

Educational Innovations in Undergraduate Health Care: A Scope Review

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Abstract

Higher education has undergone a series of significant transformations in recent decades, driven by advances in technology and the demands of a constantly evolving world. This scoping review investigated educational innovations in health education, guided by the transformations resulting from technological advances and the dynamic demands of contemporary society. The study was carried out based on the recommendations of the Joanna Briggs Institute (JBI) protocol and the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist. The search engines used were PubMed Central, Virtual Health Library (VHL) and Embase, through the Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) with Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH). After reading and analyzing the 17 articles selected, three categories emerged: "Active study methodologies"; "Learning technologies"; and "Integration between active methodologies and technologies as a teaching strategy". Active study methodologies, such as problem-based and team-based learning and the use of real clinical scenarios, have been shown to be effective in promoting student involvement in the learning process. The use of learning technologies, such as virtual reality, online simulations and mobile health applications, complements and enriches health teaching. The integration of active methodologies and digital technologies is emerging as an essential strategy for health teaching in the contemporary era.

Keywords: health education, technological innovations, educational technologies, professional training in health

1. Introduction

Higher education has undergone a series of significant transformations in recent decades, driven by advances in technology and the demands of a constantly evolving world. The COVID-19 pandemic has brought unexpected challenges, but it has also stimulated the search for educational innovations in health courses, especially in the ways they are conceived and propagated (Ho et al., 2021). The literature review elucidated three key specific aspects surrounding educational innovations in undergraduate health courses: study methodologies, learning technologies and the integration of technologies and active methodologies as a teaching strategy.

Study methodologies in undergraduate health courses have evolved to adapt to the profile of contemporary students. Initiatives such as the use of problem-based learning (Monteiro et al., 2018) and active methodologies (Macedo et al., 2018) have stood out for providing a more dynamic and participatory learning environment. In addition, the integration of digital technologies into medical education has been a major trend (Silva et al., 2022), providing access to interactive resources and simulation tools that enrich the training of future health professionals (Wang et al., 2022).

The healthcare job market is also undergoing changes, with a growing focus on quality and safety in patient care. In this sense, quality improvement training initiatives (Brown; Sreenan & McGarvey, 2019) have been implemented, preparing students to work in a constantly evolving healthcare system. In addition, research into innovation in nursing leadership has contributed to training professionals who are better prepared to take on leadership roles in healthcare (Machon, Cundy & Case, 2019).

Interpersonal skills are equally crucial in the training of health professionals. Innovative approaches, such as the use of photographic narratives (Leyva-Moral et al., 2022), are being explored to improve the communication and empathy of future doctors. These skills are fundamental not only for a better doctor-patient relationship, but also for teamwork and interprofessional collaboration (Lomis et al., 2020).

In this context of transformations, it is essential to analyze educational innovations in undergraduate health education and understand how these changes are shaping the profile of future health professionals. This research aims to explore innovations in health education in contemporary times, with the following guiding question as its central guide: What are the educational innovations in undergraduate health education in recent years? By directing our research towards uncovering this constantly changing scenario, we seek to elucidate the nuances and contributions that shape the educational panorama in health.

This study aimed to investigate innovations in health teaching, guided by the transformations resulting from technological advances and the dynamic demands of contemporary society.

2. Method

This is a scoping review, with the aim of mapping the main definitions and scientific evidence on a given topic, based on available studies and analyses (Cordeiro & Baldini, 2019).

The study was carried out based on the recommendations of the Joanna Briggs Institute (JBI) protocol (Peters et al., 2020). In order to ensure methodological rigor during the writing and review, the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist was used, which contains twenty mandatory items and two optional items in the composition of a scoping review (Tricco et al., 2018).

2.1 Identification of the Study and Research Question

The process began with the definition of the research question, following the structure of the acronym PCC. The letter "P" refers to the population; "C", to the concept; and "C", to the context. The following research question was formulated: "What are the educational innovations in undergraduate healthcare in recent years?"

In order to search for and identify relevant studies, descriptors were carefully chosen that addressed the topic of innovation in higher education in health. Descriptors indexed in Portuguese and English were used in the Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH). Boolean operators "AND" and "OR" were applied, restrictively and additively, respectively, as shown in figure 1.

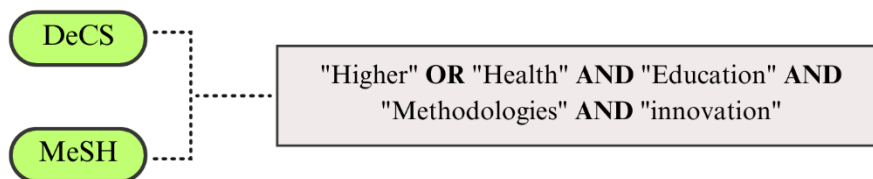


Figure 1. Arrangement of descriptor sets and Boolean operators used to search for and identify relevant studies

Source: authors, 2024.

2.2 Eligibility of the Bibliographic Collection

To compose the bibliographic collection, searches were conducted in three academic databases, PubMed Central, EMBASE, through the Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and the Virtual Health Library (VHL). Table 1 shows the description of the search strategies carried out in the databases, as well as the cross-referencing of the descriptors and the number of studies found.

Table 1. Strategies for crossing descriptors, databases and number of studies found

| Crossing strategies | Database | Number of studies found |
|---|----------------|-------------------------|
| ("Higher" OR "Health" AND "Education" AND "Methodologies" AND "innovation") | Pubmed | 167 |
| | Capes - embase | 155 |
| | VHL | 73 |

Source: authors, 2024.

The following inclusion criteria were established for the eligibility of the bibliography: articles published in Portuguese or English, published from 2016 onwards, in national or international journals, with a quantitative or qualitative focus, in the areas of health education, health innovation and higher education. The articles were refined based on these inclusion and exclusion criteria, excluding studies involving animals.

2.3 Analysis of the Bibliographic Collection

To analyze the articles found, we used the Rayyan platform, a free online software from the Qatar Computing Research Institute (QCRI). Two independent researchers excluded duplicate articles and read the titles and abstracts of the articles found. Then, after applying the inclusion and exclusion criteria, the articles selected in the first stage were read in full. To extract the data, a spreadsheet was created in which the following columns were created: Title, Category, Digital Object Identifier (DOI), Uniform Resource Locator (URL), Reviewer 1 (GS), Reviewer 2 (PHGB), Decision, Reviewer, Final Decision, Comments, Year, Journal, Authors and Language. Initially, reviewers 1 and 2 independently read the articles and, based on the inclusion criteria, included or did not include the article, adding 1 or 0 respectively. If the sum was 2, the article was included, if it was 1, another evaluator decided on inclusion and if it was 0, the article was excluded.

After the final reading, the evaluators identified similar themes in the approach of the studies and placed them in the Category column. Thus, the results and discussion of this scoping review focus on innovations in health education with a focus on the following themes: teaching methodologies, teaching technologies and integration between technologies and active methodologies as a teaching strategy.

3. Results

A total of 395 articles were found using the descriptors mentioned. In the first refinement phase, 61 articles were included, of which 14 were conflicting. To include the articles in this scoping review, a quality search was carried out, with clear and relevant methodological rigor.

For the conflicting articles, the researchers carried out a joint check and analysis and only after consensus was reached was the final exclusion and inclusion of the selected articles. After the final analysis, following the inclusion and exclusion criteria, 17 articles were selected, as shown in figure 2.

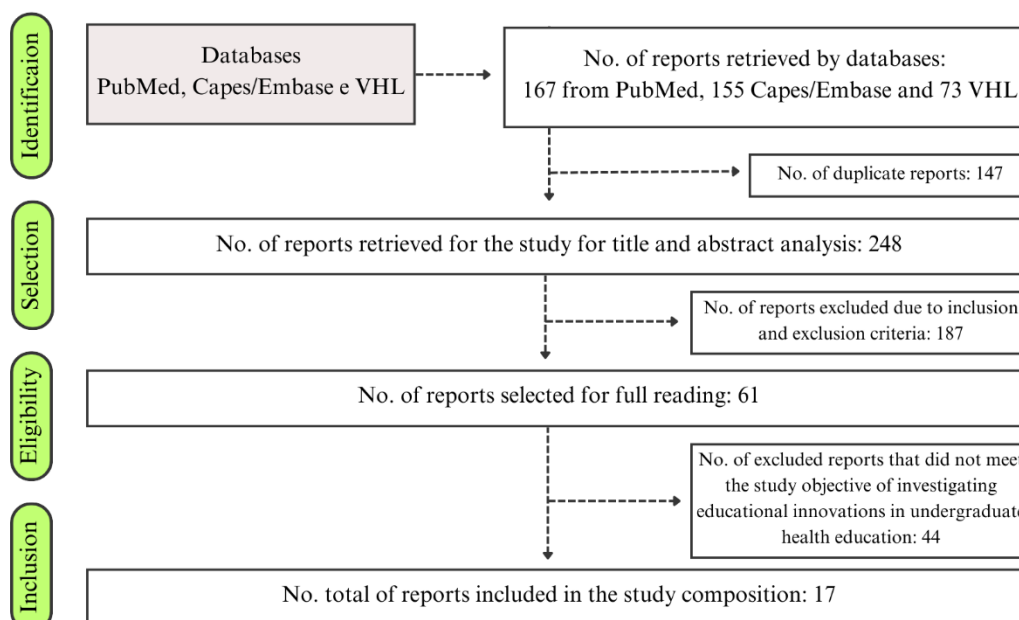


Figure 2. Flowchart of the route to retrieve publications from the databases.

Source: PRISMA-ScR, 2024.

Reading the selected articles in full led to a description of them in terms of year, title, author, study objective and study design, as shown in Table 2.

Table 2. Description of the articles selected according to year, title, author, objective and study design

| Article no. | Year | Title | Author | Objective of the study |
|-------------|------|---|---|---|
| A1 | 2017 | Impact of an iDevice application on student learning in an occupational therapy kinesiology course | Hughes, J. K. & Kearney, P. | Evaluating the impact of an iDevice application on student learning in an occupational therapy kinesiology course. |
| A2 | 2018 | Evaluating mobile applications for health teaching: a systematic review | Filho, E. M. B. Kubrusly, M. & Silva, C. L. | Obtain an overview of how mobile applications are being used to aid teaching in the health field. |
| A3 | 2018 | Medical Training at UFSB: III. Problem and Competency Oriented Learning | Filho, N. A., et al. | To discuss the concept of "competence" in conjunction with the demands of an expanded, citizen and professional education, incorporating resolute technologies into humanized care and health work processes. Present tools and active learning methodologies. |
| A4 | 2018 | Active learning methodologies: possible paths for innovation in health teaching | Macedo, K. D. S., et al. | Report on the experience of teachers in discussing active learning methodologies as a problematizing pedagogical strategy for higher education in health. |
| A5 | 2020 | Virtual and augmented reality: Implications for the future of nursing education | Mendez, K. J. W., et al. | Describe virtual reality and augmented reality technologies available for nursing education and discuss the implications of virtual and augmented reality for future nursing education. |
| A6 | 2020 | State of the art on nursing education and the challenges of using remote technologies in times of the Corona Virus pandemic | Bezerra, I. M. P. | To describe the state of the art in nursing education and the challenges of using remote technologies in times of the Coronavirus pandemic. |
| A7 | 2020 | Learning musculoskeletal anatomy through new technologies: a randomized clinical trial | Rodríguez-López, E. S., et al. | To investigate the influence of the application of new learning methodologies and student motivation in the subject of Anatomy. |
| A8 | 2020 | The Fellows Project: Education Skills for Health Profession Students | Caramori, U., et al. | To improve the training of undergraduate health students who are interested in pursuing a career in education and teaching in their professional life; to promote, through active methodologies, education and training so that these students become familiar with strategies for education, leadership, management, interdisciplinarity and teamwork and professional development, with a view to a future teaching career; to put knowledge into practice by developing a teaching project (teamwork) for health students, developed in different teaching-learning scenarios, preferably in locations in the Unified Health System (SUS). |
| A9 | 2020 | The clinical method, model competence in the learning medical education | Galván-Morales, M. A., Nepomuceno, F. M. & Palomar-Morales, M. E. | Present a brief overview of the incursions of pedagogy into medicine and the clinical method as a non-static technique or discipline that evolves with changes in knowledge. |
| A10 | 2021 | Advancing Medical Education Through Innovations in Teaching | Ho, P. A., et al. | Examine emerging teaching methodologies to understand the opportunities available to medical education to innovate our teaching practices for students in the midst of the |

| | | During the COVID-19 Pandemic | | COVID-19 pandemic. |
|-----|------|--|--|---|
| A11 | 2021 | Innovations in the teaching-learning process of psychiatric nursing and mental health | Tavares, C. M. M., et al. | To learn about innovative pedagogical experiences developed by teachers in the teaching of psychiatric nursing and mental health in undergraduate nursing courses at public universities in the state of Rio de Janeiro. |
| A12 | 2021 | Learning of social skills in nursing students according to the methodology in the classroom | Pando, D. G., et al. | To evaluate different methodologies available for training nursing students in social skills. |
| A13 | 2022 | Active methodologies and digital technologies in medical education: new challenges in times of pandemic | Silva, D. S., et al. | To analyze the use of digital technologies in medical and health education, highlighting their association with the main forms of active methodologies and the challenges of remote access education, in the context of the Covid-19 pandemic. |
| A14 | 2022 | Nursing students' perceptions of the efficacy of narrative photography as a learning method: A cross-sectional study | Leyva-Moral, J. M., et al. | To determine nursing students' perception of the effectiveness of narrative photography as a learning method, including self-perception of satisfaction. |
| A15 | 2022 | The use of active methodologies and technologies for innovative health education: an integrative review | Schmidt, C. L., Souza, A. O. & Silva, L. | To understand how active methodologies and technology have been used in the process of training health professionals. |
| A16 | 2023 | Engaging large classes of higher education students: a combination of spaced learning and team-based learning | Carlos, V., et al. | Implement Team-Based Learning (TBL) and Spaced Learning (SL) to measure pedagogical innovation to promote collaboration among students, keep them engaged throughout the semester, and keep the teacher satisfied through student participation in class and positive feedback. |
| A17 | 2023 | Understanding the inclination of South Indian nursing graduates in using mobile learning applications | Milton, C. & Subramaniam, A. | To explore the feasibility, familiarity, usefulness and attitude of nursing graduates in South India towards mobile learning applications. |

Source: authors, 2024.

After in-depth reading and analysis of the selected articles, three categories emerged, namely: "active study methodologies"; "technologies for learning"; and integration between technologies and active methodologies as a teaching strategy, as described in Table 3.

Table 3. Categorization of studies according to predominance of content

| Category | Categorization of studies | Educational innovations |
|---|------------------------------------|---|
| Active methodologies | teaching A3, A4, A9, A12, A14, A16 | Commitment to Meaningful Learning (CML); Active Learning Teams (ALT); Integrated Shared Learning System (ISLS); Problem and Competency Oriented Learning (PCOL); Problem and Evidence Oriented Record (PEOR); Assessment; Portfolio; Concept Map; Clinical Method; Collaborative Learning; Narrative Photography; and Integration between Team Based Learning (TBL) and Spaced Learning (SL). |
| Learning technologies | A1, A2, A5, A17 | Mobile Applications, Virtual Reality and Augmented Reality. |
| Integration of technologies and active methodologies as a teaching strategy | A6, A7, A8, A10, A11, A13, A15 | Remote technologies, Use of 3D images associated with prior theorizing, Telemedicine, Online curriculum, Virtual rotations, Virtual conferences, Virtual simulations, Learning consortia, Gamification, Virtual learning environment, Virtual learning object, Educational technologies and software. |

Source: authors, 2024.

4. Discussion

The verb "to teach" comes from the Latin *insignare*, meaning "to mark with a sign" and this sign would be that of life, search and awakening to knowledge. The word "strategy" comes from the Greek and Latin "strategia", and is based on the art of applying or exploiting favorable and available means and conditions to achieve specific goals. In this context, teachers become excellent strategists, as they must study, select, organize and propose the best tools to facilitate students' appropriation of knowledge (Anastasiou & Alves, 2015).

It can be said that higher education institutions have been shaping their learning profiles by transforming their teaching processes. The traditional method, which involves memorizing through reading, showing slides and listening, is being replaced or associated with more complex active practices that involve talking, debating, illustrating, reproducing, dramatizing, teaching and exposing summary ideas, favoring the retention of information and its transformation into knowledge (Roman et al., 2017).

The discussion on educational innovations in undergraduate health education is gaining relevance in the context of rapid technological evolution and the complex demands of contemporary society. Health education, geared towards responding to these demands, must incorporate innovative pedagogical strategies, advanced learning technologies and preparation for changes in the job market, as well as emphasizing the development of interpersonal skills (Prober & Heath, 2012). The literature points out that such educational innovations have been classified as active study methodologies, learning technologies and the integration of active methodologies and technologies as a teaching strategy

4.1 Active Study Methodologies

Active study methodologies are becoming a significant approach to health teaching and have been described as educational innovations by promoting greater student involvement in the learning process. Studies such as Prober & Heath (2012) suggest that the combination of problem-based learning, team-based learning and the use of real clinical scenarios contribute to a deeper and more applicable understanding of health concepts.

A study (Filho et al., 2018) conducted among medical students at a Brazilian federal university reported that active learning methodologies, such as Meaningful Learning Engagement, Active Learning Teams, Integrated Shared Learning System, Problem and Competency Oriented Learning, Problem and Evidence Oriented Record, have emerged as effective educational innovations for training qualified professionals.

The Commitment to Meaningful Learning strategy inserts a perspective in which teaching is based on the student's

commitment to structuring rules for their own learning, being the author and producer of active and responsible knowledge, while the Integrated Shared Learning System (ISLS) encourages the student to become a tutor for students from previous cycles of the curriculum, acting as a mentor and providing the necessary support (Filho et al., 2018). From this perspective, ISLS reiterates the concept put forward by Paulo Freire (2001) that those who teach learn, as they recognize knowledge that has been learned before.

In this scenario, the Active Learning Teams (ALT) strategy also emerges, in which characteristics of the Problem Based Learning (PBL) and Team Based Learning (TBL) methodologies are integrated. While PBL is based on the student as the center of the educational process, instigating autonomy and the construction of their own knowledge, TBL appropriates dialogue and interaction, aiming to build knowledge in small groups (Roman et al., 2017). TBL integrates the construction and reconstruction of provisional syntheses in a shared way, in which information is acquired interprofessionally and students share responsibility for training their peers (Filho et al., 2018).

Similarly anchored is Collaborative Learning, a methodology in which teaching is provided through small interactive groups through a system of interdependencies and rewards. A study by Pando et al. (2021) carried out with undergraduate nursing students in Gijón, Spain, showed that teaching social skills through this strategy was associated with greater academic performance, motivation and student autonomy by stimulating collective coping with problem situations.

Problem and Competency Oriented Learning (PCOL) integrates the PBL, TBL and Evidence Based Medicine (EBM) approaches, EBM being a precept in which the scientific method is used to organize and apply current data to improve health decisions associated with the clinical experience of the health professional (Tenny & Varacalo, 2022). PCOL encourages collectivity and the construction of knowledge through problematization, associated with scientific research with elements of practical reality. In addition, this methodology stimulates interaction between students from different years and health courses in order to encourage interprofessional work (Filho et al., 2018).

Many educational innovations have integrated PBL and TBL approaches with other teaching strategies. According to Carlos et al. (2023), it is also possible to combine TBL with Spaced Learning (SL). SL is based on the rapid capture of information and advocates that long-term retention of information is improved if a long interval is inserted between the phases of the learning process. Therefore, the combination of the two strategies is incorporated by using the TBL stages with longer intervals between them. These intervals should include distractors unrelated to the lesson content (which do not stimulate the same neural memory pathways).

A narrative review (Galván-Morales, Nepomuceno & Palomar-Morales, 2020) on the teaching of medicine associated the application of the clinical method with PBL. With regard to the clinical method, this would be an outlined process, based on a sequence of actions, in which the medical student would develop knowledge through clinical practice. According to the study, the clinical method could be associated with PBL through case studies, raising hypotheses and searching for answers, favoring the process of analysis.

With regard to the clinical method, it could also be associated with other teaching strategies, such as classes or lectures, individual investigations by students, EBM through investigations of similar cases, case reviews and clinical records aimed at deepening the smallest aspects of the patient's clinical practice and meaningful learning, through learning medical procedures with real or simulated patients (Galván-Morales, Nepomuceno & Palomar-Morales, 2020).

According to Filho et al. (2018), it would also be possible to stimulate clinical reasoning through the Problem and Evidence Oriented Record (PEOR) strategy. PEOR suggests a more diversified model than the traditional medical record model, allowing not only patient information but also the integration of learning and healthcare provision. This tool would also help to obtain the final diagnosis, because when the evidence is scientifically justified, the "problem" would no longer be a diagnostic suspicion, but a final diagnosis.

Among other educational innovations, it is true that the use of assessment, portfolios and concept maps as teaching strategies has been gaining ground in university institutions. According to Macedo et al. (2018), assessment processes can go beyond a quantitative sum associated with grades, but also a learning tool capable of promoting self-knowledge, through the creation of objectives and assessment criteria based on cognitive skills (theoretical knowledge), practical skills (technical knowledge) and attitudinal skills.

The portfolio teaching strategy is marked by the development of the student and the teacher through the search for new knowledge, dialog and exchange of experiences. Macedo et al. (2018) cites that this teaching tool is able to establish a close and intense relationship between student and teacher so that the student commits to the problematization method. The concept map, on the other hand, is cited as a tool that should be built from a specific question, which should be broken down into details, arranged hierarchically, enabling understanding and learning.

Contemporary and alternative active methodologies are being applied as educational innovations. A cross-sectional study (Leyva-Moral et al., 2022) carried out in Barcelona, Spain, identified the Narrative Photography strategy as a teaching

method capable of developing imagination, meaningful interpretations, critical and creative thinking and empathy. This tool is based on encouraging students to read, watch and experience situations as if they were the main actors in them, asking questions such as: "how would you feel if something like this happened to you or your family?".

4.2 Learning Technologies

Digital technologies such as virtual reality, online simulations and mobile health applications have proved to be valuable resources for complementing and enriching health teaching and learning. George et al. (2014) points out that virtual reality can be used to simulate surgical procedures, allowing students to practice skills in a controlled environment and without risk to patients. These technological innovations not only improve students' technical skills, but also promote autonomous and continuous learning. According to Munir et al. (2023), most of the technological tools available for teaching are aimed at acquiring and retaining knowledge through mobile devices such as cell phones and tablets.

The study by Hughes & Kearney (2017) carried out with occupational therapy students at a university in the United States showed that a mobile app was effective in helping students learn kinesiology. Kinesiology determines muscle movement related to an individual's activities of daily living. The iDevice app in question was created to facilitate student learning with high quality content related to visual and textual information about muscle actions, the muscle(s) responsible for these actions, the axis of movement, as well as videos demonstrating goniometric measurements (joint range of motion).

Filho, Kubrusly & Silva (2018) found valuable insights into how these technologies are contributing to educational innovation in undergraduate health education in their systematic review on teaching health through mobile applications. The study denotes some characteristics of mobile apps that have been most effective in supporting health learning. This includes considering the usability of the apps, their interface and functionalities, as well as the quality of the educational content made available. In addition, it is essential to assess how mobile apps are taking advantage of advanced technological resources, such as augmented reality, artificial intelligence and gamification, to make learning more dynamic and engaging.

The findings culminate with the data found by Milton & Subramaniam (2023) in their quantitative study carried out with nursing students from university institutions in the states of Tamil Nadu and Kerala in India. The study found that among 447 students, 57.7% had learning apps on their cell phones, and 30% of them had downloaded at least 10 apps. The apps served a variety of purposes, including access to nursing information, test preparation and information on medicines. There was a greater acceptance of the use of technology in learning by students, mainly associated with the need to use it during the COVID-19 pandemic.

It has to be considered that, with the decrease in the value of smartphones, many individuals already own a mobile device, favoring the reality in which many academics can have access to mobile teaching devices (Oliveira & Alencar, 2017). With the advance of smartphones, there are now a wide variety of features on mobile devices such as video playback, photo displays and larger media storage spaces. With these features, mobile technologies can allow teachers and students to interact anytime, anywhere. Therefore, the use of mobile applications for learning, assessment and teaching in health is potential (Nascimento, 2021).

A systematic review (Filho, Kubrusly & Silva, 2018) identified in 39 studies that the areas of health that most use mobile apps for teaching are medicine, nursing, physiotherapy and biomedicine, with medicine predominating with 84.62%. Among the main specialties used are pediatrics, surgery, general practice, neurology, anatomy, anesthesia, psychiatry and cardiology. The main resources identified in health teaching apps were texts, images, quizzes, exercises with explanations of the answers, videos, annotations, 3D animations and graphics.

It is a fact that mobile learning applications are part of the transformations resulting from technological advances and the demands of contemporary society (Filho, Kubrusly & Silva, 2018). This innovative approach responds directly to the dynamic demands of contemporary society, which require health professionals to be not only technically competent, but also adaptable to new learning and communication technologies (Hughes & Kearney, 2017).

Still on the subject of the use of learning technologies, virtual reality and augmented reality stand out as possible innovative teaching strategies. Firstly, it is important to designate the semantic differentiation of the two methodologies, with virtual reality (VR) being related to a synthetic environment with three common characteristics, these being immersion, perception of the synthetic environment and interaction with that environment, while augmented reality (AR) would be a variation of VR, where digital content or objects are superimposed on the physical environment. AR has three defining characteristics: a combination of reality and virtuality, real-time interaction and 3D content. In addition, AR can expand to insert virtual images combined with the real world (Mendez et al., 2020).

In recent years, VR has been used in health education. Specifically in nursing, it is used in some disciplines to create virtual hospitals and situations that facilitate learning and clinical reasoning, allowing students to find a safe environment in the face of the complexity that exists in the real world. AR, although less used in nursing education, has been

implemented in pilot studies and prototypes aimed at mobile learning (mLearning), where students can access materials through hyperlinks that direct them to additional content, and has also been used to improve communication and safety at the bedside through glasses and headsets that provide augmented reality, increasing students' perception of realism.

4.3 Integration of Active Methodologies and Technologies as a Teaching Strategy

The World Health Organization (WHO) calls technological innovations with application in the health area e-Health, thus encompassing the provision of health resources, services and information. Currently, e-Health has become part of the health system, favoring clinical practice, reducing errors and improving the provision of health services more effectively (Fonseca et al., 2021). In this sense, it makes us wonder how these technological innovations have contributed to health teaching.

Remote technologies are the pinnacle of the history of integrating technological tools into health teaching, emerging as a strategy strongly associated with and motivated by the COVID-19 pandemic. With the need to continue classes in a non-face-to-face manner, remote technologies were introduced, thus bringing a new look at technological implementation in a differentiated educational context (Bezerra, 2020).

With the implementation of remote technologies in teaching, we began to think about how these strategies could mediate teaching and learning in such a way that they were seen as a complement to other learning methods and not just a simple distance learning tool. To this end, it has become essential to apply these technologies based on an organized pedagogical process, guided by theoretical and scientific reflections in order to enable teaching that is mobilizing, introspective, engaging, diligent, flexible in time and space and, above all, based on active methodologies (Bezerra, 2020).

Regarding technological transformations in teaching, weighted in a structured pedagogical process, the FELLOWS project (Caramori et al., 2020) was developed at a Brazilian university for undergraduate health students. This project is based on hybrid teaching (face-to-face and distance learning), with the aim of combining active health education methodologies with incentives for students to participate in congresses, activities of the Association for Medical Education in Europe (AMEE) and the Brazilian Association of Medical Education (ABEM) and collective discussions with the aim of improving educational skills.

Other strands point to the implementation of a combination of face-to-face and remote education, for example in the teaching of psychiatry in medicine, through online communication platforms such as Zoom, Skype, Microsoft Teams, GoToMeeting, Webex and others. The data shows that this strategy enables greater social support, by making it easier for the teacher not to have to reserve physical space for the class, and for the student, with regard to the flexibility of the timetable in remote teaching (Ho et al., 2021).

The same study (Ho et al., 2021) discerned the possibility of teaching psychiatry in medicine through the use of other virtual tools, such as participation in virtual conferences, making it possible to present scientific papers; the use of virtual reality; making online courses available through recorded video lessons with interactive experiences and conducting online consultations via telemedicine, providing not only patient care, but also the continuity of student learning with greater flexibility, especially during the COVID-19 pandemic. In another study (Schmidt et al., 2022), telemedicine combined with active teaching methodologies helped develop clinical reasoning and decision-making.

The circumstances indicate that combining active methodologies with technological tools tends to be more attractive to students. This practice makes classes more dynamic, enhances the discussion of certain topics and can drastically contribute to advances in teaching practices by arousing student curiosity. Given that active methodologies are teaching strategies centered on the primary participation of students, their combination with digital technologies becomes an essential pedagogical innovation (Schmidt et al., 2022).

According to Silva et al. (2022) digital technologies are being associated with active methodologies such as TBL, problematization, constructivist spiral, TBL and project-based learning. PBL has been associated with digital technologies in person and remotely, so that students have access to a virtual area with problem situations, hypertexts and other media. In addition, case discussions are provided through virtual forums and online portfolios.

TBL is being approached technologically through online communication platforms such as Google Meet or Zoom, which currently support the participation of a greater number of people. The combination of digital technologies with this type of approach has made it possible for invited experts to participate in a way that is not often facilitated. The use of virtual forms, in real time, also places the integration between this methodology and digital technologies. The problematization method (PM), closely associated with TBL, differs from it by the nature of the trigger used, which is based on reality (PM) and not on simulated cases (TBL). PM has been linked to the application of interventions in the reality studied through telemedicine and simulated educational actions (Silva et al., 2022).

The constructivist spiral, a problem-based methodology, implies the use of dialog, the exploration of divergent ideas and the interaction between emotion and reason, based on the construction of new knowledge. It is being encouraged through the processing of problem situations and emotions triggered by videos and films in person or online, with the assessment

process being online or in person (Silva et al., 2022).

Project-based learning, a strategy that perpetuates collaborative learning by mobilizing the cognitive and behavioural capacities of groups of students, has adapted to the technological environment in various ways, using digital support tools, mainly software, 3D printers and online portfolios, enhancing remote teaching (Silva et al., 2022). According to Schmidt et al. (2022), the use of software promotes interactivity and expands the use of active teaching methodologies, increasing student curiosity.

A randomized case-control study (Rodríguez-López et al., 2020) carried out with nursing students in Madrid, Spain compared the teaching of anatomy through the use of traditional methodology with textbooks (control group) and the application of previous theory associated with 3D atlases and ultrasound videos (case group). The results showed that the highest rate of correct answers in relation to anatomical parts was in the case group. It was proved that the combination of digital technologies and active methodologies enhanced learning, bringing greater understanding of the subject.

Gamification, virtual learning objects (VLO) and virtual learning environments (VLE) are other technological innovations associated with active methodologies that are contributing significantly to advances in teaching practices. Gamification proposes the use of digital games as a learning proposal and has been evaluated as an innovative teaching method, especially when associated with active methodologies, providing a favorable space for greater assimilation of concepts, discussion and motivation (Schmidt et al., 2022).

VLOs are virtual resources produced in various formats (PowerPoint presentation, videos, animations, texts, hypertexts) and used on computers, notebooks, smartphones or tablets. Their association with active methodologies allows for greater flexibility due to their characterization as reusable, highly compatible and low-cost (Schmidt et al., 2022). VLEs are frequently used in various university institutions and, as the name suggests, they are virtual learning environments that allow for more dynamic, flexible and interactive educational practices (Tavares et al., 2021).

5. Final Considerations

Innovative strategies in health teaching represent a revolution in the way knowledge is transmitted and assimilated in higher education institutions. The development of these strategies, based on active methodologies and learning technologies, redefines the role of the teacher as a skillful strategist whose purpose is to create an environment conducive to students absorbing knowledge in a meaningful and applicable way.

In view of the transformations in the educational scenario and the demands of contemporary society, this study set out to investigate innovations in health teaching, based on technological advances and the dynamic needs of today's society.

The literature review provided a comprehensive understanding of educational innovations in undergraduate healthcare, highlighting advances in study methodologies, learning technologies and the integration of technology and active methods as a teaching strategy. This has provided an important overview for the training of qualified professionals who are adaptable to the contemporary demands of the health sector.

Therefore, educational innovations in health teaching reflect not only a paradigm shift in the teaching-learning process, but also a response to the emerging demands of society and the market. Continuous engagement with these innovative strategies is key to ensuring quality and relevant training for the health professionals of the future.

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Authors contributions

All the authors participated from the conception to the final revision of the article. All authors have read and approved the final manuscript.

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Competing interests

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

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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References

- Anastasiou, L. G. C., & Alves, L. P. (2015). Teaching processes at university: Assumptions for classroom work strategies (10th ed.). Joinville, SC: Editora Univille.
- Bezerra, I. M. P. (2020). State of the art of nursing education and the challenges to use remote technologies in the time of Corona Virus pandemic. *Journal of Human Growth and Development*, 1, 141-147. <https://doi.org/10.7322/jhgd.v30.10087>
- Brown, A., Sreenan, S., & McGarvey, A. (2019). Closing the gap: A transatlantic collaboration to foster quality improvement training in graduate entry medical students using applications of QI methodologies to medical education. *BMJ Open Quality*, 8(3), e000610. <https://doi.org/10.1136/bmjoc-2018-000610>
- Caramori, U., et al. (2020). Fellows Project: Education Skills for Health Professions Students. *Brazilian Journal of Medical Education*, 44. <https://doi.org/10.1590/1981-5271v44.1-20190233.ing>
- Carlos, V. et al. (2023). Engaging large classes of higher education students: a combination of spaced learning and team-based learning. *Front. Educ.*, 8. <https://doi.org/10.3389/feduc.2023.1129763>
- Cordeiro, L., & Baldini, S. C. (2020). Scoping review: potentialities for a synthesis of methodologies used in qualitative primary research. *BIS*, 20(2), 37-43. <https://doi.org/10.52753/bis.2019.v20.34471>
- Filho, E. M. B., Kubrusly, M., & Silva, C. L. (2018). Evaluating mobile applications for health teaching: a systematic review. *Revista Tecnologia Educacional*, (221), 40-50.
- Filho, N. A. et al. (2018). Medical Training at UFSB: III. Competency and Problem Based Learning. *Brazilian Journal of Medical Education*, 42(1). <https://doi.org/10.1590/1981-52712015v41n3rb20170026>
- Fonseca, M. H., et al. (2021, September 10). E-Health Practices and Technologies: A systematic review from 2014 to 2019. *Healthcare*, 9(9), 1-32. MDPI AG. <https://doi.org/10.3390/healthcare9091192>
- Freire, P. (2001). Pedagogy of autonomy: Knowledge necessary for educational practice. São Paulo: Paz e Terra. <https://www.scielo.br/j/ea/a/QvgY7SD7XHW9gbW54RKWHcL/?format=pdf&lang=pt>
- Galván-Morales, M. A., Nepomuceno, F. M., & Palomar-Morales, M. E. (2020). The clinical method, model competence in the learning medical education. *Rev. med. Hosp. Gen. Méx.*, 83(2). <https://doi.org/10.24875/hgmx.20000081>
- George, P. P., et al. (2014). Online eLearning for undergraduates in health professions: A systematic review of the impact on knowledge, skills, attitudes, and satisfaction. *Journal of Global Health*, 4(1). <https://doi.org/10.7189/jogh.04.010406>
- Ho, P. A., et al. (2021). Advancing Medical Education Through Innovations in Teaching During the COVID-19 Pandemic. *The Primary Care Companion For CNS Disorders*, 23(1). <https://doi.org/10.4088/PCC.20nr02847>
- Hughes, J. K., & Kearney, P. (2017). Impact of an iDevice application on student learning in an occupational therapy kinesiology course. *mHealth*, 3, 43-43. <https://doi.org/10.21037/mhealth.2017.08.02>

- Leyva-Moral, J. M., et al. (2022). Nursing students' perceptions of the efficacy of narrative photography as a learning method: A cross-sectional study. *Nursing & Health Sciences*. <https://doi.org/10.1111/nhs.12932>
- Lomis, K. D., et al. (2020). The Accelerating Change in Medical Education Consortium: Key Drivers of Transformative Change. *Academic Medicine*, 96(7), 979-988. <https://doi.org/10.1097/ACM.0000000000003897>
- Macedo, K. D. S., et al. (2018). Active learning methodologies: possible paths to innovation in health teaching. *Anna Nery School Journal of nursing*, 3. <https://doi.org/10.1590/2177-9465-ean-2017-0435>
- Machon, M., Cundy, D., & Case, H. (2019). Innovation in Nursing Leadership. *Nursing Administration Quarterly*, 43(3), 267-273. <https://doi.org/10.1097/NAQ.0000000000000361>
- Mendez, K. J. W., et al. (2020). Virtual and augmented reality: Implications for the future of nursing education. *Nurse Education Today*, 93, 104531. <https://doi.org/10.1016/j.nedt.2020.104531>
- Milton, C., & Subramaniam, A. (2023). Understanding the inclination of South Indian nursing graduates in using mobile learning applications. *J Educ Health Promot.*, 12(63). https://doi.org/10.4103/jehp.jehp_1082_22
- Monteiro, N., et al. (2018). Medical Training at UFSB: III. Competency and Problem Based Learning. *Brazilian Journal of Medical Education*, 42(1), 129-141.
- Munir, I., et al. (2023). Prevalence and Purpose of Medical App Usage In Pakistan: A cross-sectional study. *Journal of Aziz Fatimah Medical & Dental College*, 5(1), 25-29. <https://doi.org/10.55279/jafmdc.v5i1.228>
- Nascimento, K. A. S. (2021). A systematic review of mobile technologies in health education presented at the International Distance Education Congress. *Revista Edapeci*, 21(1), 85-96. <https://doi.org/10.29276/redapeci.2021.21.115265.85-96>
- Oliveira, A. R. F., & Alencar, M. S. M. (2017). The use of health applications for mobile devices as sources of health information and education. *Rdbc. Revista Digital de Biblioteconomia e Ciência da Informação*, 15(1), 234-245. <https://doi.org/10.20396/rdbci.v0i0.8648137>
- Pando, D. G., et al. (2021). Learning of Social Skills in nursing students according to the methodology in the classroom. *Archivos Venezolanos de Farmacología y Terapéutica*, 40(6), 569-574.
- Peters, M. D. J. et al. (2020). Updated methodological guidance for the conduct of scoping reviews. *JBI Evid Synth*, 18(10), 2119-2126. <https://doi.org/10.11124/JBIES-20-00167>
- Prober, C. G., & Heath, C. (2012). Lecture halls without lectures — A proposal for medical education. *New England Journal of Medicine*, 366(18), 1657-1659. <https://doi.org/10.1056/NEJMp1202451>
- Rodríguez-López, E. S., et al. (2020). Learning musculoskeletal anatomy through new technologies: A randomized clinical trial. *Revista Latino-Americana de Enfermagem*, 28. <https://doi.org/10.1590/1518-8345.3237.3281>
- Roman, C., et al. (2017). Active teaching-learning methodologies in the teaching health process in Brazil: a narrative review. *Clinical & Biomedical Research*, 37(4), 349-357. <https://doi.org/10.4322/2357-9730.73911>
- Schmidt, C. L., Souza, A. O., & Silva, L. (2022). The Use of Active Methodologies and Technologies for Innovative Education in the Health Area: Integrative Review. *Conjecturas*, 22(5), 753-767. <https://doi.org/10.53660/CONJ-1009-N02>
- Silva, D. S. M., et al. (2022). Active methodologies and digital technologies in medical education: new challenges in pandemic times. *Brazilian Journal of Medical Education*, 46.
- Tavares, C. M. M., et al. (2021). Innovations in the teaching-learning process of psychiatric nursing and mental health. *Revista Brasileira de Enfermagem*, 74(Suppl 5). <https://doi.org/10.1590/0034-7167-2020-0525>
- Tenny, S., & Varacalo, M. (2022). Evidence-based medicine (EBM). Treasure Island (FL): StatPearls Publishing, PMID: 29262040. Available at: <https://pubmed.ncbi.nlm.nih.gov/29262040/>.
- Tricco, A. C., et al. (2018). Effectiveness of eLearning in Health Professions Education: A Systematic Review of Systematic Reviews. *Annals of Internal Medicine*, 168(10), 1-10. <https://www.acpjournals.org/doi/10.7326/M18-0850#a1-M180850>
- Wang, J. J., et al. (2022). Technology Literacy in Undergraduate Medical Education: Review and Survey of the US Medical School Innovation and Technology Programs. *JMIR Medical Education*, 8(1), e32183. <https://doi.org/10.2196/32183>