Among Turkish students, female students who were single and whose parents had a high level of education obtained higher scores in professional values compared to others.

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TABLE 1 (Continued)

Article number	References	Country	Objective	Sample	Design	Instruments	Results
14	Bleda et al. (116)	Spain	Analyze nursing students' perceptions of professional values throughout the 4 years of education.	*N* = 315 nursing students	Cross-sectional descriptive study.	The EVPS (Nursing Professional Value Scale Revised) is a self-administered instrument consisting of 26 items, divided into three dimensions: ethics, professional competence, and professional mastery. Each response is provided using a 5-point Likert scale of importance: (1) not important at all, (2) somewhat important, (3) important, (4) very important, and (5) extremely important. The respondents selected the degree of importance they assigned to each nursing practice value statement.	The students' perceptions of professional values were found to be significantly correlated with their academic year. Overall, the students scored higher in the ethics dimension. This suggests that as students progress through their nursing education, they develop a stronger understanding and importance placed on ethical considerations in their professional practice.
15	Barman et al. (146)	India	Analyze the ability to recognize different bioethical issues in relation to patient care Analyze the ability to recognize changes in the pattern of bioethical issue recognition after formal training	*N* = 50 medical and nursing students (MBBS) (F = 22, M = 28) Ages between 20 and 22 years	Cross-sectional study	Self-administered questionnaire. Each question on a Likert scale, with a minimum score of 1 (1 = strongly disagree) and a maximum score of 5 (5 = strongly agree). After 6 months of training and clinical exposure, the students were re-evaluated using the same questionnaire.	All respondents in the study group agreed that medical ethics is highly important, but only 24% were aware of the existence of an ethics committee at the institute. Changes were observed after clinical exposure in responses such as disclosing the patient's condition to close relatives (54 to 84% agreement before and after exposure, respectively) and discussing ethical issues related to clinical cases (74 to 94% agreement before and after exposure, respectively). Some issues remained unclear even after clinical exposure, such as doctors refusing to perform an abortion (56% disagree and 38% agree), consent for treatment in children (60% disagree and 32% agree), and the use of brand-name medications versus generics (76% generics and 26% brand-name).
16	Ashfaq et al. (147)	Pakistan	Evaluate the basic knowledge and perception of medical students regarding bioethical issues in clinical practice following their exposure to formal bioethics education in their curriculum	*N* = 285 students (F = 196, M = 89) Mean age 21–23 years	Cross-sectional study	Self-administered questionnaire that included multiple-choice and scenario-based questions related to ethical dilemmas encountered during clinical practice. 5-point Likert scale.	Overall, 63% of students had adequate knowledge of bioethics. Medical students from private universities (57%) had slightly better knowledge of bioethics than their counterparts from public universities (43%).

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TABLE 1 (Continued)

Article number	References	Country	Objective	Sample	Design	Instruments	Results
17	Althobaiti et al. (148)	KSA	Evaluate the knowledge, attitude, and medical ethics in nurses	*N* = 1,943 nurses and technicians F = 63.1% M = 36.9%	Descriptive cross-sectional study	Ad hoc questionnaire developed based on previously published literature to collect demographic data, position, duration of practice, prior study of medical ethics, previous training in bioethics, presence of an ethics committee in the institution, and previous experience of an ethical issue and how it was addressed. The questionnaire included items on participants' knowledge, attitude, and practice related to care ethics.	Specialist/nursing technicians with 20- < 30 years of experience and female participants with prior training in bioethics had significantly higher average attitude scores than others.
18	Sinha et al. (119)	India	Evaluate the knowledge of ethics among young students and professionals, and the ethical practices in healthcare among medical professionals in a government university hospital in India.	*N* = 84 doctors, postgraduates, and consultants. Average age: 20–24 years	Cross-sectional study using convenience sampling	Data were collected through a structured and validated self-administered questionnaire consisting of 27 items on knowledge, beliefs, and attitudes toward the principles and practice of bioethics in clinical research. The questionnaire was administered before and after a conference/seminar on ethical principles.	Based on the pre- and post-workshop assessment, there is a significant need to emphasize ethical principles and review these concepts. Workshops and interactive sessions are a good means for periodic evaluation and reinforcement of these values in our research and clinical practice. Therefore, they should be included in the curriculum of all educational institutions.
19	Chughtai et al. (149)	Pakistan	Develop an instrument to assess the ethical sensitivity of newly licensed dentists.	*N* = 107 (F = 70, M = 37) Mean age = 23.7 years	Instrument development study (IDS)	Dental Ethical Sensitivity Scale (DESS).	No significant relationship between gender and ethical sensitivity. The scale can be used locally to assess newly licensed dentists and enhance their cognitive ethical decision-making.
20	Esquerda et al. (150)	Spain	Assess the impact of ethics education by measuring the evolution of Kohlberg's moral reasoning and ethical sensitivity in resolving clinical cases.	*N* = 175 third-year medical students (78 before taking bioethics and 97 after taking bioethics, in different courses). (F = 126; M = 45; missing = 4) Mean age = 20.8 years	Cross-sectional observational study.	A sociodemographic questionnaire, Rest's Defining Issue Test as a measure of moral reasoning, and Hébert's Problem Identification Test as a measure of ethical sensitivity were administered.	No differences are found in the moral development of medical students before and after formal education in bioethics, but differences are observed in case resolution skills. Females exhibit higher post-conventional reasoning, indicating greater moral development.

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TABLE 1 (Continued)

Article number	References	Country	Objective	Sample	Design	Instruments	Results
21	Palanisamy and Xiong (151)	USA	Reinforce and enhance the practical knowledge of medical ethics students regarding patient capacity assessment and discharge planning in the context of acute neurological impairment.	*N* = 23 3rd-year medical students.	Cross-sectional study.	First, they completed a brief pre-test consisting of five questions to measure their prior knowledge of the learning objectives of the activities. Then, the students participated in a 1-h interactive session, facilitated by an instructor, in small groups. After the activity, we assessed their knowledge again using a five-question questionnaire. Pre-post test questionnaire	Qualitatively, students reacted positively to the interactive activity, and the pre- and post-test scores demonstrated an improvement in their factual knowledge of the activity's objectives (+40%). The innovative use of an interactive teaching method proved effective in achieving our educational goals.
22	Kenny et al. (152)	Australia	Analyze the effectiveness of Ethics in Professional Practice (EPP) (simulation) training for healthcare ethics in students.	*N* = 81 voluntary students from Health professions in Australia. *n* = 12 Exercise Physiology *n* = 16 Rehabilitation Counseling *n* = 53 Speech Pathology	Quantitative and qualitative study.	Learning measured by Semantic Differential Scales (pre-post EPP). Behavior measured by clinical case vignettes. Effects measured using a rubric. Kirkpatrick Model (reaction, learning, behavior, and effects).	Improvement observed in concepts such as collaboration, communication, and quality of care.
23	Wall (120)	USA	Analyze the effectiveness of an ethics training seminar (75 min) in oncology nurses.	*N* = 107 oncology nurses	Longitudinal descriptive panel study	*Ad hoc* knowledge test with 18 multiple-choice questions	A significant short- and medium-term improvement in knowledge acquisition was observed. In the long term, knowledge tends to decline. Auditors recommend continuous training.
24	Mosalanejad et al. (153)	Iran	Design a blended learning program based on a constructivist approach to ethical reasoning and determine its effect on students' reflection and learning.	*N* = 35 medical ethics students	Quasi-experimental study with a single-group pretest-posttest design	Self-Reflection and Insight Scale (SRIS) Objective structured clinical examination (OSCE) test (with TOSCE)	The blended constructivist approach may have a favorable effect on students' clinical reasoning. Thus, the model appears to be an appropriate method for teaching medical ethics and resolving ethical conflicts.

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TABLE 1 (Continued)

Article number	References	Country	Objective	Sample	Design	Instruments	Results
25	Momennasab et al. (121)	Iran	Analyze the impact of group training on nurses' knowledge, attitude, and performance regarding ethical codes.	86 nurses. Intervention Group: *N* = 44, Mage = 30.15 (4.96); Control Group: *N* = 42, Mage = 30.95 (5.17)	Quasi-experimental study with a control group.	Knowledge tests based on *ad hoc* ethical codes and Iranian nursing. Ethics Codes; *ad hoc* attitude rating scale; *ad hoc* performance questionnaire.	After the training, nurses showed improvements in attitude and skills scores but not in knowledge.
26	Pais et al. (154)	India	Assess the knowledge, practice, and attitudes of postgraduate students in medicine, dentistry, and physiotherapy toward healthcare ethics.	*N* = 60 postgraduate students in medicine, dentistry, and physiotherapy. Mean Age: 26.23 ± 2.33	Descriptive correlational study.	*Ad hoc* created questionnaire on healthcare ethics.	Postgraduate students in dentistry scored lower in their knowledge levels compared to postgraduate students in physiotherapy and medicine.
27	Geis et al. (118)	USA	Develop and test a digital curriculum on ethics and professionalism in neonatology, and analyze the effects on students' knowledge and confidence.	*N* = 49 neonatology students Mean age = 32.3 years (SD 3.0)	Quasi-experimental longitudinal panel study	Kirkpatrick model; TEKNeo; Trust and Competence Test	A significant improvement was observed in general ethical knowledge and confidence. Furthermore, there were significant improvements in the principles of bioethics, maternal-fetal decision making, prenatal counseling, genetic screening, justice and social issues, resource allocation, rights and ethics, morality, and medical errors.

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Methodological limitations in research on bioethical knowledge in the health field

In the context of ethics and bioethics training strategies, there is variability in terms of approaches and durations. The examined studies used both ad-hoc training and standardized scales to assess knowledge and ethical outcomes. In most cases, ad-hoc questionnaires were implemented to measure ethical knowledge (1, 2, 3, 5, 6, 10, 11, 15, 16, 17, 18, 21, 23, 25, 26, 27). Additionally, specific scales (113) such as the Nursing Professional Values Scale-Revised (NPVS-R) were employed to evaluate ethical values in nursing professionals (12, 13, 14), which consists of six main dimensions: altruism, autonomy, knowledge, ethics, integrity, and justice.

The objectives set in the studies were also diverse. One of the most common objectives was to evaluate the effectiveness of bioethics training through the implementation of curricula or specific training programs (2, 4, 9, 15, 20, 21, 22, 23, 24, 25, 27). Additionally, the aim was to assess the knowledge, attitudes, and ethical competencies of individuals (1, 5, 8, 17, 18, 26) and analyze the reflective process associated with ethical decision-making in healthcare practice (6, 7, 10, 11).

Overall, the results indicate that specific bioethics training is effective in developing ethical knowledge, attitudes, values, and competencies in both students and practicing professionals. Both integrated curriculum-based training and external supplementary training have proven to be effective. These trainings combine theory with practice, utilizing didactic tools such as clinical cases, vignettes, discussion forums, simulation scenarios, and mobile applications.

Furthermore, training targeted at practicing professionals has also demonstrated their efficacy. Intensive and long-term programs have been proposed. Some intensive programs focus on theoretical seminars, while others adopt more participatory approaches such as storytelling techniques, role-playing, and simulation. These programs have successfully improved the ethical competencies of physicians and nurses, as well as promoted reflection on personal values that may influence ethical decisions.

However, it is important to highlight the need for ongoing updating and renewal of these training. It has been observed that, in the long term, stagnation in results may occur, indicating that ethical training should be a continuous and dynamic process to ensure its effectiveness over time (23). This idea aligns with the views of authors such as Alarcón and Chapa (134), Tarzian and Asbh Core Competencies Update Task Force (135), and White (136).

In summary, the reviewed studies provide evidence for the importance of ethics and bioethics training for professionals and students in the healthcare field. Despite existing limitations, specific bioethics training has proven effective in developing ethical knowledge, attitudes, values, and competencies. Both integrated curriculum-based training and external supplementary training have yielded positive results in enhancing ethical competencies. Intensive and ongoing programs have also shown favorable outcomes. However, continuous updating of these training is necessary to maintain their long-term impact.

Conclusion

To conclude, the analysis of the 27 reviewed scientific articles in the field of medical ethics and bioethics reveals a lack of knowledge and skills to address ethical conflicts among healthcare professionals and students. Specific training in bioethics has been identified as an effective strategy to improve ethical knowledge, attitudes, values, and competencies in professional practice.

However, there is a lack of support from academic institutions and workplaces in implementing mandatory training programs in professional ethics. The importance of work experience and educational level as factors associated with improvement in ethical knowledge and values is highlighted.

Furthermore, significant differences were found in terms of ethical knowledge based on geographical region and healthcare discipline. Developed regions and certain disciplines showed better results in terms of ethical knowledge. These findings emphasize the need to consider regional and disciplinary specificities when designing ethical training programs.

A comprehensive approach is required to promote ethical training in the healthcare field. This involves incorporating medical ethics into academic curricula, providing continuous and effective training programs for practicing professionals, and addressing the specific needs of each regional and disciplinary context. Enhancing ethical and quality practice in the healthcare field is crucial to ensure the wellbeing of patients and the professional development of healthcare providers.

Data availability statement

The original contributions presented in this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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