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ORIGINAL RESEARCH ARTICLE

The Use of Digital Technologies in Physiotherapy Higher Education: a Mixed-Methods Study

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ABSTRACT

Background: Previous studies demonstrated that digital tools can be effectively integrated into physiotherapy higher education. However, their adoption remains limited. This study aimed to 1) evaluate the perceived knowledge, confidence, and frequency of digital technology use among Italian lecturers and 2) explore lecturers' experiences with digital technology in higher education.

Methods: We performed a convergent mixed-method study using an online survey instrument for Italian physiotherapy lectures. We employed a 5-point Likert to evaluate perceived knowledge, confidence, and frequency of digital technology use, with consensus defined as an agreement of ≥70% on a statement. An optional qualitative section explored lecturers' experiences with technology, which we analyzed using Reflexive Thematic Analysis.

Results: Between June and September 2023, 118 lecturers (mean age: 45 ± 11; 69% female, n = 81) completed the survey. Participants expressed confidence in utilizing digital tools such as videoconferencing (95%), online repositories (88%), and communication apps (78%). On average, 32% reported using technologies "often" or "always." In the qualitative section, completed by 77 participants, we generated three themes: 1) "Technology can promote a constructive educational approach"; 2) "Action of technologies on students' learning process," with mixed results on their impact; and 3) "Technology is not within everyone's reach," due to barriers to its implementation in didactics. Qualitative and quantitative findings confirmed one another, allowing for a deeper understanding of digital technologies among Italian physiotherapy lecturers.

Conclusions: Our findings indicate that digital tools are still underutilized among Italian physiotherapy lecturers. The main barriers include inadequate infrastructure and a lack of digital competencies.

Keywords: Allied health personnel, Digital technology, Education, Mixed methods, Physical therapy modalities, Physical therapy specialty, Public health professional

What is already known about this topic:

- *Digital technologies, including learning management systems and virtual reality, enhance physiotherapy education, improving student engagement, knowledge, and skills. However, barriers such as limited lecturer confidence, inconsistent use, and inadequate infrastructure hinder widespread adoption.*

What the study adds:

- *The study enhances current knowledge by analyzing digital technology use in Italian physiotherapy education, identifying faculty competency gaps and barriers, and providing insights applicable to global medical education, focusing on technology integration and curriculum innovation.*

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Introduction

Digital education is an umbrella term encompassing various approaches, concepts, methods, and technologies (1). Digital Health Education Collaboration has defined digital education as "the act of teaching and learning by means of digital technologies" and digital technologies as "tools, systems and electronic resources that can generate, store or process data" (2). The most common digital technologies

in digital learning are learning management systems (3,4), online repositories (5,6), synchronous and asynchronous e-learning technologies (7), social media (8,9), communication apps and tools (10), forums and online learning groups (11), audience response systems (ARS) (12,13), virtual reality interfaces (14-16). In the last few years, several studies have been conducted to investigate the role of technology in education (17-20). The United Nations Educational, Scientific and Cultural Organization (UNESCO) stated that digital learning can enhance teaching practices and improve the quality and sustainability of higher education (21). Evidence showed that incorporating technology into allied health professionals' (e.g., physiotherapists) education is increasingly widespread with several benefits, including flexibility of access to quality content, support of life-long learning, improved communication networks, and personalization of learner experience (22).

For example, online learning modules and learning management systems have been shown to facilitate peer learning, interaction, and training flexibility (3). Multimedia resources and interactive tools such as podcasts and ARS have been proven effective in supporting active student engagement (13,23,24). Virtual reality and computer-assisted learning methods could improve learning outcomes and promote interprofessional collaboration (25). Online technologies in undergraduate physiotherapy education enhance practical performance, facilitate knowledge acquisition, stimulate reflective thinking, and increase awareness of the professional core values (22,26). Additionally, technology-supported interactive teaching models have been found effective in increasing motivation and engagement, improving self-management skills, providing flexibility and transparency in the learning process, and supporting the achievement of educational goals (22,26).

Despite the advances in learning digital technologies, their use remains underutilized and inconsistently implemented across higher education courses, limiting the potential of these resources (30,31). Successful adoption of digital technologies requires careful planning (32), collaborative efforts among educators (33), use of student-centered tools (29), clear instructions (23), flexible and accessible resources (11), effective feedback mechanisms (13), and integration of authentic virtual environments (25). In physiotherapy education, effective integration of digital tools relies on lecturers' technical skills, adaptability, and ongoing professional development (27). Beyond technical literacy, lecturers' belief in their ability to successfully implement technology is a crucial factor influencing its use, as widely reported in the literature (28,29). Additional challenges to adopting digital technologies in physiotherapy education include organizational issues such as large class sizes, limited budgets, and time constraints (32), technical problems, and unclear instructions (33). The lack of technical infrastructure and support was also a barrier (34).

Therefore, the Research Agenda of the American Physical Therapy Association (APTA) prioritized research on using technology to enhance student learning in Education and Professional Development (35). No previous study has investigated the use of educational technologies in Italian physiotherapy undergraduate courses. Therefore, this mixed-methods study aimed to explore Italian lecturers' perceived knowledge, confidence, and frequency of use of key educational technologies in physiotherapy undergraduate programs. The second purpose was to investigate faculty insights into the advantages, disadvantages, barriers, and facilitators of using digital resources, considering the importance of addressing obstacles in technology integration. The findings of this study could guide strategies to improve technology use in physiotherapy education, bridging traditional methods with the digital landscape, enhancing student engagement, and preparing graduates for modern clinical practice.

Materials and Methods

Study Design and Ethical Issues

This study used a convergent mixed-methods design to gather complementary quantitative and qualitative data (36). Data collection and analysis were conducted concurrently and independently. Results were compared and integrated for a more comprehensive understanding. This mixed-methods design was chosen because of its potential to gain deep knowledge of the use and experience with digital technologies in Italian physiotherapy higher education. We performed a web-based cross-sectional survey exploring the perceived level of knowledge, confidence, and frequency of use of the leading educational technologies by lecturers in Italian university physical therapy courses. It also deepened faculty perspectives on the potential of technological tools and possible facilitating and hindering factors in their integration into teaching practices.

Ethical approval was obtained from the Ethics Committee for University Research (CERA: Comitato Etico per la Ricerca di Ateneo), University of Genova (approval date: 22/05/2023; Code: 2023.31). The study was conducted according to the Declaration of Helsinki principles, ensuring ethical standards were upheld to protect the rights and welfare of participants, and reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (37), the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) (38), the Consolidated Criteria for Reporting Qualitative Research (COREQ) (39) and the Good Reporting of a Mixed Methods Study (GRAMMS) (40).

Survey Instrument Creation and Development

For the creation of the survey instrument, a preliminary literature review was performed to identify the key educational technologies adopted in physiotherapy and other health sciences education (see Supplementary 1 for further information). Nine key educational technologies were identified: learning management systems, online repositories, synchronous e-learning technologies, asynchronous e-learning technologies, social media, communication apps and tools, forums and online learning groups, ARS, and virtual reality interfaces.

Following the International Handbook of Survey Methodology, the authors developed the survey instrument based on the research question, the literature review results, and the expertise of the individual authors (36). The research

team members (FT, SB, CF, FM, and MT) defined the survey instrument's objective and design. FT (She/Her), MT (He/His), and SB (He/His) are all physiotherapists. FT has a Master's degree in Health Professional Rehabilitation Sciences. MT has a PhD in Rehabilitation Science and Physiotherapy. SB has a joint PhD in Neurosciences and Medical Science and is proficient in conducting mixed-methods studies. CF (She/Her) is a researcher with a PhD in clinical psychology, and FM (He/His) is a researcher with a PhD in Engineering Science with a specialization in e-learning. They both have a background in medical education. After two rounds of revision, the authors reached a consensus, and the final draft was compiled. Before being distributed, the questionnaire was tested on five physiotherapy lecturers who agreed on its relevance and clarity. The final online version of the survey instrument was delivered in Italian and lasted 10-20 minutes based on participants' willingness to reply to the qualitative parts. It consisted of 17 items ordered in four sections across four pages. Items were not randomized. A detailed description of the survey instrument and its translated version is reported in Supplementary 2.

Quantitative Section

In section 1 (questions 1 to 2), there were links to the participant information sheet and privacy policy about the study. Participants need to read and accept they had read the documents and agreed with them to proceed. In section 2 (questions 3 to 9), we identified the populations' characteristics, acting as eligibility criteria. Firstly, the participant had to declare to be a physiotherapist and lecturer in a BSc in Physiotherapy in Italy. Then, participants' demographic characteristics were investigated: age, gender, number of years as lecturers, Italian region of the University they were lecturing, and subject(s) they lectured.

In section 3 (questions 10 to 12), the participants had to agree with three statements about their perceived level of knowledge of digital technologies in education, their perceived confidence in using technologies, and their frequency of use of digital tools in the academic year 2022-2023. We chose not to investigate previous academic years because we believe that the COVID-19 pandemic particularly influenced the use of technology in education in those years. Questions in this section were based on the nine clusters of digital technologies identified through the preliminary literature review.

Qualitative Section

Section 4 (questions 13 to 17) was optional and included four open-ended questions to qualitatively investigate the advantages and disadvantages of digital resources and factors limiting and facilitating the use of technology in physiotherapy higher education.

Data Collection

The implemented survey instrument was disseminated online between June 15 and September 25, 2023, through *Microsoft 365 Forms*, a secure web application compliant with the European General Data Protection Regulations (EU Regulation 2016/679) designed to build and manage online surveys and databases while ensuring data encryption, controlled access, and privacy protection throughout the data collection process (41). Consent for participation was gained at the beginning of the survey after a brief cover letter outlining the study's aim and duration. It was necessary to proceed and complete the survey. Completion of the survey instrument was anonymous and entirely voluntary. Researchers' contact details were supplied to enable any questions or concerns to be answered before completing the online survey instrument. Respondents were able to review and change answers before submitting the questionnaire. To submit the questionnaire, all questions had to be answered.

Participants

This study included physiotherapists who had taught for at least one academic year before enrolling in the study. To ensure that participants had these characteristics, at the beginning of section one of the survey instrument, we asked if they had a degree in Physiotherapy and if they had taught for at least one academic year in Italy. People who answered "No" to at least one of these two questions could not continue the survey.

An open survey design was employed. Participants were reached by sending out the online version of the survey instrument link via e-mail through the course leaders of different 'Physiotherapy' Bachelor of Science (BSc) courses. To get in touch with them, we contacted the National Commission for Degree Courses in Physiotherapy, which shared our survey link with the course leaders. This entity coordinates the educational activities of physiotherapy degree programs in Italy and comprises course leaders from Physiotherapy BSc programs across Italy. No incentives were offered to participants to complete the survey instrument. Responses were solicited twice via an e-mail reminder during the data collection period.

Data Analysis

Quantitative Data Analysis

Demographic and Academic Characteristics of the Sample

Descriptive analysis was carried out to understand demographic and academic characteristics. The open answers to question 9 (the lecture's title) were categorized based on the type of subjects (i.e., musculoskeletal rehabilitation, neurological rehabilitation, cardiovascular and chest physiotherapy, urogynecological rehabilitation, oncological rehabilitation, geriatric rehabilitation, pediatric rehabilitation, professional laboratory, anatomy and kinesiology, professional ethics and management, research methodology, aids, and assistive technologies). The categories were identified based on physiotherapists' specific competence areas defined by the Italian professional profile and the deontological code (www.aifi.net).

Knowledge and Confidence in Using Digital Technologies

A 5-point Likert-type scale was used to measure the perceived knowledge (question 10) and confidence (question 11)

in using digital tools. The scale ranged "completely false" (score 1), "partially false" (score 2), "neither true nor false" (score 3), "partially true" (score 4), and "completely true" (score 5) (42). Participants who considered the statement partially or completely true agreed with the statement, with 70% of the agreement considered consensus (43,44). The frequencies of the answers were reported in a table and graphically represented in a bar chart.

Frequency of Use of Digital Technologies

Participants indicate how frequently they used digital technologies in the last academic year (2022-2023) with a 5-point Likert scale ranging "never" (score 1), "rarely" (score 2), "occasionally" (score 3), "often" (score 4), "always" (score 5). Frequencies were calculated and reported in a table.

Qualitative Data Analysis

Thematic Analysis (TA) was used to analyze the open answers reported in Section 4 (questions 14-17). The analysis process followed the principles of Braun's and Clarke's "Reflexive Thematic Analysis" (RTA). RTA is an interpretive method for analyzing qualitative data that enables identifying and examining patterns or themes within a given dataset (45-48). See Supplementary 3 for further information and theoretical framework.

Integration

Integration was conducted to enhance validation and identify further insights through triangulation of quantitative and qualitative results. Comparisons between quantitative and qualitative findings were interpreted in terms of three possible outcomes (36): (1) confirmation (when quantitative results reinforced qualitative results or vice versa), (2) expansion (when quantitative and qualitative results diverged and helped expand insights by addressing different or complementary findings), and (3) discordance (when quantitative and qualitative findings contradicted or disagreed with one another). In this study, quantitative and qualitative data were analyzed independently using appropriate methods for each data type as described above. Quantitative data were analyzed first, followed by the independent analysis of the qualitative data. No priority was given to one kind of data over the other. No transformation processes (e.g., from quantitative to qualitative or vice versa) were applied. Instead, findings were integrated during the interpretative phase, where results from both datasets were systematically compared to identify convergences, divergences, and complementary insights (36).

Results

Quantitative Analysis

A total of 156 people accepted the invitation to participate in the study, and 118 (age: 45 ± 11, 69% female) completed the survey instrument between June and September 2023. Among them, 77 (age: 44 ±11, 68% female) also completed the optional (qualitative) section 4. Only questionnaires with at least sections 1 to 3 completed were analyzed, as Microsoft Forms 365 does not record submissions where mandatory fields are left blank, and the quantitative section was compulsory. Descriptive characteristics are reported in Table 1.

Perceived Knowledge of and Confidence in the Use of Digital Technologies

Regarding knowledge of the possibilities of using digital technologies in education, consensus was achieved for 5 (56%) out of 9 statements (Figure 1). Physiotherapists declared to know the potential of tools for video conferencing and remote synchronous lessons (95%), online repositories (88%) and learning management systems (82%), tools for blended and asynchronous learning (80%), apps for communication (78%). Regarding confidence in using digital technologies in

TABLE 1 - Participants' demographic characteristics

Descriptive Data	
Age [years (mean, SD)]	45 (11)
Gender [N, (%)]	
Female	81 (69)
Male	37 (31)
Other	0 (0)
Years as lecturers [N, (%)]	
Less than 1 year	4 (3)
1-2 years	18 (15)
3-4 years	23 (20)
5-10 years	32 (27)
More than 10 years	41 (35)
Area of Italy where they lecture [N, (%)]	
North	97 (82)
Center	16 (14)
South	5 (4)
Lectures' topic [N, (%)]	
Musculoskeletal rehabilitation	25 (18)
Neurological rehabilitation	21 (15)
Cardiovascular and chest physiotherapy	10 (7)
Urogynecological rehabilitation	6 (4)
Oncological rehabilitation	6 (4)
Geriatric rehabilitation	8 (6)
Pediatric rehabilitation	4 (3)
Professional laboratory	25 (18)
Anatomy and kinesiology	12 (9)
Professional ethics and management	7 (5)
Research methodology	10 (7)
Aids and assistive technologies	3 (2)

Legend: SD, standard deviation; N, number.

higher education, consensus was achieved for 3 (33%) out of 9 statements (Figure 2). Participants declared themselves to be capable of using apps for communication, tools for video conferencing and remote synchronous lessons, and online repositories and storage systems. Raw data are reported in Table 2 and Table 3.

Frequency of Use of Digital Technologies

Referring to the last academic year 2022–2023, most participants declared they never used virtual reality (81%), forums and online study groups (65%), social media (65%), audience response systems (62%), tools for blended or asynchronous learning (45%), apps for communication (37%) and learning management systems (36%). Tools for video conferencing and remote synchronous lessons were often used by lecturers (20%), as well as online repositories and storage systems. Raw data are reported in Table 4.

Qualitative Analysis: Lecturers' Experience Using Technology

A total of 77 physiotherapists (age: 44 ± 11, 68% female) agreed to participate in the optional section of the survey instrument and answered four open questions about their experience using digital technologies in physiotherapy higher education. Most of them had been teaching for more than ten years (31%), 30% had been teaching for 5-10 years, 19% for 3-4 years, 16% for one or two years and 4% for less than one year. Three themes were developed from the analysis of the lecturers' answers: 1) Technology can promote a constructive educational approach, 2) Action of technologies on students' learning process, and 3) Technology is not within everyone's reach. Supplementary 4 contains all the quotations and codes behind the themes.

Theme 1: Technology Can Promote a Constructive Educational Approach

Lecturers identified various advantages of integrating technology in education and promoting a constructive educational context, leading to the theme: "Technology Can Promote a Constructive Educational Approach" (see Supplementary 4 for quotations and codes). These advantages include the ability to easily store and share data and resources, greater accessibility, and flexibility in teaching, described as *close to the world where students come from*.

TABLE 2 - Perceived knowledge and confidence in using digital technologies

I am aware of the possibility of using the following tools [N, (%)]	Completely false	Partially false	Neither true nor false	Partially true	Completely true
Tools for video conferencing and remote synchronous lessons	1 (0)	1 (1)	5 (4)	19 (16)	93 (79)
Online repositories and storage systems	0 (0)	9 (8)	5 (4)	25 (21)	79 (67)
Learning Management Systems	12 (10)	5 (4)	4 (3)	40 (34)	57 (48)
Tools for blended learning and/or asynchronous e-learning	4 (3)	8 (7)	12 (10)	40 (34)	54 (46)
Apps for communication	6 (5)	5 (4)	15 (13)	26 (22)	66 (56)
Social media	10 (8)	9 (7)	21 (18)	35 (30)	44 (37)
Forums and online study groups	7 (5)	15 (13)	28 (24)	39 (33)	30 (25)
Audience response system	34 (29)	20 (17)	10 (8)	31 (26)	23 (19)
Virtual reality interfaces	32 (27)	24 (20)	28 (24)	22 (19)	12 (10)

Legend: N, number.

TABLE 3 - Perceived confidence in using digital technologies

I feel confident in using the following tools [N, (%)]	Completely false	Partially false	Neither true nor false	Partially true	Completely true
Tools for video conferencing and remote synchronous lessons	4 (3)	3 (3)	5 (4)	37 (31)	69 (58)
Online repositories and storage systems	3 (3)	6 (5)	10 (8)	42 (36)	57 (48)
Apps for communication	7 (6)	6 (5)	12 (10)	31 (26)	62 (53)
Learning Management Systems	18 (15)	11 (9)	13 (11)	45 (38)	31 (26)
Tools for blended learning and/or asynchronous e-learning	9 (8)	13 (11)	23 (19)	40 (34)	33 (28)
Social media	14 (12)	12 (10)	26 (22)	29 (25)	37 (31)
Forums and online study groups	17 (14)	20 (17)	33 (28)	27 (23)	21 (18)
Audience response system	44 (37)	20 (17)	18 (15)	19 (16)	17 (14)
Virtual reality interfaces	61 (52)	22 (19)	14 (12)	16 (14)	5 (4)

Legend: N, number.

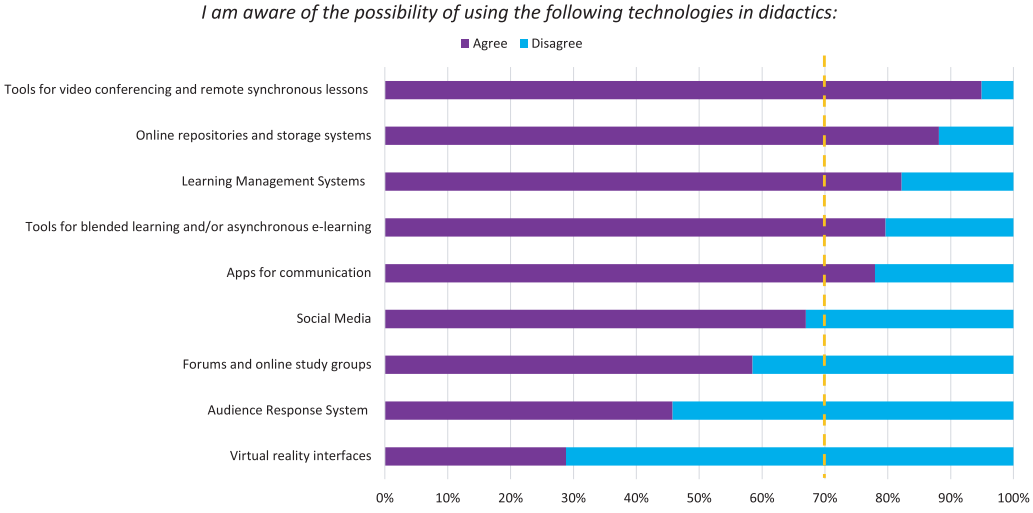

FIGURE 1 - Knowledge of digital technologies

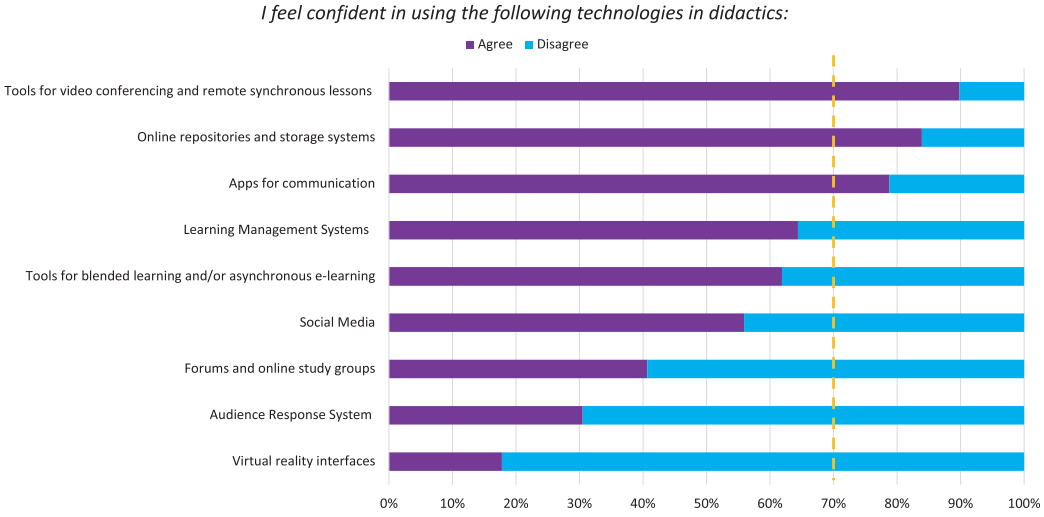

FIGURE 2 - Confidence in the use of digital technologies

They emphasized improved communication and inclusivity enabled by digital tools, which *encourages the participation of even the most timid students*. Digital technology is also a *great support during lessons and for students with difficulty*, allowing the inclusion of students who could not reach the University through distance learning methods. Regarding interactivity, opinions differed: some believed technology increased lesson interactivity, while others felt it did not facilitate interaction, especially in distance learning. Technology enhances lessons and diversifies teaching tools and methodologies, offering blended or asynchronous learning flexibility. Distance learning was viewed as inclusive, accessible, cost-effective, and able to *reduce climate-altering emissions and time lost* by eliminating travel issues. Some participants argued that digital technologies optimize time, though others noted the need for more preparation time and the risk of wasting time during lessons. Nevertheless, technology supports lecturers in organizing resources and lessons, being an *extra tool for the teacher to manage students and lessons* and allowing the provision and receipt of real-time feedback while easily tracking teaching progress. From the lecturers' perspective, using digital technologies completes the educational process and helps achieve educational objectives, increasing effectiveness. A key issue was in clinical practice, where participants recognized the usefulness of virtual reality and simulations but expressed concerns about a potential reduction in hands-on experience in natural settings.

Theme 2: Action of Technologies on Students' Learning Process

Digital technologies can impact each student's learning process, leading to the theme: "Action of Technologies on Students' Learning Process" (see Supplementary 4 for

TABLE 4 - Frequency of use of digital technologies in the last academic year

How often did I use digital tools in the last academic year? [N, (%)] N = 118	Never	Rarely	Occasionally	Often	Always
Learning management systems	42 (36)	6 (5)	16 (14)	32 (27)	22 (19)
Online repositories and storage systems	19 (16)	12 (10)	23 (19)	34 (29)	30 (25)
Tools for video conferencing and remote synchronous lessons	24 (20)	11 (9)	24 (20)	37 (31)	22 (19)
Tools for blended learning and/or asynchronous e-learning	53 (45)	13 (11)	20 (17)	24 (20)	8 (7)
Social media	77 (65)	10 (8)	10 (8)	16 (14)	5 (4)
Apps for communication	44 (37)	17 (14)	19 (16)	15 (13)	23 (19)
Forums and online study groups	77 (65)	12 (10)	10 (8)	12 (10)	7 (6)
Audience response system	73 (62)	13 (11)	13 (11)	10 (8)	9 (8)
Virtual reality interfaces	95 (81)	10 (8)	10 (8)	2 (2)	1 (1)

Legend: N, number.

quotations and codes). The analysis showed that digital tools positively affect students' motivation and engagement. Lecturers agreed that technology supports and accelerates learning, stimulates cooperative learning, and is *excellent for thesis writing or group work meetings*. It facilitates in-depth study and integrates diverse information sources. However, some noted that the rapid pace of digitalization might hinder reflective abilities: *not always everything has to be so fast*. Regarding attention, some felt digital tools enhanced participation and attentiveness, while others believed remote learning and pre-prepared materials might reduce focus during lectures. Regarding interpersonal relationships, lecturers observed that distance learning could diminish human interactions, raising concerns about depersonalization and student passivity, who *may never feel part of the academic journey*. This detachment might adversely affect the acquisition of professional relational skills indispensable for aspiring physiotherapists.

Theme 3: Technology is Not Within Everyone's Reach

Lecturers reported several challenges hindering the effective integration of digital technologies in physiotherapy higher education. This consideration led to the theme: "Technology is Not Within Everyone's Reach" (see Supplementary 4 for quotations and codes). Participants raised concerns about inadequate infrastructure, tool functionality, and university connectivity. They highlighted the need for financial resources, better equipment, and economic incentives for lecturers. Significant obstacles were the lack of university support, comprehensive information, and regulations on using digital technologies in higher education. Robust academic regulations and well-informed guidelines are needed to help lecturers adopt technology and promote blended learning. Finally, another limiting factor reported was "technological illiteracy." Digital tools are used inappropriately and unwittingly because of the lack of knowledge and specific technological skills. The difficulty in using technology was seen as influenced by the age of both lecturers and students. Participants emphasized the need for continuous training for lecturers and the importance of exchanging information among them. Finally, they stressed that lecturers' mentality, motivation, and willingness to change are key to innovation, along with *collaboration with and interest of the students*.

Integration

Integrating quantitative and qualitative findings revealed both confirmation and expansion of the results. Quantitative findings regarding knowledge of digital technologies demonstrated by participants were confirmed by qualitative insights, which emphasized the benefits of digital tools in enhancing accessibility, flexibility, and educational outcomes. Concerning the lack of confidence and the low frequency of use of digital technologies highlighted by the quantitative data, the qualitative findings expanded upon these insights. Specifically, qualitative responses detailed significant barriers and difficulties faced by lecturers in Italian universities, uncovering nuanced perspectives on the challenges of technology adoption, such as inadequate infrastructure, lack of training, and digital literacy gaps, which were not explicitly addressed in quantitative results.

Discussions

This study investigated the perceived knowledge, confidence, and frequency of use of digital technologies in the context of Italian physiotherapy higher education. Our results reflect the literature evidence revealing a general underutilization of digital technologies in physiotherapy education, limited knowledge, confidence, and use of these tools among lecturers, as well as persistent barriers to their integration.

Knowledge of and Confidence in Digital Technologies

Our findings show limited knowledge and confidence in digital tools for physiotherapy education, consistent with previous research on the lack of systematic adoption and reliance on intuitive use (29). Video conferencing and remote lesson tools were the most familiar, likely due to their rapid adoption during the COVID-19 pandemic. These tools' flexibility and cost-effectiveness align with the advantages

noted by Vaona et al. (2015) (7). However, many educators expressed concerns about reduced in-person interaction that could lead to a sense of detachment among students, supporting the view that digital tools should complement rather than replace traditional teaching (7,25,44). Aligning with previous research, there was also agreement on the importance of apps and communication tools for maintaining interaction and feedback exchange, which is beneficial for analyzing and adapting activities during lessons (13,30). Lecturers acknowledged that virtual reality might support practical activities in professional laboratories, which aligns with Lucena-Anton and colleagues' statements (2022) (16). However, concerns were raised about the potential devaluation of hands-on experience, which is essential in physiotherapy education. Our findings suggested that integrating various digital resources enables diverse didactic strategies and communication channels, enriching educational offerings. According to previous research, personalized learning experiences, supported by well-aligned technologies and clear learning objectives, enhance students' achievement of their goals (29,45).

Frequency of use

Our findings, consistent with previous studies, revealed that digital technologies were rarely used to support teaching (22,30,31). However, tools for videoconferencing, communication apps, and learning management systems saw high usage rates. These technologies help organize and share didactic materials and create innovative online environments that facilitate active and cooperative learning, promote interaction and collaborative learning, and foster critical thinking (5,44).

Barriers to Implementation

Despite our participants appreciating the benefits of digital technologies, their use remains constrained by several challenges and deficiencies. Technical issues such as inadequate infrastructure and outdated devices were major challenges, emphasizing the need for strong technical support and infrastructure for effective technology use, as reported elsewhere. Revising regulations to foster a blended approach that combines in-person and online learning may offer a more deliberate framework for effectively leveraging technology in higher education (7,25).

Participants underscored internal factors like "technological illiteracy," highlighting the need for better training, organizational support, and incentives from universities. This supports the views of Royal et al. (2016), who stated that being a good lecturer requires continuous knowledge updates, collaboration with education specialists, and considering and studying education as a subject of its own (51). Although Italian universities offer services through "Teaching and Learning Centers" to promote teaching quality and encourage lecturers' training, these services appear underutilized.

Time is crucial for participants, especially since many physiotherapists work simultaneously in University and clinical settings. Another challenge is the resistance to change reported by lecturers, who need help to innovate teaching methodologies. Successful introduction of innovative student-centered approaches relies on the motivation and willingness of lecturers to embrace change, together with students' interest and collaboration (52).

Implications for Education and Research

Our findings underscore the need for targeted interventions to enhance digital technology adoption in physiotherapy education. Universities should provide clearer guidelines and stronger institutional support to foster a blended learning approach that integrates digital and traditional methods effectively. Investments in infrastructure, comprehensive training programs, and incentives for lecturers are crucial for overcoming technical and organizational barriers. Educators must engage in continuous professional development to align their teaching practices with technological advancements. Future research should investigate strategies to increase lecturer and student engagement with digital tools, assessing their impact on learning outcomes and professional preparedness. Furthermore, examining the potential of virtual reality and other immersive technologies could reveal innovative applications for practical learning in physiotherapy.

Strengths and Limitations

Some limitations and strengths of these studies and possible biases need to be acknowledged. This study provides valuable insights into the challenges and opportunities of integrating digital technologies in Italian physiotherapy education. The mixed-methods approach allowed us to capture both quantitative trends and qualitative nuances, enriching the understanding of lecturers' experiences to explore the phenomenon's complexity better. However, our study had some limitations that should be acknowledged. Firstly, our findings were based on a survey instrument created ad hoc by the research team relying on the latest evidence and the individual experience. Calculating the sample size or response rate was impossible, as the total number of physiotherapists who serve as lecturers in Italian physiotherapy degree programs is undefined. Besides, most participants were women, and most of them lived in a similar geographical area (i.e., northern Italy), which could affect the generalizability of the results. We were aware of the risk of selection bias and attempted to mitigate it by distributing the survey across all regions and universities in Italy. We also ensured anonymity to minimize the potential for social desirability bias. Regarding the risk of recall bias, we narrowed the recall period to the previous academic year. We provided clear definitions and examples of the tools mentioned in the questionnaire to enhance the accuracy of participants' responses. For digital bias, we prioritized accessibility by providing clear instructions and user-friendly interfaces, ensuring compatibility across different devices (smartphones, tablets, or computers). To mitigate response bias, we assured anonymity and adopted neutral language to avoid influencing respondents' answers. To address time and availability bias, we offered flexible timing for participants and sent reminders to potential respondents. Finally, to obtain a more representative

sample of participants and ensure that all participants had an equal likelihood of being selected, we sampled from different institutions across Italy.

Conclusions

Despite the literature highlighting the importance of using digital technologies in higher education, our findings indicated that the frequency of use of digital technologies in the last academic year was generally low, and there was a lack of knowledge and confidence in the use of most of the investigated digital tools by the lecturers. However, the lecturers recognized the potential benefits of these capabilities. Among the main factors limiting the introduction of technologies in didactics are the lack of adequate infrastructure and organizational support in universities and the lack of lecturers' digital competencies. Further studies are needed to clarify barriers to the use of technologies better and improve lecturers' adherence to the use of digital tools.

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