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UNLOCKING THE FUTURE OF MEDICAL EDUCATION: UPDATING TEACHERS IN ARTIFICIAL INTELLIGENCE FOR A NEW ERA OF TEACHING

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Abstract: Artificial intelligence encompasses a range of skills, including pattern and image recognition, understanding written and spoken language, perceiving relationships and the ability to follow decision-making algorithms devised by experts. In addition, artificial intelligence can integrate new experiences to improve itself, solving problems and performing tasks. In medical education, it is essential to incorporate digital skills in order to train professionals who are more capable and prepared for the challenges of contemporary clinical practice. The growing integration of digital technologies in medicine, such as electronic health record systems, diagnostic artificial intelligence and telemedicine, requires future doctors to be familiar with and competent in the use of these tools. Digital competencies enable professionals to access and critically evaluate health information online, collaborate effectively in multidisciplinary teams and use technological resources to improve the diagnosis, treatment and monitoring of patients from a distance. Therefore, incorporating digital competencies into the medical curriculum not only prepares students for current clinical practice, but also enables them to adapt to a constantly evolving medical environment. The aim of this study is to update medical school teachers on the development of teaching activities using digital technologies. Before taking part in the course, the teachers had a diverse perception of the use of artificial intelligence in the educational context, ranging from skepticism to recognition of its transformative potential. After the workshop, the teachers expressed a more informed and enthusiastic view, perceiving the tools and techniques learned as valuable resources for improving pedagogical practice.

Keywords: Artificial Intelligence. Medical education. Learning. Educational Technology.

INTRODUCTION

Artificial intelligence (AI) is becoming more and more a part of our daily lives and, given this, it is fair to say that it is the accelerator, catalyst and, why not, the driving force behind humanity. Technological change has never been faster. We therefore need to be aware of and adapt to the immersion of digital technologies, robotization and AI in our personal lives, in the world of work and, consequently, in the educational sphere. If it's not just today that we replace physical effort with instruments and tools, why not work on replacing mentally predictive activities with digital tools? (Briganti, Le Moine, 2020).

The concepts of teaching and learning have undergone demystification, additions and valuable contributions over the centuries. However, the fact is that learning to teach has never been as challenging as it is today. On the one hand, a universe of possibilities and access to content and tools that used to be limited to a bibliographic collection and the knowledge of the teacher. On the other hand, a new generation of students - restless and often immersed in technology from their earliest years. The teacher, in the midst of this digital metamorphosis, moves between being the protagonist and contemplating the cognitive transmutations provided by the new technologies (Galvão *et al.*, 2023).

The traditional approach to education, based on the passive transmission of content, mechanized memorization, standardization and disciplinary fragmentation, is proving to be less and less effective, especially in the context of medical training. In this context, it is essential to develop contemporary approaches that value the active construction of knowledge, promote the integration of skills, adopt up-to-date teaching methods and recognize assessment as a complex process of understanding and application, and not just a superficial verification of learning (Briganti, Le Moine, 2020), (Lobo, 2017).

Only through these paradigmatic changes will we be able to ensure effective medical training in line with the demands of the modern world, where versatility and the ability to adapt are essential for professional success amid growing automation and the advance of artificial intelligence (Lobo, 2018).

The main objective of this article is to explore the importance of artificial intelligence training for medical school teachers, highlighting the relevance of this process for modernizing and improving medical education, as well as demonstrating teachers' understanding of AI tools and their implementation in medical education.

THEORETICAL FRAMEWORK

The integration of educational technologies in the context of medical education has become an increasingly essential and common practice. The benefits that these technologies can bring to the teaching and learning process of future health professionals are numerous, including stimulating creativity, encouraging research, broadening horizons and facilitating communication and collaboration between students. However, for the use of these technologies to be effective in the academic medical environment, it is essential that teachers are properly trained to apply them in a pedagogically relevant way. In addition, the lack of adequate technological infrastructure can also represent a significant challenge for the effective implementation of technologies in medical education (Kaul, Enslin, Gross, 2020).

The lack of specific training in the use of digital technologies during master's and doctoral studies is one of the main difficulties faced by university professors. Another noteworthy obstacle is the resistance of some teachers to digital technologies, which can be a significant barrier to implementing these technologies in the classroom. According to Tondeur *et al.* (2017), many teachers still consider that the use of digital technologies can interfere with the quality of teaching and student learning, which can lead them to underuse or avoid using these technologies in the classroom.

To overcome these difficulties, specific training and education in the pedagogical use of digital technologies is essential. It is also important that teaching practices are rethought and updated in order to incorporate digital technologies in a meaningful way, to develop content that is engaging, engaging and in line with current possibilities (Chiu *et al.*, 2023).

In summary, the difficulties encountered by teachers when using technology are related to a lack of specific training, insufficient technological infrastructure and resistance to the use of technology. To overcome these difficulties, it is essential that measures are taken to train teachers, improve technological infrastructure and rethink teaching practices (Tavares, Meira, Amaral, 2020).

ARTIFICIAL INTELLIGENCE AND MEDICINE

The concept of AI dates back to the early 1950s, when Alan Turing proposed a test comparing the ability of a computer with that of a human being to solve problems. The term "Artificial Intelligence" was made official in the 1950s by McCarthy and collaborators, with its applications in medicine beginning with Shortlife's article in 1963. Szlovits, in 2009, recognized that AI in medicine is becoming an essential part of medical informatics and a significant resource in solving health problems (Kaul, Enslin, Gross, 2020)

In medicine, AI, automation and robotization are already widely used in diagnosis in various types of tests, such as radiology, ultrasound and magnetic resonance imaging, as well as data from *wearable* devices, which provide continuous information on blood glucose, ECG and movement. Using decision algorithms, these systems can generate differential

diagnoses with highly reliable probabilities of occurrence (Lobo, 2017; Sapci, Sapci, 2020).

The experience acquired over the years in clinical practice enables professionals to improve their assessment of these diagnostic hypotheses, either by questioning the patient directly or by suggesting specific tests to be carried out. This accumulated knowledge can be complemented and enhanced by artificial intelligence (AI) in the medical context. AI can help healthcare professionals analyze large volumes of clinical data and patient histories, providing valuable insights and diagnostic suggestions based on patterns identified in similar cases. In addition, AI systems can suggest more efficient and personalized complementary examination protocols for each patient, optimizing the decision-making process and contributing to a more accurate and rapid diagnostic approach. Therefore, combining clinical experience with the capabilities of artificial intelligence can result in better diagnostic and treatment outcomes for patients (Pinto *et al,.* 2022).

It is also possible to see the benefits of implementing AI in electronic medical records, in the cross-referencing of drugs and prescribed conducts and patient data, thus avoiding interactions or inappropriate doses. Reflecting in a better and safer drug prescription. Doctors, pharmacists, nurses and other health professionals benefit greatly from these systems that compare data, conduct and prescriptions (Chiu *et al.*, 2023).

IMPLEMENTING AI IN MEDICAL EDUCATION

Medical students face a particular challenge due to the sheer volume of content in the core subjects. Many of these students, who are used to spending a lot of their time in front of screens, whether on social networks, games or entertainment channels, may find it difficult to maintain concentration during traditional classes. In addition to this challenge, many are still going through adaptive processes in relation to learning methodologies, considering that the high school curriculum structure in most schools still follows traditional learning teaching (Briganti, Le Moine, 2020).

In this context, active learning strategies that incorporate technological elements can prove to be more effective and attractive for engaging students and motivating them to learn. Gradually, study practices based on reading texts and handwritten notes are being joined by digital platforms that offer more immersive and interactive learning experiences, personalized by algorithms, through videos, *podcasts*, interactive tests, digital *flashcards* and mind maps. For educational managers, these platforms provide valuable data on student interaction, allowing detailed monitoring of the performance, attendance and activity of both students and teachers (Lobo, 2017).

In the educational context, various forms of artificial intelligence can be used to improve the learning experience of students and facilitate the work of teachers. And these tools go far beyond the famous ChatGPT and Kahoot it (Figure 1). There are recommendation systems, which analyze students' individual performance and interests to suggest personalized study materials and activities. In addition, educational *chatbots* can be implemented to provide instant support to students, answering questions and helping to resolve doubts. Another common application is the use of intelligent tutorials, which adapt the pace and content of teaching according to each student's progress, providing a more individualized and effective learning experience. In addition, the analysis of educational data using *machine learning* algorithms can provide valuable insights for educators, allowing them to identify patterns in student performance and develop more efficient and personalized teaching strategies. These are just some of the main forms of artificial

intelligence that have the potential to revolutionize the educational landscape, making it more adaptable, accessible and effective for students and teachers (Fava, 2028, p. 158).
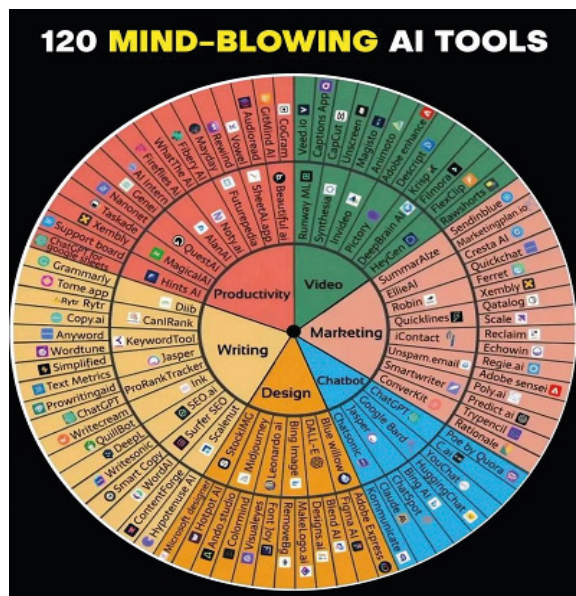

Figure 1 - AI tools to go far beyond ChatGPT.
Source: https://ediscoverytoday.
com/2023/07/21/120-mind-blowing-ai-
-tools-artificial-intelligence-trends/

METHODOLOGY

This analytical and descriptive study consisted of a *workshop* entitled "Developing Content with Artificial Intelligence", aimed at teachers from the basic and clinical cycles of the medical course at Afya Faculdade de Ciências Médicas de Jaboatão. The workshop was attended by 22 course lecturers, who were invited to take part voluntarily during the Faculty Development Week. The training was structured into three main stages:

WORKSHOP PLANNING
AND EXECUTION

• The workshop's program content has been carefully planned, covering topics such as an introduction to artificial intelligence, the tools and resources available, as well as case studies relevant to medicine.

• Teaching materials and audiovisual resources were prepared to help present the content and practical activities.

• During the training, the teachers actively participated by exploring various AI tools.

APPLICATION OF THE EVALUATION QUESTIONNAIRE

• A structured questionnaire was designed to assess the participants' perceptions at three points: before, during and after the workshop.

• Participants answered the questionnaire about their perceptions before the workshop began, to assess their level of prior knowledge about AI and their expectations of the training.

• During the workshop, participants also completed a questionnaire to provide immediate feedback on the content and identify any difficulties or points for improvement.

• After the workshop, the participants answered the questionnaire again to assess their satisfaction, the learning they had acquired and their intentions to apply the knowledge they had acquired in practice.

DATA ANALYSIS

• The data collected through the questionnaire was analyzed quantitatively using appropriate statistical techniques.

• In addition, the open-ended responses were analyzed qualitatively to identify patterns, emerging themes and relevant insights.

This study design allowed for a comprehensive assessment of teachers' perceptions before, during and after taking part in the workshop, providing valuable insights into the effective-

ness of the training and the receptiveness of artificial intelligence as a tool in the development of content for the medical course.

RESULTS

Of the 22 teachers who took part, 17 answered the questionnaire fully. When asked about the use of digital tools in teaching practice, more than 60% said they used these tools (Figure 2), especially ChatGPT and interactive tools such as Kahoot it and Padlet.

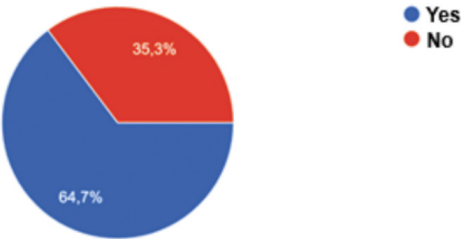Did you use Artificial Intelligence (AI) in your teaching and/or professional practice?
17 answers

Figure 2 - Teachers' use of AI before the Workshop: Developing Content with Artificial Intelligence.

Source: AUTHORS (2024)

Despite the above response, more than half of the teachers were either unfamiliar or partially gullible to the possibility of the resources that these digital tools can provide in our academic practice (Figure 3 and 4). This shows how these resources are often underutilized. According to a 2018 study by Lobo, published in the Brazilian Journal of Medical Education, a major challenge for teachers is to learn and seek self-development, according to their vocation and interests. Flexibility in learning and adapting to new tasks and functions and new tools should be the goal not only of a connected generation of students, but also of teachers, who must be committed to increasingly flexible learning, which should prevail in a society where Artificial Intelligence will be increasingly important.

How would you rate your level of familiarity with the topic "Developing Content with Artificial Intelligence" before attending the workshop?17 answers
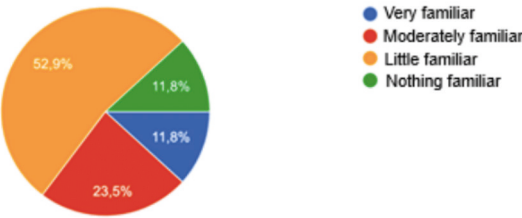

Figure 3 - Familiarity with AI tools before the workshop.
Source: AUTHORS (2024)

To what extent did you believe that the use of Artificial Intelligence could be applied in the context of medical education?17 answers
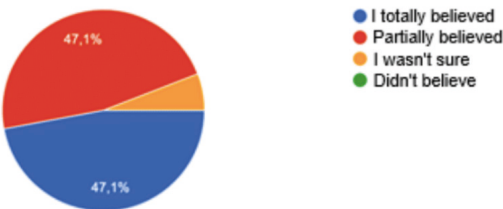

Figure 4 - Teachers' credibility in AI before the workshop.
Source: AUTHORS (2024)

The way the training was presented mimicked an interactive approach that could be reproduced in the classroom: sometimes we went through the lecture, sometimes we paused for *brainstorming*, sometimes the teachers had to carry out an activity, such as creating a *prompt* (commands) for a specific question. The dynamism presented, which made the training facilitators and the teachers, who represented our students there, move between active and passive moments over the course of an entire afternoon resulted in comments such as "I didn't even feel the time passing". The impact, as shown in Figure 5 and 6, reinforces the extent to which active, innovative and interactive pedagogical practices increase engagement in the classroom (Chiu *et al.*, 2023), (Fava, 2028, p. 184).

What aspects of the workshop were most impactful or surprising to you?17 answers

Figure 5 - Impact of the workshop on the development of digital skills.

Source: AUTHORS (2024)

How would you describe the workshop's approach to facilitating the use of concepts related to Artificial Intelligence in the development of educational content?17 answers
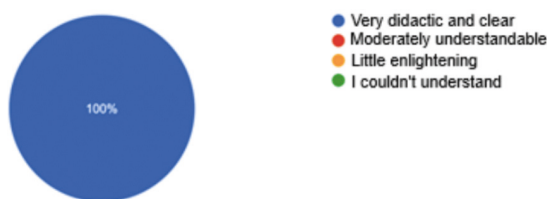

Figure 6 - The use of digital tools during the workshop.

Source: AUTHORS (2024)

In his book "Robot-proof: *higher education in the age of artificial intelligence*", Joseph E. Aoun, linguist and dean of Northeastern University, argues about the importance of preparing students to adapt to the changes brought about by technological automation. He stresses the need to replace old career models with new skills required in a society increasingly driven by robots, software and artificial intelligence. If the need to train students with these skills is tangible, teachers urgently need to be prepared for an educational approach that goes beyond the traditional emphasis on undergraduate and postgraduate degrees (Ulloa-Cazarez, 2020).

In our analysis, what had the greatest impact on our teachers was the ability of AIs to respond to well-designed *prompts* (Figure 7). Although many already use the tools, we iden-

tified difficulties in drawing up a clear and objective command to develop an activity, script, lesson plan or other academic and teaching assignment as expected. This fact highlights the important premise that AI will "steal" the teaching job, when in reality the professional who masters digital resources and technologies will always be ahead of them and not the tool (Galvão *et al.*, 2023).

After the training, it was found that the teachers' perception of the use of AIs in teaching practice changed positively for those who still had doubts about incorporating these tools into classroom (Figure 8 and 9). During the practical activities, we were able to demonstrate that by using these tools, the pillars of critical thinking (the ability to rationally analyze ideas and apply them skillfully), systems thinking (the ability to establish correlations between different functions, situations and contexts), entrepreneurship (the ability to take initiative, elaborate, innovate and implement) and cultural agility (the ability to make decisions in different and even conflicting contexts) proposed by Aoun in 2017 can be fully implemented (Ulloa-Cazarez, 2020).

How has your perception of the applicability of Artificial Intelligence in the development of educational content changed after attending the workshop?17 answers
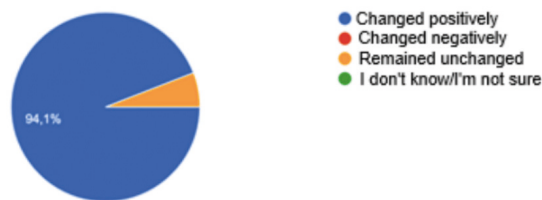

Figure 8 - AI applicability after the workshop

Source: AUTHORS (2024)

Was there a specific moment or topic discussed at the workshop that you found particularly relevant to the context of medical education?17 answers
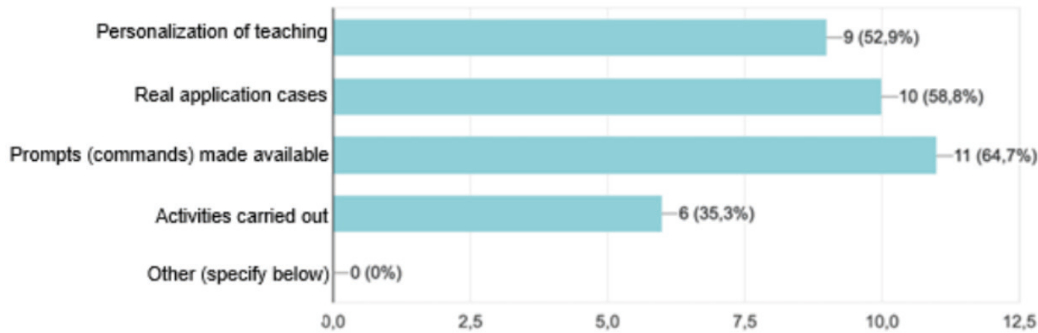

Figure 7 - Digital skills and medical education.

Source: AUTHORS (2024)

Are there specific areas where you see immediate potential to apply the knowledge youhave acquired in your educational practices?17 answers
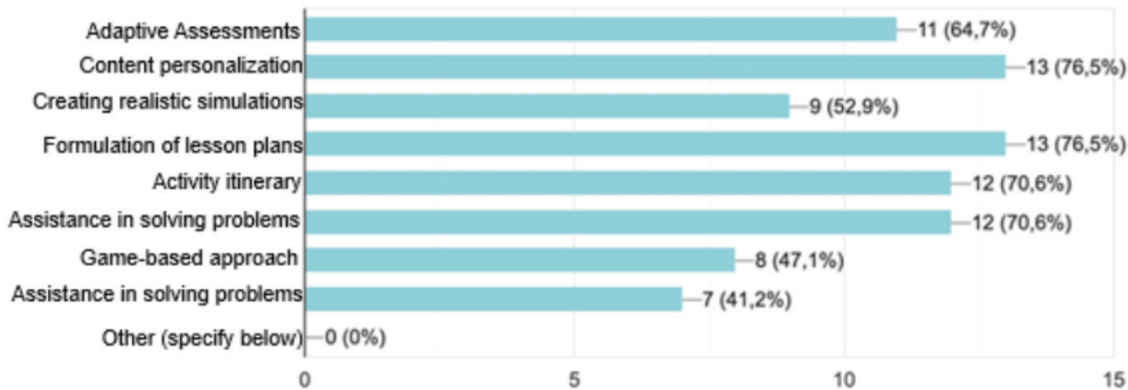

Figure 11 - Implementation of AI in teaching practice.

Source: AUTHORS (2024)

Do you feel that you have acquired practical skills or specific knowledge that can be applied immediately in your activities as a madicine teacher/tutor?17 answers
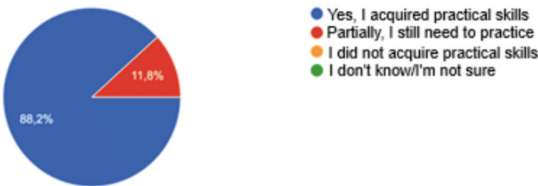

Figure 9 - Skills developed by teachers.

Source: AUTHORS (2024)

As mentioned earlier, the use of technologies in the development of the teaching process is difficult, and consequently teachers need support, structure and ongoing training to improve themselves for use in their teaching and personal learning processes (Fava, 2028, p.74). After approximately four hours of training, we were able to change our teachers' understanding of AI resources, thus strengthening the potential for implementing these technologies in their future classes, lectures, conferences and courses (Figure 9 and 10).

How did the workshop influence your vision of the potential of Artificial Intelligence to transform medical education? 17 answers

- It strengthened my belief in the transformative potential
- Changed my perspective positively
- It didn't influence my vision
- I don't know/I'm not sure

29,4%
70,6%

Figure 9 - AI's potential in medical education.

Source: AUTHORS (2024)

How do you plan to integrate the concepts you learned in the workshop into your future medicine classes? 17 answers

- Integrate immediately
- Plan gradual integration
- I have no integration plans
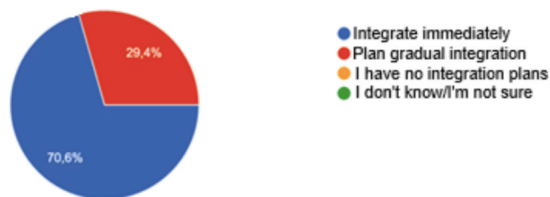- I don't know/I'm not sure

29,4%
70,6%

Figure 10 - Implementing AI in medical education.

Source: AUTHORS (2024)

When asked what pedagogical practices they would apply the knowledge acquired in AI to, we can see that personalizing content, helping to formulate lesson plans and drawing up activity scripts were the points most voted for by teachers (Figure 11). Although AI can offer valuable support to the educational process, helping to create personalized content, evaluate student performance and even adapt the curriculum to individual needs, the role of the teacher remains irreplaceable. Teachers must also cultivate complex cognitive skills, such as critical thinking, creativity and collaboration, which are essential for success in a world driven by technology. So, while artificial intelligence can be a powerful tool in the educational process, it is important to recognize and value the unique and irreplaceable role of the teacher in the training of medical students (Lobo, 2018).

It is well known that artificial intelligence demonstrates a remarkable ability to facilitate the execution of mechanical and predictive activities when fed with personalized and well-defined *prompts*. By receiving clear and specific instructions, AI algorithms can automate a variety of repetitive tasks, such as processing data, classifying information and even making decisions based on identified patterns. This ability to respond efficiently and accurately to specific *prompts* allows AI to take on a variety of roles in different sectors, increasing operational efficiency and freeing up humans to focus on more complex and creative tasks (Chiu *et al.*, 2023).

FINAL CONSIDERATIONS

In a context permeated by automated processes and advances in artificial intelligence, educational proposals that advocate adapting the educational model to the demands of the market are gaining prominence. This highlights the importance of preparing medical students with skills and competencies that enable them to keep up with technological automation. Therefore, the results of this study demonstrate that a medical university education should go beyond an emphasis on traditional teaching, but should also prioritize the continuous development of digital skills, which will be necessary to meet the demands of an economy increasingly driven by robots, *software* and artificial intelligence.

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