

## EMERGING TECHNOLOGIES AND ACTIVE METHODOLOGIES: THE NEW PARADIGM OF MEDICAL EDUCATION IN THE 21ST CENTURY

### TECNOLOGIAS EMERGENTES E METODOLOGIAS ATIVAS: O NOVO PARADIGMA DA EDUCAÇÃO MÉDICA NO SÉCULO XXI

### TECNOLOGÍAS EMERGENTES Y METODOLOGÍAS ACTIVAS: EL NUEVO PARADIGMA DE LA EDUCACIÓN MÉDICA EN EL SIGLO XXI



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#### ABSTRACT

To investigate the challenges of emerging technologies in 21st century medical education, describing teaching methods and pedagogical strategies in educational environments. Methods: This is a study with a qualitative-exploratory approach that analyzed scientific articles in the Medline (39,078 records), Scielo (2,040 records) and Science Direct (151 records) databases from 2021 to 2023. The research identified two main methodologies: competency-based learning and interaction between mentor and mentee. Results: The results indicate that students' active participation in reflective processes strengthens their understanding of medical practice. The integration of different methodologies, such as student-centered learning and peer mentoring programs, is a promising trend for medical education, expanding learning opportunities and promoting students' personal and emotional development. Conclusion: Competency-based learning stands out for its focus on developing technical and practical skills, while interactive learning environments between mentor and mentee involve activities focused on sharing knowledge and experiences. These approaches strengthen mutual trust, stimulate critical thinking and encourage student reflection.

**Keywords:** Medical Education. Technical Skills. Emerging Technologies. Pedagogical Mentoring.

#### RESUMO

Investigar os desafios das tecnologias emergentes na educação médica do século XXI, descrevendo métodos de ensino e estratégias pedagógicas em ambientes educacionais. Métodos: Trata-se de um estudo com uma abordagem qualitativa-exploratória que analisou artigos científicos nas bases de dados Medline (39.078 registros), Scielo (2.040 registros) e Science Direct (151 registros) no período de 2021 a 2023. A pesquisa identificou duas metodologias principais: aprendizagem baseada em competências e interação entre mentor

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e aprendiz. Resultados: Os resultados indicam que a participação ativa dos estudantes em processos reflexivos fortalece a compreensão da prática médica. A integração entre diferentes metodologias, como as aprendizagens centradas no aluno e os programas de mentorias entre pares é uma tendência promissora para o ensino médico, ampliando as oportunidades de aprendizagem e promovendo o desenvolvimento pessoal e emocional dos estudantes. Conclusão: As aprendizagens baseadas em competências destacam-se pelo foco no desenvolvimento de habilidades técnicas e práticas enquanto que os ambientes de aprendizagem interativos entre mentor e aprendiz envolvem atividades focadas na troca de conhecimentos e experiências. Essas abordagens fortalecem a confiança mútua, estimula o pensamento crítico e incentiva a reflexão dos alunos.

**Palavras-chave:** Educação Médica. Competências Técnicas. Tecnologias Emergentes. Mentoria Pedagógica.

## RESUMEN

Investigar los desafíos de las tecnologías emergentes en la educación médica del siglo XXI, describiendo métodos de enseñanza y estrategias pedagógicas en entornos educativos. Métodos: Se trata de un estudio con un enfoque cualitativo-exploratorio que analizó artículos científicos en las bases de datos Medline (39.078 registros), Scielo (2.040 registros) y Science Direct (151 registros) en el período de 2021 a 2023. La investigación identificó dos metodologías principales: aprendizaje basado en competencias e interacción entre mentor y aprendiz. Resultados: Los resultados indican que la participación activa de los estudiantes en procesos reflexivos fortalece la comprensión de la práctica médica. La integración entre diferentes metodologías, como el aprendizaje centrado en el estudiante y los programas de mentoría entre pares, es una tendencia prometedora para la enseñanza médica, ampliando las oportunidades de aprendizaje y promoviendo el desarrollo personal y emocional de los estudiantes. Conclusión: El aprendizaje basado en competencias se destaca por su enfoque en el desarrollo de habilidades técnicas y prácticas, mientras que los entornos de aprendizaje interactivos entre mentor y aprendiz involucran actividades centradas en el intercambio de conocimientos y experiencias. Estos enfoques fortalecen la confianza mutua, estimulan el pensamiento crítico y fomentan la reflexión de los estudiantes.

**Palabras clave:** Educación Médica. Competencias Técnicas. Tecnologías Emergentes. Mentoría Pedagógica.

## 1 INTRODUCTION

Recent pedagogical approaches such as student-centered, humanistic training with an emphasis on practical disciplines, mentoring, active methodologies, including simulations, teamwork, are fundamental to change students' perspective on their academic experience and their future role as doctors. These methodologies help transform students' perceptions of their undergraduate journey and medical practice (Acherman *et al.*, 2021; Ahmad; Page; Goodsmann, 2023; Albuquerque; Botelho; Caldato, 2021; Asunción, 2021; Hvidt *et al.*, 2022; Lisboa *et al.*, 2021).

According to the 2014 National Curriculum Guidelines (DCNs), undergraduate studies in Medicine aim to offer critical, comprehensive and reflective training. The objective is to train students for an ethical, psychological and humanistic understanding of the doctor-patient relationship, prepare them to work at all levels of health care and carry out promotion, prevention and rehabilitation actions (MINISTRY OF EDUCATION, 2014).

The DCNs in the medical area aim to train students with skills in Comprehensive Health Care, Health Education and Health Management, preparing them to face challenges in Brazilian society and public health. They highlight the importance of adapting to the needs of the Unified Health System (SUS) and implementing essential programs, such as the National Primary Care Policy (Meireles; Fernandes; Silva, 2019).

In addition, the DCNs emphasize the importance of respecting the rights of citizenship and the dignity of the patient, ensuring a medical practice that values the humanization of care and professional integrity.

The need for a review of teaching methods and pedagogical strategies is a constant challenge. This study aims to shed light on the current trends and challenges affecting medical education in the twenty-first century, as well as to identify pedagogical strategies that are being used in Higher Education Institutions that can help shape the training of health professionals for the future.

In this sense, the objective of this study is to investigate contemporary challenges and emerging opportunities in medical education, using an integrative literature review. The work emphasizes the importance of studying health education in the twenty-first century, highlighting the need to adapt professionals so that they are more prepared to face the challenges of the profession.

## 2 METHODOLOGY

This study is characterized as an integrative review, carried out according to the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* – PRISMA protocol

(Moher *et al.*, 2009). Records from the Medline (39,078 records), Scielo (2,040 records) and Science Direct (151 records) databases were examined, integrating 40,968 records. The free bibliographic reference manager software EndNoteWeb (CLARIVATE, 2024) was used.

The search for articles was carried out in August 2023, including qualitative and quantitative studies, published in the periods of 2021, 2022 and 2023, published in English and/or Portuguese. The following descriptors ("medical education"; "mentoring"; "technology in medical education"; "medical educational innovation" and "educational medical skills").

The selection of articles was carried out through the application of different filters: in the Scielo database there was a filter to select the complete articles, the review articles and the time period; in the Medline database the main themes were selected, such as "medical education" and "undergraduate education in medicine" and, in Science Direct, only the filter relating the time period. In this selection stage, duplicate records were excluded.

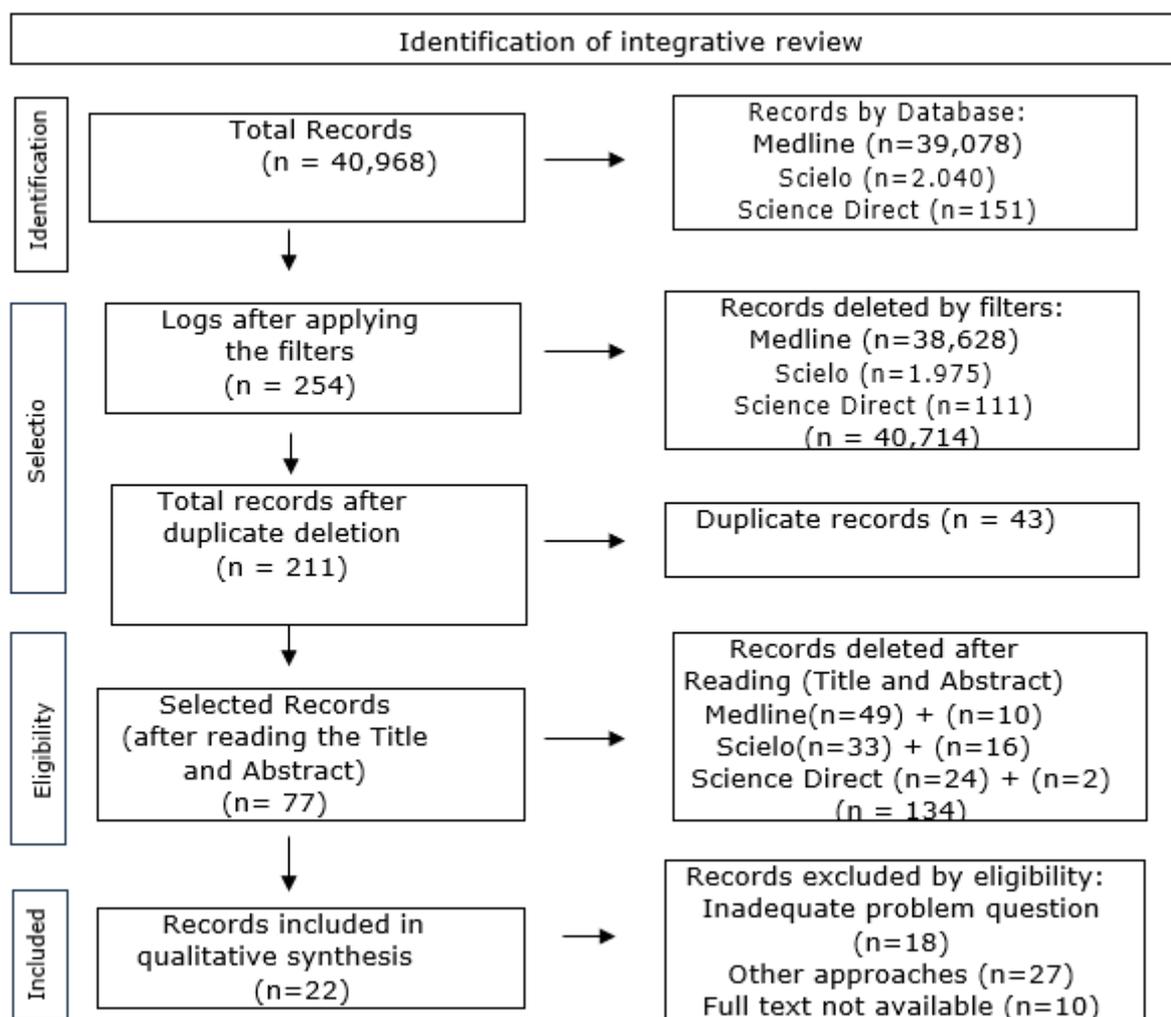
The criteria used for the selection of articles were applied progressively, starting with the reading of the title, followed by the reading of the abstract and, finally, the complete reading of the article. Records considered ineligible during the reading of the titles (such as those dealing with elementary and secondary education, basic health units (UBS), hospitals, health centers, licentiate courses, technological education, articles from systematic reviews, scoping, integrative and meta-analyses, medical education in graduate studies and educational evaluation) were excluded; ineligible during the reading of the abstract, as they are not related to medical education; and those that did not meet the requirements because they were incompatible with the problem-question, full text not available, and other applicability approaches. After this process, all records that met the criteria were exported to the EndNote software. The information extracted from the records included: author, year, place of study, objectives, methodology, and main results.

The research was delimited with the objective of answering the following question: "What are the characteristics of the learning methodologies applied to medical students that aim to improve the teaching and learning process?". This question will guide the investigation in a systematic way, being structured based on the PICO strategy.

After applying the filters and eligibility criteria, 22 records with different learning approaches applied in medical education were included in a qualitative synthesis, as shown in the flowTable described in Figure 1.

**Figure 1**

Search and eligibility strategy for records consulted in the Medline, Scielo, and Science Direct databases in August 2023, with studies published from the 2021, 2022 and 2023 periods, published in English and/or Portuguese



Source: Adapted from the flow diagram provided by Moher *et al.* (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*, 2009; 339:B2535.

### 3 RESULTS

From the selected records, the highest concentration was with interactive learning methodologies between mentor x mentee (n=12), followed by competency-based methodologies (n=10).

Interactive learning environments between mentor and mentee involve activities focused on the exchange of knowledge and experiences. This approach strengthens mutual trust, encourages critical thinking, and encourages reflection. The exchange enables continuous learning, in which both mentor and mentee benefit from a collaborative relationship. The learner becomes more prepared to apply what he or she has learned in

practical situations, while the mentor improves his or her skills by sharing his or her knowledge, according to Table 1.

**Table 1**

*Result of the integrative review in the Scielo, Science Direct, and Medline databases, including author, year, country, study objective, methodology(s), and main results, collected in August 2023, regarding interactive learning between mentor x mentee (n=12)*

Author, year, country	Objective of the study	Methodology	Main results
1 - Acherman <i>et al.</i> , 2021, Brazil	Identify strong and weak areas in the educational environment through <b>peer mentoring</b> .	This was a cross-sectional study with data collected from 1,470 students in the first level. The Satisfaction with Social Support Scale and the Dundee Ready Education Environment Measure Scale were used.	The results revealed statistically significant differences in relation to the course cycle, sexual orientation, collection of aid bags and regular practice of physical activity. This indicates that peer mentoring programs can benefit students' perceptions of social support and the academic environment.
2 - Brondani <i>et al.</i> , 2021, Brazil	Implement a <b>mentoring program</b> to prevent emotional overload and improve the quality of teaching.	Elective course of 16 hours with up to 12 students and monthly meetings, where the student chooses the workshops he wants to participate.	The program has seen an increase in student enrollment, with positive <i>feedback</i> related to freedom of choice and diversity of workshops. The mentors addressed topics previously defined or suggested by the students, including topics such as academic stress, competition versus cooperation, quality of life, social networks, meditation, yoga and self-massage.
3 - Cruz <i>et al.</i> , 2023, Brazil	Assess perception among students through <b>peer mentoring</b> to provide <i>insights</i> into the learning process.	Cross-sectional study with 129 students. The Dundee Ready Education Environment Measure scale was applied to assess the perception of the educational environment.	The most commonly used study techniques included the practice of summaries (88.4%), reading (77.5%), questions and exercises (71.3%), schemes (65.9%) and the Pomodoro method (63.6%). Weaknesses were identified, such as teaching that is not very student-centered and the lack of clarity in the objectives of the course, which does not stimulate the development of skills.
4 - Couto <i>et al.</i> , 2021, Brazil	Report the results of the <b>mentoring program</b> in supporting the personal and professional development of students.	This is a descriptive, qualitative study with interviews with students to assess the conformity of humanistic disciplines in relation to the National Curriculum Guidelines for Medical Courses.	The mentoring program proved effective in offering emotional and academic support. The study facilitated the exchange of experiences and reflection on topics related to humanistic, critical and ethical education. The program proved to be a model to help students

			overcome difficulties, contributing to their personal and professional development.
5 - Fidelis, Ribeiro e Rocha, 2021, Brazil	Discuss the challenges encountered in the <b>mentoring program</b> , highlighting the importance of this support and proposing solutions. This includes continuing education suggestions and supervision for mentors.	The study used a phenomenological approach to gather perceptions and challenges from the students who participated in the mentoring program. These challenges include issues related to mentor participation, understanding the program's objective, and the needs for curricular changes.	The study revealed mixed feelings of the students in relation to the orientation program. Some have found the program beneficial, while others have questioned its relevance and effectiveness in medical training. The main criticisms included the mandatory nature of the program and the inadequacy of some advisors. In addition, challenges such as excessive workload, department-specific demands, and lack of recognition of mentorship as a valuable activity have resulted in some mentors leaving after training.
6 - Kaji <i>et al.</i> , 2021, Brazil	Encourage the creation of <b>peer mentoring</b> programs aimed at welcoming freshmen by "veterans" in a more holistic way.	Vertical mentoring by pairs with 14 mentors (seniors between the third and eighth period) and 14 freshmen (students entering the first and second period).	It was observed that the bond generated between freshman and veteran favored the integration of freshmen with the university community. The activities included: construction of material and recording of training for mentors; selection of freshmen and veterans; Development of mentoring with subsequent collection and analysis of <i>feedback</i> .
7 - Lauterjung, Ehlers and Guntinas-Lichius, 2021, Germany	Evaluate the last practical year of medical education, adding <b>mentoring and feedback</b> in the training of students.	Online questionnaire applied to 201 students to compare the learning progress between students who participated in the project and those who did not.	The group that participated in the project (n = 92) reported greater satisfaction with their practical training, feeling more prepared for the work compared to the control group (n = 165). The mentoring and <i>feedback</i> developed helped to improve the students' medical skills and practices.
8 - Menezes <i>et al.</i> , 2021, Brazil	Assess learners' perceptions of peer <b>mentoring</b> for personal, academic, and mental health development among students.	Exploratory research with a descriptive and qualitative approach, conducting interviews with 20 learners.	The results revealed positive experiences, highlighting emotional and social support, as well as study planning as key categories. The study contributed to the personal and academic growth of the learners, reducing <i>stress</i> and anxiety, promoting their adaptation and integration into the academic environment.
9 - Nascimento <i>et al.</i> , 2021, Brazil	Promote gender equity by ensuring equal opportunities for men, women, and gender minorities through a <b>mentoring program</b> .	Qualitative research through the training of small heterogeneous groups of mentors, with follow-up sessions in the area of surgical,	There was an exchange of knowledge between the groups, highlighting the need to, in addition to supporting women (cisgender, transgender) and gender non-binary people, educate society

		anesthetic and obstetric care.	about gender identities beyond the binary perspective. The program encourages other students to pursue careers in these fields, promoting gender equity.
10 - Secchi and Vieira, 2021, Brazil	Describe the evolution of a <b>mentoring program</b> to promote students' professional and personal development.	The program has become an extension project where weekly discussions are held on practical, moral, and ethical aspects of the medical profession.	The program showed high levels of commitment, attendance, and positive <i>feedback</i> , contributing to the training of students and physicians. The participants reported positive points about their reflections from the mentoring sessions, based on individual <i>feedback</i> .
11 - Senger <i>et al.</i> , 2021, Brazil	Incorporate a <b>practical mentoring module</b> with topics related to the need for students and teachers to take ownership of the Course's Pedagogical Project (PPC).	Topics included in the syllabus: reflection on the learning process; self-assessment; professional identity; interpersonal, educational and professional development.	The study emphasized the importance of mentors in offering individualized support to mentees, suggesting that individual activities ensure greater privacy. The practice of mentoring must be structured in a way that is aligned with educators, adapting to the particularities of each course and the objectives of the PPC.
12 - Sotto-Santiago, Mac and Genao, 2023, USA	Understand how Black and Latino teachers are being mentored in the use of <b>mentoring programs</b> .	The study used the Culturally Engaging Campus Environments (CECE) model, emphasizing the importance of creating inclusive and equitable environments that promote the academic and personal well-being of all, regardless of their backgrounds and identities.	The study revealed a connection between mentorship and cultural familiarity. Mentors must have a deep understanding of students' cultural perspectives in order to provide effective guidance. Participants reported benefits from receiving academic support and also valuing their cultural heritage.

Source: Prepared by the authors.

Competency-based learning stands out for its focus on the development of technical and practical skills. Among the main aspects addressed are activities centered on students' skills, health communication, *feedback* and early introduction to clinical practice. In addition, this approach promotes personalized training, adapted to the needs of each student, encouraging autonomy and critical thinking. In the context of the medical field, it is essential to prepare professionals to deal with complex situations and make decisions, focusing on the patient's well-being, according to Table 2.

**Table 2**

Result of the integrative review in the Scielo, Science Direct, and Medline databases, including author, year, country, study objective, methodology(s), and main results, collected in August 2023, regarding competency-based learning (n=10)

Author, Year, Country	Objective of the study	Methodology	Main results
1 - Day <i>et al.</i> , 2023, Canada	Understand how resident physicians experience <b>medical education centered on students' abilities</b> to develop future interventions.	Semi-structured interviews with 16 residents from seven residency programs, with a constructivist approach.	Residents were receptive to student-centered medical education, but pointed out disadvantages in evaluation and <i>feedback</i> , such as anxiety about performance, lack of clarity in evaluations, and generic <i>feedback</i> .
2 - Ewnte and Yigzaw, 2023, Africa	Observe how medical students react to early <b>introduction to clinical practice</b> in the problem-solving process.	Cross-sectional research with quantitative (questionnaire) and qualitative (group discussions) methods including 358 medical students.	This medical methodology helped solve problems, increased students' motivation and active learning, and promoted their involvement with the community. However, it faces challenges such as work overload, disconnection between academic and health institutions, and lack of guidance in implementation.
3 - Kataoka <i>et al.</i> , 2022, Japan	Evaluating the effectiveness of <b>Evidence-Based Medicine (EBM)</b> involves the entire process, from searching for and evaluating evidence to its practical application. This includes analyzing the patient's clinical case, integrating the evidence with the patient's clinical experience and history for a more informed and personalized approach.	This is a qualitative study with semi-structured interviews with professors and physicians, including the problem question, search for clinical evidence, selection and understanding of the case.	In EBM, it is essential that students participate in clinical practice, identifying problem issues. By developing skills in information retrieval and critical evaluation, along with understanding the patient's history, students realize the relevance of EBM, which increases their motivation to learn this methodology.
4 - Hashim <i>et al.</i> , 2023, United Arab Emirates	Evaluate the effectiveness of <b>student-centered learning</b> , allowing them to take a more active role in the learning process.	Use of the <i>LecturePlus technique</i> , with lectures and problem-solving activities based on real cases and final discussion.	The learning outcomes were evaluated and compared to the previous school year. A multiple-choice test, performed before and after the learning process, indicated a significant improvement in the application of knowledge ( $p < 0.001$ ). The technique was considered satisfactory by 95% of the participants.
5 - Mandia and Teixeira, 2023, Brazil	Understand patients' personal stories to improve the doctor-patient relationship by exploring <b>narrative-based</b> health communication between patient health professionals.	Apply the Balint group technique, through the <b>patient-centered clinical method</b> , with discussions centered on real cases.	Communication is fundamental in medical practice, but it has been neglected in the training of health professionals. This insight underscores the importance of effective communication in patient care. The disease goes beyond symptoms and diagnoses,

			profoundly affecting the patient's life.
6 – Ottenhoff-de Jonge <i>et al.</i> , 2021, The Netherlands	Understand <b>teacher-centered (knowledge transmission) and student-centered (learning facilitation)</b> educational beliefs.	Qualitative study with 26 teachers on teaching-learning based on the original framework of Samuelowicz and Bain. Model that classifies educators' beliefs about teaching and learning.	The educator should focus on the student and essential competencies, such as clinical reasoning and collaboration, as well as promote effective communication in small groups. The physician must act as a collaborator, identifying the student's interests and stimulating their motivation to maximize learning.
7 - Pereira, Santos and Caldas, 2021, Brazil	Identify the use of <b>information and communication technologies (ICT)</b> in teaching and research.	This is an analytical, cross-sectional observational study with 216 students with data collection through an online form.	Remote communication highlighted the need for teacher and student training. The smartphone was the most used medium (68.1%), followed by text messaging applications (99.5%) and internet browsers (96.8%). In contrast, the use of medication apps was lower (48.1%), as well as that of specialized calculators (31%).
8 - Pricinote <i>et al.</i> , 2021, Brazil	Evaluate students about <b>feedback-based learning</b> and the frequency with which they receive it in the teaching-learning process.	Qualitative research with case study and content analysis to improve interactions between health professionals and patients.	The study found that there was a gap between theory and practice regarding the restricted use of <i>feedback</i> . The students emphasized that the teacher should point out mistakes and guide them for improvements and not just show the results of the tests.
9 - Rusiecki <i>et al.</i> , 2023, USA	Explore <b>health communication skills</b> , through the construction of interactions/bonds with patients.	Descriptive and qualitative research, conducted through virtual workshops and interviews, included a workshop with 37 students focused on advancing health equity.	The results showed positive <i>feedback</i> , highlighting that the theatrical exercises led to improvements in listening and observation skills, greater understanding of systemic inequalities, as well as improved interpersonal skills, personal growth, and responsiveness to unexpected situations in patient care.
10 - Zainal <i>et al.</i> , 2023, Singapore	Identify gaps in teaching with the use of <b>digital competencies in health</b> , seeking to standardize the objectives of learning and collaboration among medical schools.	Qualitative research through individual interviews with 19 participants, including professors, physicians and vice-rectors of universities.	Need for formal training in digital health, data management and application of digital technologies in clinical practice. Patient safety and the integration of these concepts into the curriculum should be prioritized. In addition, it is critical that there is collaboration between medical schools and the health system to align the current curriculum with clinical practice.

Source: Prepared by the authors.

## 4 DISCUSSION

Contemporary medical education has evolved by integrating various pedagogical approaches, adopting varied methodologies to improve the training of future health professionals. From the results found, two main forms of learning emerge: the interaction between mentor and apprentice, and competency-based learning, which will be described below.

### Class 1 - Interactive learning between mentor x mentee

Acherman *et al.* (2021) explore the importance of mentoring and mentees in the academic environment, highlighting that mentoring is essential to help new students adapt to the course. Experienced mentors answer questions and provide emotional support, creating a welcoming environment in the early years of the course, preventing mental health problems among students. In the same logic, Brondani *et al.* (2021) address the positive impact of mentoring activities through meditation and yoga. These programs help students meet the challenges of the course, which is often marked by a competitive and lonely environment.

Cruz *et al.* (2023) revealed that peer mentoring and participation in study groups can improve students' perception of the educational environment. The authors suggest a continuous evaluation of teaching environments, essential to promote the academic and professional development of students. The authors Couto *et al.* (2021) highlight the effectiveness of mentoring in reducing academic stress and integrating students and professors with greater adherence to academic activities. The approach was considered effective in promoting the health and integral development of students.

Fidelis, Ribeiro and Rocha (2021) describe the evolution of a mentoring program started in 2001 which was interrupted due to the lack of adherence of teachers. It was later reestablished in response to student demands. There was criticism about the adequacy of teachers and the mandatory nature of mentoring. However, the advantages of the program were recognized. Another mentoring model, described by Kaji *et al.* (2021) where veteran students guide freshmen, using their own experiences to help new students, promoting integration between different academic phases. Both authors highlight that mentoring proved to be beneficial, reinforcing its importance. Similarly, Menezes *et al.* (2021) highlighted the benefits of mentoring, showing a positive impact on integration and adaptation to the academic environment. The proximity and empathy between mentors and apprentices creates a fertile environment to share feelings and insecurities, in addition to helping the student in self-management, communication, planning, stress and anxiety reduction skills.

Lauterjung, Ehlers, and Guntinas-Lichius (2021) investigated the lack of preparation of medical students in the last years of training, especially in relation to patient care. The

disparity between academic theory and hospital practice is a common concern. The introduction of mentoring in the last year of training proved to be effective in increasing the student's confidence to face professional challenges.

Nascimento *et al.* (2021) explored how mentoring can promote gender equity in surgical specialties, which have historically been dominated by one sex. Research has shown that mentoring, by integrating health education, helps reduce prejudice and improve the mental health of physicians and students, especially in areas such as surgery, anesthesia, and obstetrics. Mentoring was valuable in promoting gender equality.

Secchi and Vieira (2021) highlight the difficulty in finding volunteer mentors, due to the lack of specific qualities and time constraints. Additionally, the effectiveness of mentoring may vary among students, suggesting that participation should be optional. To be successful, mentoring must be based on a genuine, long-term relationship between mentor and mentee. While Senger *et al.* (2021) report the creation of a mentoring program for the first three years of the course with physicians acting as mentors. The focus is on the acclimatization, adaptation of students and preparation for internship. The studies highlight the need for continuous training of mentors, which is considered a valuable support for the integral development of students.

Sotto-Santiago, Mac, and Genao (2023) highlight the importance of mentoring programs to promote student diversity and inclusion. The survey shows that African Americans face difficulties in achieving academic stability. Using the *culturally engaging campus environments* (CECE) method with high school classes, the study reveals that mentoring conducted by black and Latino teachers is more effective in promoting inclusive support, due to shared cultural knowledge.

It is perceived, through these different mentoring approaches, that they can complement each other, providing a diversified learning experience. In the medical curriculum, mentorships are especially important, as they allow mentor and mentee to learn together.

#### Class 2 - Competency-based learning

Day *et al.* (2023) highlight the potential of competency-based medical education (CME) to improve the quality of medical education, assessment, and *feedback*. The study identified that faculty support was instrumental in improving the resident experience by promoting medical education centered on students' abilities. Following a similar approach, Hashim *et al.* (2023) evaluated the effectiveness of the *LecturePlus* technique, which promotes student-centered learning. In this experience, students participated in lectures followed by problem-solving activities, in small groups, concluded with discussions

moderated by teachers and students. The results showed an improvement in short-term learning, indicating that *LecturePlus* is effective in teaching knowledge and facilitating practical application. In turn, Ewnte and Yigzaw (2023) investigated medical students' perceptions of early clinical exposure (DBS). The study showed that DBS has a positive impact on academic development and problem-solving skills. However, challenges such as heavy workload, faculty training, effective team collaboration, and lack of integration between academia and health institutions were identified. DBS is beneficial for familiarizing students with the clinical setting. These three studies highlight the need for teachers to be updated for the success of the techniques, which will reflect on the quality of teaching, creating an effective learning environment.

Kataoka *et al.* (2022) conducted a qualitative study with physicians working with the evidence-based medicine (EBM) technique. The authors identified five main themes: identifying issues, observing models, active learning, understanding patients' context, and motivation to learn EBM. They concluded that EBM is more effective when students actively participate in clinical practice and relate learning to the patients' context.

Mandia and Teixeira (2023) point out that, despite the importance of health communication, it receives less attention in medical education compared to technological and biomedical aspects. The study used the Balint method to reveal several approaches to communication in medicine. The Balint method influenced the development of the Patient-Centered Clinical Method (MCCP) and Narrative Medicine (NM). While the MCCP remained stable, the MN continues to evolve, incorporating elements of the Balint method. The authors emphasize the importance of these approaches to improve patient therapy. In the same vein, Rusiecki *et al.* (2023) organized a *workshop* with students to develop communication skills with a focus on the doctor-patient relationship, equity, and racism. The *workshop* improved the students' communication skills. It can be seen that both Mandia and Teixeira (2023) and Rusiecki *et al.* (2023) have in common the focus on the importance of communication skills in medical practice and highlight the need to improve these competencies to improve the doctor-patient relationship.

Ottenhoff de Jonge *et al.* (2021) conducted a study with professors from two medical schools and described a matrix of educational beliefs to integrate the role of the professor and the student, listing the main objectives of medical education. The study confirmed the relevance of the original structure, identifying new beliefs in the areas of student motivation, origin of knowledge and professional development. The research resulted in a proposal to adapt the teaching plan to align pedagogical practices.

The authors Pereira, Santos and Caldas (2021) analyzed the use of information and communication technologies (ICT) by students. A preference for messaging apps and internet browsers was observed, while the use of medication apps and specialized calculators by students was lower. They highlighted that the main benefit of ICTs is distance communication. Whereas, in the study by Zainal *et al.* (2023) three gaps were identified in the teaching of digital competencies in health: digital health skills, data management, and application of technologies in clinical practice. Qualitative research points to the global need to integrate these areas into the medical curriculum, with a focus on patient safety. In both studies, specific training is required for teachers and students.

Pricinote *et al.* (2021) conducted a qualitative study with students, revealing that they have a limited understanding of *feedback*. Students reported low understanding of the use of *feedback* and a weak connection with professors, subjects, and course time. Despite this, they recognize the positive impact of *feedback* on medical learning. It is perceived that *feedback* helps students to understand their progress, creating a constructive learning environment.

Competency-based mentor-learner interaction learning is essential in medical education, especially in a context where emerging technologies are increasingly present. The mentor-apprentice relationship provides a direct exchange of knowledge and skills, which are fundamental for the training of health professionals who are better prepared to face the professional challenges of the future. This type of interaction allows the learner to develop critical thinking, learn to make clinical decisions based on medical practice. Additionally, the presence of an experienced mentor offers support and guidance, contributing to the learner's confidence and resilience in an environment that can be challenging and demanding.

The integration between mentor-learner interaction and competency-based learning provides medical training that combines technical knowledge with practical skills, necessary for effective health care.

This study was limited in its content analysis in relation to some aspects: (a) selection bias, i.e., the limited number of themes may introduce bias in the research, as the themes found may not be representative of all aspects of teaching-learning in medical education; (b) the search for records was carried out in August 2023, in the periods of 2021, 2022, and 2023, which means that the search was limited to these periods, allowing the inconclusiveness of the literature review and (c) the search restricted to some databases may have hidden studies available in unconsulted databases.

As a suggestion for future studies, the application of these learning methodologies in specific clinical contexts, such as pediatrics, geriatrics, surgery, among others, can be mentioned, aiming to identify particular adaptations and benefits of each approach.

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