



REVIEW

Active methodologies and didactic techniques in medical education: A systematic review



Susan Peña^{a,b}, Carlos Martinez-Santander^{b,*}, Veronica Cantos-Reyes^b and Mireya Frausto Rojas^a

^a Universidad Americana de Europa, Mexico

^b Universidad Católica de Cuenca carrera de Medicina, Ecuador

Received 7 January 2025; accepted 10 February 2025

Available online 24 March 2025

KEYWORDS

Teaching-learning;
Active methods;
Medicine;
Team-based learning

Abstract

Introduction: For the teaching-learning process in medicine, knowing the effectiveness of active methods and didactic techniques is important to improve and guarantee competent professionals in their field.

Materials and methods: The PRISMA 2020 guide was used to carry out this systematic review, identifying and analyzing the active methodologies used in the teaching-learning process of the different subjects in the medical sciences.

Results: After searching scientific databases, 18 studies that met the research objectives were selected, allowing the active methodologies used in the teaching-learning process to be identified.

Discussion: Active methodologies complement the traditional methodology, allowing more dynamic learning with long-term knowledge retention, thus significantly improving grades and motivating students and teachers to commit to this process.

Conclusions and future work: In the effective teaching of medicine, using active and traditional methodologies is important because they promote the active participation of students and teachers, resulting in long-term and significant learning. A detailed analysis of active methods and their effective integration with traditional methods is needed.

© 2025 The Author(s). Published by Elsevier España, S.L.U. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

* Corresponding author at: Universidad Católica de Cuenca carrera de Medicina, 010101, Av. De las Américas y Humboldt, Cuenca-Ecuador.
E-mail address: cmartinezs@ucacue.edu.ec (C. Martinez-Santander).

PALABRAS CLAVE

Enseñanza y aprendizaje;
Métodos activos;
Medicina;
Aprendizaje basado en equipos

Metodologías activas y técnicas didácticas en la educación médica: Una revisión sistemática

Resumen

Introducción: Para el proceso de enseñanza-aprendizaje de la medicina es importante conocer la eficacia de los métodos y técnicas activas para mejorar y garantizar la formación de profesionales competentes en su campo.

Métodos: Se utilizó la guía PRISMA 2020 para llevar a cabo esta revisión sistemática, en la que se identificaron y analizaron las metodologías activas utilizadas en la enseñanza y el aprendizaje de las diferentes disciplinas de las ciencias médicas.

Resultados: Tras buscar en bases de datos científicas, se seleccionaron 18 estudios que cumplieran los objetivos de la investigación, lo que permitió identificar las metodologías activas utilizadas en el proceso de enseñanza-aprendizaje.

Discusión: Las metodologías activas complementan la metodología tradicional y permiten un aprendizaje más dinámico con un conocimiento a largo plazo, lo que mejora significativamente las notas y motiva a estudiantes y profesores a comprometerse con este proceso.

Conclusiones y trabajo futuro: En la enseñanza efectiva de la medicina, es importante utilizar metodologías activas y tradicionales, ya que fomentan la participación activa de estudiantes y docentes, lo que resulta en un aprendizaje significativo y duradero. Es necesario realizar un análisis detallado de los métodos activos y su efectiva integración con los métodos tradicionales.

© 2025 El Autor/Los Autores. Publicado por Elsevier España, S.L.U. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

The higher education system has adopted models that meet modern pedagogical requirements,¹⁻³ and the transmission of knowledge has evolved and adapted to advancements, resulting in a dynamic and interactive education.² Traditional classroom teaching, where the teacher imparts knowledge, is no longer the norm. Education constantly challenges implementing new models or systems to ensure learning. Therefore, flexible education allows students to develop their skills and acquire knowledge at their own pace, using their tools and integrating information technologies with pedagogical elements.^{2,3}

Transferring knowledge from teacher to student has been the focus of traditional and unilateral teaching customs. However, more than this approach is needed to meet the new challenges in the health field. Linear learning has become a system that enables the development of skills and critical thinking in students, transforming them into knowledge generators with the support and guidance of teachers.²⁻⁴ This scenario has encouraged the improvement of education quality.⁴⁻⁸ Consequently, complex disciplines such as medicine require specific didactic techniques and methodologies. For instance, applying current pedagogical tools and active methods is essential to promoting active participation and meaningful, comprehensive learning for future health professionals.

The Covid-19 pandemic has highlighted the need for education to adapt to new teaching and learning models. The virtual system has become essential for this challenge, but it may not be the most recommended option for the health sector.⁹⁻¹¹ As a result, new strategies are being adopted, including the following: The text already appears

to meet the desired characteristics and is free from errors. Therefore, no changes have been made.

In medicine, teaching methodologies have evolved significantly with the advance of technology and the educational needs of health professionals. Today, the most widely used methodologies are e-learning, learning with electronic devices, and Team-Based Learning (TBL). E-learning has made learning more flexible, offering access to educational content at a distance through digital platforms, facilitating knowledge acquisition through mobile tools, such as tablets and smartphones, and providing interactivity and immediate access to information. Finally, team-based learning (TBL) has been consolidated as an effective strategy in medical education, promoting collaboration among students for clinical problem-solving and evidence-based decision-making.^{12,13}

It is crucial to understand the effectiveness of active methodologies and didactic techniques in the health sector to enhance and ensure medical students' teaching and learning process, considering the specific requirements of their field of study. Therefore, this research aims to identify the most commonly used and effective active methodologies in the last five years for training medical professionals and developing clinical skills, critical thinking, problem-solving abilities, motivation, and academic commitment.

Materials and methods

The systematic review was conducted using the PRISMA 2020 guide.¹⁴ Protocol registration on the official PRÓSPERO website was not taken into account, as the main objective of this research is to determine and analyze the active methodologies used in the teaching and learning process of various medical science subjects.

Eligibility criteria

The inclusion criteria comprised cross-sectional and qualitative studies published between 2018 and 2023. These studies applied active methodologies in the teaching-learning process for the School of Medicine undergraduate students. Studies that did not answer the research questions posed were excluded. Additionally, works in languages other than English and Spanish, studies with unspecified sample selection, and studies with non-representative samples were also excluded.

Sources of information

The following databases were consulted for the search phase: Scopus, Web of Science, Taylor & Francis, Science Direct, Wiley Online Library, and ACM. In addition, the results were enhanced using scientific literature search engines such as PUB-MED and Google Scholar.

Search strategies

Logical operators and special fields were used in each database to broaden or narrow the search as needed. The keyword search strategy methodologies, pedagogy, pedagogy, didactics, techniques, tools, teaching, and medicine were employed. This generated the search string methodologies OR pedagogy OR didactics OR technique OR tools OR teaching AND medicine. In this way, we obtained a specific selection of the desired bibliography.

Study selection process

Three independent authors conducted the search using the databases described above between May 2023 and August 2023. The authors began by selecting relevant studies based on their titles, followed by analyzing the summaries of the works obtained in this first stage. Subsequently, the authors selected the studies that met the objectives set for the development of this work.

Data extraction process

The authors captured and synthesized the results in an Excel spreadsheet, considering the year of publication, author, title, subject, population, methodology, tool, country, complications, benefits, significant differences in learning, and future work.

Results

A total of 18 articles were selected from the initial search, which consisted of four phases. In the first phase, 533 results were identified from Scopus, 20 from Web of Science, 10 from Taylor & Francis, 6 from PUB-MED, 220 from Science Direct, 21 from Wiley Online Library, 90 from ACM, and 1900 from Google Scholar. In the second selection phase, 2800 studies were analyzed based on their title, abstracts, and whether they were in Spanish or English. A total of 2670 were discarded for requiring an active teaching-learning

methodology and for not being open access. In the third eligibility phase, 130 studies were analyzed through a complete text reading, leaving out 70 papers. The fourth inclusion phase selected 18 studies that met our objectives. Fig. 1 illustrates this selection process.

An analysis was conducted on all 18 selected papers to answer the research questions posed at the beginning of the work. These questions were:

RQ1: What active methodologies and didactic techniques are used in medical education?

RQ2: Which countries are the pioneers in applying active methodologies and didactic techniques in medicine?

RQ3: What are the benefits of active methodologies in medical education, as expressed by teachers and students?

RQ4: What complications or problems are perceived when using active methodologies in medical education?

RQ5: Are there significant differences in learning medicine when using active methodologies?

RQ6: What are the future works that can be proposed in teaching medicine by using active methodologies?

The information in Table 1 illustrates the answers to these questions.

Active methodologies in teaching and learning medicine for undergraduate students have been investigated for effectiveness in various countries, including India, Chile, Spain, Italy, China, the USA, South Africa, the United Arab Emirates, Iran, and Mozambique. Several active methodologies have been analyzed and applied to undergraduate medical students, as shown in Fig. 2, countries in which active methodologies have been applied.

The research demonstrates the use of 11 active methodologies in the teaching and learning of medicine. David L's work,¹⁵ highlights the simultaneous use of three active methodologies: e-learning, B-learning, and Self-directed learning (SDL). In his research, Fu Xue Tao¹⁴ presents the simultaneous application of two active methodologies: problem-based learning (PBL) and Case-based learning (ABC), as shown in Table 2, Methodology Employed.

The research of the selected studies shows that several active methodologies are applied in the teaching-learning process in medical careers. E-learning, learning with electronic devices, and Team-based learning (TBL) are the most commonly used. These active methodologies are indispensable in the teaching of medicine, especially in times of the Covid-19 pandemic. The following are also widely used: The graph below illustrates the use of various teaching methods, including self-directed learning (SDL), near-peer, information and communication technology (ICT), two-way feedback, problem-based learning (PBL), case-based learning (ABC), flipped classroom, blended learning, and inquiry-based learning (IBL). As shown in Fig. 3, these methods are commonly used in education.

According to Gómez-Lus Centelles,¹² using inquiry-based learning (IBL) to teach microbiology in medicine results in better grades for students than traditional teaching methods.

Research using E-Learning, B-learning, and Self-Directed Learning (SDL) in medical education has shown increased student motivation and interest in complex subjects.^{15–19} Similarly, students report higher satisfaction with implementing this method in their online learning experience, particularly during the COVID-19 pandemic, which disrupted

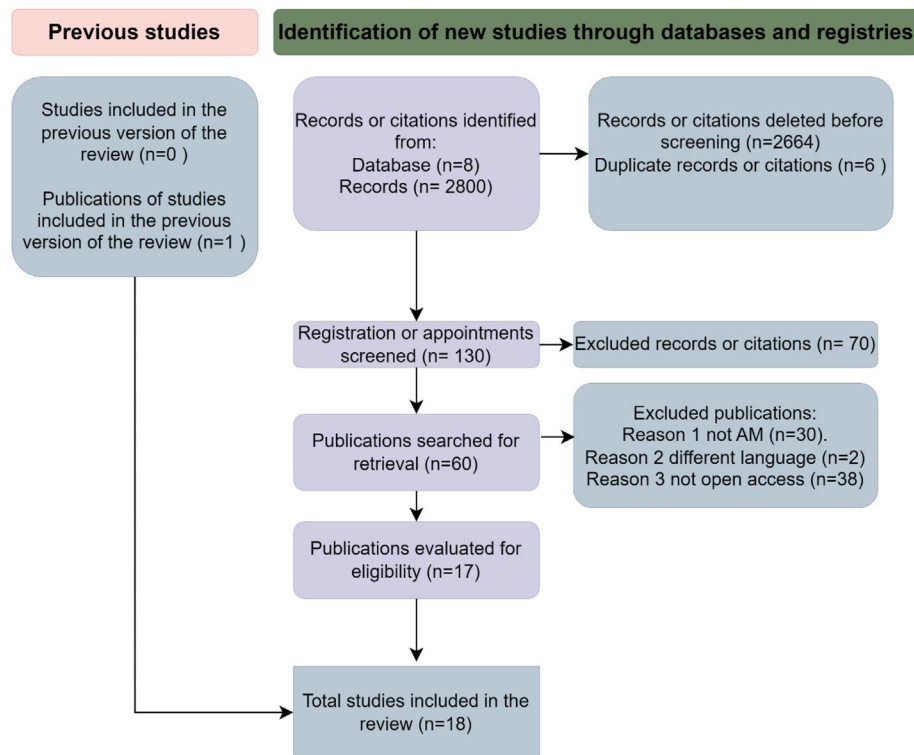


Figure 1 Shows the study selection process according to the PRISMA 2020 flowchart.

established secondary and higher education processes. Additionally, it is worth noting that students tend to assimilate content better when presented with visual stimuli rather than auditory ones. Despite the described benefits, it has become evident that this type of learning is only effective in theory. Face-to-face practice is also required, and it cannot replace traditional learning.

The works investigated^{20,21} showed that applying the active Near-peer methodology positively changed the teaching-learning process for students in the faculty of medicine. Additionally, better academic performance was observed in subjects where this methodology was used, including anatomy.

For some authors, the use of team-based learning (TBL),^{13,22–24} in teaching medicine has resulted in a more effective and satisfactory teaching-learning process, with better student grades than traditional teaching methods. When applied to relevant subjects, TBL is also a facilitating learning strategy for students in the faculty of medicine.

Castro Pedro L.²⁵ ICT in teaching anatomy has received positive feedback for learning, but there are differing opinions regarding its use in exams. On the other hand, Sailaja Tadepalli Krupa,²⁶ found that learning medicine, specifically in anatomy, is more effective when using a combination of PowerPoint and the traditional blackboard. Therefore, the success of learning depends on the use of both ICT and conventional teaching methods.

The acquisition of anatomical knowledge is essential for medical students. According to Debnath Sumit,²⁷ two-way feedback can enhance the teaching and learning of this subject for both teachers and students. Roshni M.²⁸ found that feedback in small group discussions (SGD) applied in

family medicine teaching to medical school students significantly improves students' understanding and attention.

However, regarding Fu Xue Tao's perspective, the implementation of active methodologies, such as problem-based learning (PBL) and case-based learning (ABC) is explained.²⁹ Teaching neurology has resulted in a combination of active and traditional teaching methods that benefit the teaching-learning process of medicine. This approach leads to motivated students with better knowledge of health.

We are teaching biochemistry to medical students using the Flipped Classroom as an active methodology,³⁰ which results in better grades. This approach should be considered for application in the teaching and learning process for other subjects in the medical curriculum. It complements traditional teaching methods.

Discussion

After analyzing the information from the selected studies, it has been determined that there needs to be more evidence in America, particularly in Latin America, regarding the benefits of applying active methodologies in the teaching and learning of medicine. This text exhibits a need for more interest in evaluating the effectiveness of certain tools in training health professionals, which is a crucial process to ensure effective learning and keep up with advances in academic training. In contrast, India has shown a keen interest in assessing the effectiveness of active methodologies in physician training.

Table 1
Analysis of Chosen Studies.

ID	Year	Refe	Title	Subject	Population	Result	Applied Methodology	Developed Tool	Country
PS01	2018	Gómez et al. 2018	Introducing inquiry-based learning in Microbiology into the medical degree course: outcome of student involvement	Microbiology	92 students in the second year of the degree of medicine 2015–2016	Better grades by applying the AM	Inquiry-based learning IBL	N/A	Spain
PS02	2018	David et al. 2018	Interactive digital microscopy at the center for a cross-continent undergraduate pathology course in Mozambique	Pathology	126 undergraduate medical students 2015–2016	motivated and interested students in the subject through the application of the AM	E-learning; B-learning	digital microscopy	Mozambique
PS03	2019	Logan et al. 2019	"Rebuilding what has eroded": a descriptive, survey-based study of near-peer instructors' experiences in a critical pedagogy-based sociomedical course	Sociomedical	34 students 2015–2016	Positive change in medical education	Near-peer	N/A	USA
PS04	2019	Cevik et al. 2019	Team-based learning improves knowledge and retention in an emergency medicine clerkship	Emergency medicine	145 final-year medical students 2015–2017	Student scores improved with TBL	Team-based learning (TBL)	N/A	United Arab Emirate
PS05	2020	Ramezani et al. 2020	Comparing peer education with TBL workshop in (EBM) teaching	Evidence-based medicine	42 students 2015–2017	Effective and satisfactory learning	TBL	N/A	Iran
PS06	2020	Sailaja et al. 2020	Teaching aids and students preferences in anatomy lectures in state of Telangana	Anatomy	450 medical students 2016–2020	Effective learning with the combination of PowerPoint tool and traditional whiteboard	TICS	PowerPoint	India
PS07	2020	Lancellotti et al. 2020	Evaluation of the Team-Based Learning methodology in statistics courses for medical students	Statistics	88 students	Facilitating learning strategy	TBL	N/A	Chile
PS08	2020	Patra et al. 2020	Module to facilitate self-directed learning among medical undergraduates: Development and implementation	Not specified	160 first-semester medical students	Satisfied and motivated students	Self-directed learning (SDL)	N/A	India
PS09	2020	Sheelavant 2020	Google Classroom-An Effective Tool for Online Teaching and Learning in this COVID era	Forensic Medicine	150 medical students	Students took advantage of online learning	E-learning	Google classroom	India
PS10	2020	Debnath et al. 2020	Two-Way Feedback between the students and faculty to improve the methods and style of teaching anatomy to undergraduate medical students	Anatomy	100 first-year medical students	Improved teaching and learning	TWO-WAY FEEDBACK	N/A	India

Table 1 (continued)

ID	Year	Refe	Title	Subject	Population	Result	Applied Methodology	Developed Tool	Country
PS11	2020	Roshni et al. 2020	Small group discussions as an effective teaching-learning methodology for learning the principles of family medicine among 2 nd -year MBBS students	Family Medicine	109 s-year medical students	Learning advantage, improved student comprehension and attention	FEEDBACK (small group discussion SGD)	PowerPoint	India
PS12	2021	Diaz et al. 2021	Effect of feedback from clickers or Immediate Feedback Assessment Technique in a pharmacology course in 2 health degrees in which Team-Based Learning was used	Pharmacology	192 s-year medical technology students and third-year medical students	Promotes learning by obtaining better grades	TBL	N/A	Chile
PS13	2021	Saiboon et al. 2021	E-Learning in Teaching Emergency Disaster Response Among Undergraduate Medical Students in Malaysia	Disaster response medicine	168 students	Better assimilation of knowledge with visual rather than auditory stimuli. E-learning was not preferred as a substitute for traditional learning	E-learning	ELITE-DR (platform, videos)	Malaysia
PS14	2022	Fux et al. 2022	The Use of Blended Teaching in Higher Medical Education during the Pandemic Era	Neurology	293 students 2020	Blended learning is beneficial for learning	problem-based learning (PBL), case-based learning (ABC) flipped classroom	videoconferencing, messaging	China
PS15	2022	Patel et al. 2022	"Flipped Classroom" teaching-learning method in medical biochemistry 1st professional MBBS students	Biochemistry	76 first-year students	Better grades after AM		N/A	India
PS16	2022	Orsini et al. 2022	Near-peer teaching in human anatomy from a tutor's perspective: An eighteen-year-old experience at the University of Bologna	Anatomy	348 medical students	Positive results in academic performance	Near-peer teaching	N/A	Italy
PS17	2023	Khan et al. 2023	Online anatomy education during the Covid-19 pandemic: Opinions of medical, speech therapy, and BSc Anatomy students	Anatomy	51 students	Effective learning, in theory, face-to-face practice required	E-learning	Digital platforms	South Africa
PS18	2023	Castro et al. 2023	Study on the acceptance of virtual reality as a complement to the study of human anatomy	Anatomy	274 students	Positive feedback on learning except for exams	ICT	Virtual reality, smartphones	Spain

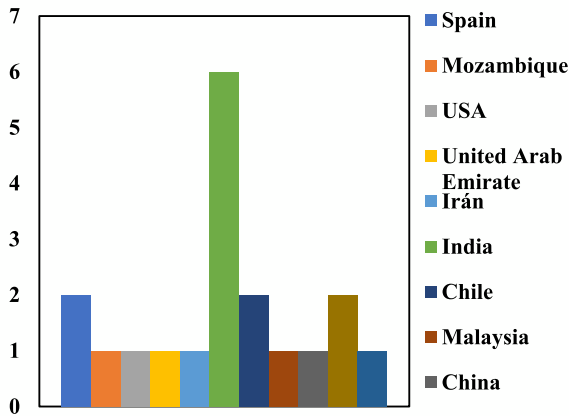


Figure 2 Countries in which active methodologies have been applied.

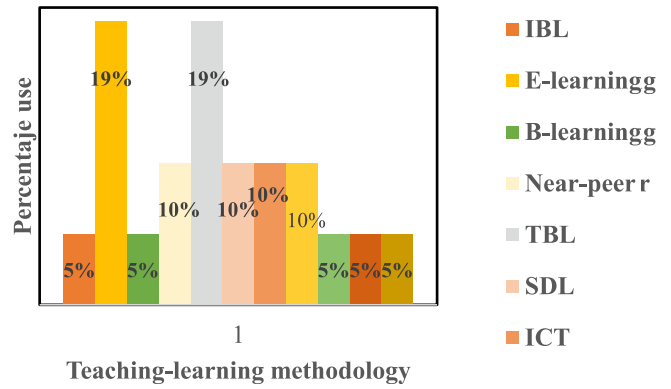


Figure 3 Active Methodologies in Medicine Teaching and Learning.

Table 2 Methodology Employed.

ID	Refe	IBL	E-learning	B-learning	Near-peer	Team-based learning (TBL)	Self-directed learning (SDL)	ICT	Two-way Feedback	Problem-based learning (PBL)	Case-based learning (ABC)	Flipped classroom
PS01	Gómez et al. 2018	✓	✓									
PS02	David et al. 2018		✓	✓			✓					
PS03	Logan et al. 2019				✓							
PS04	Cevik et al. 2019					✓						
PS05	Ramezani et al. 2020					✓		✓				
PS06	Sailaja et al. 2020							✓				
PS07	Lancellotti et al. 2020					✓						
PS08	Patra et al. 2020						✓					
PS09	Sheelavant 2020		✓									
PS10	Debnath et al. 2020								✓			
PS11	Roshni et al. 2020								✓			
PS12	Díaz et al. 2021					✓						
PS13	Saiboon et al. 2021		✓									
PS14	Fux et al. 2022									✓	✓	
PS15	Patel et al. 2022											✓
PS16	Orsini et al. 2022				✓							✓
PS17	Khan et al. 2023		✓									
PS18	Castro et al. 2023							✓				

Some authors suggest that applying active methodologies in teaching and learning medicine can be beneficial. It promotes dynamic and interactive learning, encouraging reflection and facilitating the teaching and learning process, particularly in complex subjects^{12,15,26} Like other authors,^{17,21,25} active methodologies are believed to be beneficial for visual learning due to tools and accessibility from anywhere in the world. This results in greater learning capture and critical students in the long term, which is reflected in improved grades. This promotes collaborative learning and better feedback, resulting in proactive students.

The use of active methodologies in medical education, as investigated in works,^{20,23,30} is considered highly supportive and useful. This approach motivates students through a dynamic learning process, resulting in long-term retention of knowledge and significant grade improvement. It also requires teachers to be committed to this process. Other authors argue that active methodologies complement traditional methods and can lead to more dynamic learning,^{18,26,29} better long-term knowledge retention, and improved grades. This approach can also increase student motivation and teacher commitment. It is important to note that this is not a replacement for traditional methods but rather a supplement.

The analyzed research has identified complications or problems associated with using active methodologies in teaching and learning,^{17,23,25} including the need for automatic tool updating, network issues, and insufficient knowledge or practice with technology. Additionally, it has been demonstrated that active methodologies could be more relevant in subjects of low complexity to achieve this objective.

Conclusions and future work

Effective medicine teaching requires the application of active methodologies in addition to traditional methods. This promotes active student and teacher participation, resulting in long-term and significant learning. Didactic tools can facilitate understanding, particularly in highly complex subjects, preparing future physicians for their professional lives.

Similarly, implementing active methodologies promotes teamwork, responsibility, autonomy, skill development, critical thinking, and more. This enhances their knowledge and enables them to take a more proactive role in teaching-learning, preparing them to tackle real-world challenges successfully. As a result, healthcare professionals are equipped with academic knowledge and the ability to provide appropriate patient care.

Applying methodologies for the teaching-learning process in other areas can help determine their effectiveness for a specific subject or career, gradually improving student learning outcomes. Once these results are obtained, it is advisable to include them in university educational models, using a combination of methods appropriate to the duration of the course and career.

On the other hand, researchers interested in active methodologies should compare Team-Based Learning (TBL) with traditional processes. They should also conduct workshops using this technique and complement it with Information and Communication Technologies (ICT) to determine the effectiveness of each inside and outside a university classroom.

Finally, this paper requires a detailed analysis of active methodologies and their effective integration with

traditional methods. Active methodologies and tools show promise in medical education to train comprehensive professionals. Future research could focus on establishing the most suitable way to take advantage of technological advances and complement traditional teaching, which is necessary for training health professionals.

The authors of the article "Metodologías activas y técnicas didácticas en la educación médica: una revisión sistemática" hereby declare that there are no conflicts of interest that could potentially influence the development, analysis, composition or publication of the present work in the journal *Educación Médica*. This assertion encompasses any form of financial, personal, academic or professional interest that could be construed as an undue influence on the content or outcomes of the article.

The present study is a systematic review of the literature, in which no original data from patients or human subjects were included. The data used were accessible and public scientific databases, considering and respecting copyright regulations.

Considering that no direct or indirect contact with individuals, sensitive data or private information was required, this research does not require approval by an Ethics committee, in accordance with current regulations.

Ethical disclosures

Considering that no direct or indirect contact with individuals, sensitive data or private information was required, this research does not require approval by an Ethics committee, in accordance with current regulations.

Conflict of interest

The authors declare that they have no conflicts of interest.

References

1. Niklas Oertel M, Pepper B, Schmitz M, Becker JC, Eich HT. Digital transfer in radiation oncology education for medical students-single-center data and systemic review of the literature; 2022. Available from: <https://doi.org/10.1007/s00066-022-01939-w>.
2. Luo Y, Li Y, Liu M, Long Y, Wang L, Chen D. Application of flipped classroom in biochemistry teaching reform at basic medicine college based on PBL and multimedia technology. *J Phys Conf Ser* [Internet]. 2020;1574:12083. [cited 2025 Feb 3]. Available from: <https://doi.org/10.1088/1742-6596/1574/1/012083>.
3. Trullàs JC, Blay C, Sarri E, Pujol R. Effectiveness of problem-based learning methodology in undergraduate medical education: a scoping review. *BMC Med Educ* [Internet]. 2021. [cited 2022 Oct 2]. Available from: <https://doi.org/10.1186/s12909-022-03154-8>.
4. Nml S, Sim O, Maria Lima de Sousa N, Cristina Pinheiro Fernandes de Araújo A, Isabela Maia de Oliveira S, Lima de Souza N, et al. Teaching methodologies in multiprofessional residency preceptory: a descriptive-exploratory study; 2016. Available from: <http://www.objnursing.uff.br/index.php/nursing/article/view/5680>.
5. Weigel C, Suen W, Gupte G. Using lean methodology to teach quality improvement to internal medicine residents at a safety net hospital. *Am J Med Qual* [Internet]. 2013;28(5):392–9. [cited 2025 Feb 3]. Available from: <https://doi.org/10.1177/1062860612474062>.
6. Baro Cáliz A. Metodologías activas y aprendizaje por descubrimiento; 2011. [cited 2025 Feb 3]. Available from:

- https://archivos.csif.es/archivos/andalucia/ensenanza/revistas/csicsif/revista/pdf/Numero_40/ALEJANDRA_BARO_1.pdf.
7. Silva Quiroz J, Castillo DM. A proposal of a Model for the introduction of active methodologies in higher education [Internet], vol. 17; 2017. [cited 2025 Feb 3]. Available from: https://www.scielo.org.mx/scielo.php?script=sci_abstract&pid=S1665-26732017000100117&lng=es&nrm=iso&tlng=en.
 8. Jiménez Hernández D, González Ortiz JJ, Tornel Abellán M. Active methodologies in the university and their relationship with teaching approaches. *Profesorado* [Internet]. 2020;24(1): 76–94. [cited 2025 Feb 3]. Available from: <https://revistaseug.ugr.es/index.php/profesorado/article/view/8173/PDF>.
 9. Gómez J, León E, Cubides C, Rodríguez A, Mahecha J, Rubiano JC. Evolution of teaching and evaluation methodologies: the experience in the computer programming course at the universidad nacional de colombia. *Ingeniería e Investigación* [Internet]. 2014;34(2):85–9. [cited 2025 Feb 3]. Available from: <http://www.scielo.org.co/pdf/iei/v34n2/v34n2a15.pdf>.
 10. Jebrailey M, Pirnejad H, Feizi A, Niazkhani Z. Evaluation of blended medical education from lecturers' and students' viewpoint: a qualitative study in a developing country. *BMC Med Educ* [Internet]. 2020;20(1). [cited 2025 Feb 3]. Available from: <https://pubmed.ncbi.nlm.nih.gov/33256714/>.
 11. Resmiaty T, Chaeruman UA, Kusumawardani D. The implementation of blended learning in the new normal era at vocational school of health. *Jurnal Pendidikan Vokasi* [Internet]. 2021;11(2):181–90. [cited 2025 Feb 3]. Available from: https://www.researchgate.net/publication/355815282_The_implementation_of_blended_learning_in_the_new_normal_era_at_vocational_school_of_health.
 12. Gómez-Lus Centelles ML, Alou Cervera L, Prieto Prieto J. Introducing inquiry-based learning in microbiology into the medical degree course: outcome of student involvement. *Educacion Medica* [Internet]. 2018;19(2):77–81. [cited 2025 Feb 3]. Available from: <https://www.elsevier.es/es-revista-educacion-medica-71-articulo-integrando-el-aprendizaje-activo-microbiologia-S1575181316301565>.
 13. Cevik AA, Elzubeir M, Abu-Zidan FM, Shaban S. Team-based learning improves knowledge and retention in an emergency medicine clerkship. *Int J Emerg Med* [Internet]. 2019;12(1). [cited 2025 Feb 3]. Available from: <https://pubmed.ncbi.nlm.nih.gov/31179926/>.
 14. Yepes-Núñez JJ, Urrútia G, Romero-García M, Alonso-Fernández S. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Rev Esp Cardiol* [Internet]. 2021;74(9):790–9. [cited 2023 Oct 9]. Available from: <https://www.revespcardiol.org/es-declaracion-prisma-una-guia-actualizada-articulo-S0300893221002748-pdf>.
 15. David L, Martins I, Ismail MR, Fernandes F, Sidat M, Seixas M, et al. Interactive digital microscopy at the center for a cross-continent undergraduate pathology course in Mozambique. *J Pathol Inform* [Internet]. 2018;9(1). [cited 2025 Feb 3]. Available from: <https://www.sciencedirect.com/science/article/pii/S2153353922003558>.
 16. Patra S, Khan A, Upadhyay M, Sharma R, Rajoura O, Bhasin S. Module to facilitate self-directed learning among medical undergraduates: development and implementation. *J Educ Health Promot* [Internet]. 2020;9(1). [cited 2025 Feb 3]. Available from: <https://pubmed.ncbi.nlm.nih.gov/33209923/>.
 17. Sheelavant S. Google classroom-an effective tool for online teaching and learning in this COVID era [Internet], vol. 14. *Ind J Foren Med Toxicol*. [cited 2025 Feb 3]. Available from: https://www.researchgate.net/publication/377533881_Google_Classroom_-_An_Effective_Tool_for_Online_Teaching_and_Learning_in_this_COVID_era.
 18. Saiboon IM, Zahari F, Isa HM, Sabardin DM, Robertson CE. E-Learning in teaching emergency disaster response among undergraduate medical students in Malaysia. *Front Public Health* [Internet]. 2021;9 [cited 2025 Feb 3]. Available from: <https://pubmed.ncbi.nlm.nih.gov/33996711/>.
 19. Khan J, Baatjes KJ, Layman-Lemphane JI, Correia J. Online anatomy education during the Covid-19 pandemic: Opinions of medical, speech therapy, and BSc Anatomy students. *Anat Sci Educ* [Internet]. 2023;16(5):892–906. [cited 2025 Feb 3]. Available from: <https://pubmed.ncbi.nlm.nih.gov/36924347/>.
 20. Logan AA, Delisser HM. "Rebuilding what has eroded": a descriptive, survey-based study of near-peer instructors' experiences in a critical pedagogy-based sociomedical course. *Adv Med Educ Pract* [Internet]. 2019;10:253–62. [cited 2025 Feb 3]. Available from: <https://www.dovepress.com/article/download/45518>.
 21. Orsini E, Quaranta M, Mariani GA, Mongiorgi S, Cocco L, Billi AM, et al. Near-peer teaching in human anatomy from a tutors' perspective: an eighteen-year-old experience at the University of Bologna. *Int J Environ Res Public Health* [Internet]. 2022;19(1). [cited 2025 Feb 3]. Available from: <https://pubmed.ncbi.nlm.nih.gov/35010658/>.
 22. Ramezani G, Norouzi A, Moradi E, Pourbairamian G, Aalaa M, Alizadeh S, et al. Comparing peer education with TBL workshop in (EBM) teaching. *Med J Islam Repub Iran* [Internet]. 2020. <https://doi.org/10.34171/mjiri.34.70>.
 23. Lancellotti D, Abarca A, Jorquera J, Lobos C, Aguilera D, Sánchez N. Evaluación de la metodología team based learning en cursos de estadística para estudiantes de medicina [Internet]. *Rev Med Chile*. 2020;148. [cited 2025 Feb 3]. Available from: https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0034-98872020000400488.
 24. Díaz-Velíz G, Figueroa C, Gutiérrez S, Castillo D, Maya JD. Effect of feedback from clickers or immediate feedback assessment technique in a pharmacology course in 2 health degrees in which team based learning was used. *Educacion Medica* [Internet]. 2021;22:173–8 [cited 2025 Feb 3]. Available from: <https://www.sciencedirect.com/science/article/pii/S1575181319300932>.
 25. Castro PL, Ginés R, Ramírez JA, Mompeó B, Domínguez L, Rodríguez A, et al. Study on the acceptance of virtual reality as a complement to the study of human anatomy. *Educacion Medica* [Internet]. 2023;24(4) [cited 2025 Feb 3]. Available from: <https://www.sciencedirect.com/science/article/pii/S157518132300030X>.
 26. Sailaja Tadepalli K, Awais Ahmed M, Paul RG, Navin Kumar IB, Reddy LC. Teaching aids and students preferences in anatomy lectures in State of Telangana. *Orig Res Art* [Internet]. 2020;2: 7300–4. Available from: [10.16965/ijar.2019.362](https://doi.org/10.16965/ijar.2019.362).
 27. Debnath S, Thakur KK, Balowria KS. Two-way feedback between the students and faculty to improve the methods and style of teaching anatomy to undergraduate medical students. *Int J Anat Res* [Internet]. 2020;8(41):7749–52. Available from: <https://www.ijmhr.org/IntJAnatRes/IJAR.2020.157>.
 28. Roshni M, Rahim A. Small group discussions as an effective teaching-learning methodology for learning the principles of family medicine among 2 nd -year MBBS students. *J Family Med Prim Care* [Internet]. 2020;9(5):2248. [cited 2025 Feb 3]. Available from: <https://pubmed.ncbi.nlm.nih.gov/32754482/>.
 29. Fu XT, Hu Y, Yan BC, Jiao YG, Zheng SJ, Wang YG, et al. The use of blended teaching in higher medical education during the pandemic era. *Int J Clin Pract* [Internet]. 2022;2022. [cited 2025 Feb 3]. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC9678442/pdf/IJCLP2022-3882975.pdf>.
 30. Patel J, Gamit A, Miahra A, Chauhan K. "Flipped Classroom" teaching-learning method in medical biochemistry 1st professional MBBS students. *Natl J Physiol Pharm Pharmacol* [Internet]. 2022(0):1. [cited 2025 Feb 3]. Available from: https://cdn.indiabioscience.org/media/articles/Flipped-classroom-case-study_GMERS.pdf.