


## The impact of new technologies on medical education

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### ABSTRACT

Medical education is undergoing a silent revolution, driven by the advancement of new technologies. As medicine evolves, so does the way future doctors are prepared to meet the challenges of the healthcare industry. In this article, we will explore the new technologies that are transforming medical education and their possible impacts on the quality of health care. The methodology used was an exploratory study of a qualitative nature, through bibliographic research, which was carried out from the literature review and the theoretical framework on the theme addressed.

**Keywords:** New technologies, Curriculum, Medical education.

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## INTRODUCTION

Medical education is undergoing a quiet revolution, driven by the advancement of new technologies. As medicine evolves, so does the way future doctors are prepared to meet the challenges of the healthcare industry. In this article, we will explore the new technologies that are transforming medical education and their impact on the quality of health care. At the epicenter of this change is the growing influence of new technologies, which have the potential to revolutionize medical education in ways that were previously unimaginable.

It is notorious how new technologies are redefining the traditional paradigm of medical education. From virtual reality (VR), Augmented Reality (AR), to Artificial Intelligence (AI), Telemedicine, Virtual Patient Simulations to the availability of globalized online resources, technological tools are becoming key allies in shaping the next generation of doctors.

The present research has its genesis in the Graduate Program in Education: Curriculum in the New Technologies in Education Research Line of the Pontifical Catholic University of São Paulo (PUC-SP).

## METHODOLOGY

This is an exploratory qualitative study, carried out through bibliographic research, which sought to investigate how new technologies are transforming medical education and its possible impacts on the quality of health care. Steps followed:

## LITERATURE REVIEW

First, from August to October 2022, a bibliographic survey was carried out, which consisted of reviewing the literature related to the topic addressed. Books, periodicals, articles, Internet sites, among other sources, were used. In order to delimit the research on medical education, the research was concentrated in the following databases: Latin American and Caribbean Health Sciences Literature - LILACS; PubMed, Scielo Brasil *Scientific Electronic Library Online*, EMBASE - Databases; Databases – SAÚDE, BIREME - PAHO/WHO - Pan American Health Organization and *Medical Literature Analysis and Retrieval System Online* (MEDLINE).

## SYNTHESIS OF THE THEORETICAL FRAMEWORK

Throughout this century, the technological revolution has been characterized by a process whose consequences have had a great impact on modern history.

Technological evolution has been generating new social behaviors, to the extent that individuals establish unprecedented social relationships, whose meanings emerge with the use of technologies. Individuals are often influenced without realizing that the use of technologies



modulates social behaviors, whether the subjects are aware of it or not. From this use, new models of work, health care, learning systems, among others, can emerge (MARTINHO, 2014; HEIFER; SOUZA, 2016; CHRISTIAN; HARBOR; SANTOS, 2016; OLIVEIRA, 2017).

Technology, understood as the set of knowledge applied to a given branch of activity, with emphasis on the scientific aspect, when used in teaching, represents what is specified as educational technology, being a relevant tool for the application, inclusion, strengthening of pedagogical strategies and, mainly, the guarantee of democratic actions (ALMEIDA, 2009).

Technologies alone do not guarantee democratic education, but being connected, knowing how to read, participating in the digital world and the communication network, are preconditions and feeders of freedom – and fed by it (ALMEIDA, 2011). Thus, the inclusion of new technologies in education demands public policies aimed at social inclusion and the insertion of the population in the digital society.

Technological progress has, in a more radical way in the last three decades, profoundly marked the practice in medical courses. In this sense, in order to think about the integration of technologies into the curriculum, it is essential that educators critically interpret this increasingly connected world. A first step is to try to integrate what has been created separately: the curriculum and the technologies.

Integrating technologies into the curriculum implies considering the educational principles and didactics that make up the learning mechanism, incorporating curricular technologies into the methodologies and didactics that facilitate student learning (SÁNCHEZ, 2002).

As important as understanding integration is to talk about the curriculum. The curriculum is a social construction, which is developed in action, interaction between school, knowledge, life and culture, producing diverse paths (ALMEIDA, VALENTE, 2011).

In the literature, there are many concepts attributed to the curriculum (SACRISTÁN, 2000; YOUNG, 2014). For Sacristán (2000), the curriculum is a social construction that systematizes the organization of a formative proposal to be developed over time. The author points out other regulatory issues of the curriculum that delimit the expected educational experience. "The curriculum defines a practical territory in which one can discuss, investigate, but, above all, in which one can intervene." (SACRISTÁN; GÓMEZ, 1998, p. 145).

Michael Young (2014) states that the curriculum is a system of social and power relations with a specific history. This is related to the idea that the curriculum can be understood as knowledge of the powerful. This author also points out that curriculum is also a complex body of specialized knowledge and is related, in other words, to whether the student is able to provide resources for explanations and to think about alternatives, whatever the area of knowledge and the stage of schooling.



## RESULTS AND DISCUSSIONS

### HISTORICAL CONTEXT OF MEDICAL EDUCATION IN BRAZIL

The first medical school in Brazil was institutionalized in 1808, in Bahia, and was called the "school of surgery" because it trained surgeons and not doctors. The continuity of his education took place in Europe, especially in Portugal (GONÇALVES; BENEVIDES-PEREIRA, 2009).

The first reforms of medical schools took place between 1812 and 1815, when the "schools of surgery" came to be called Medical-Surgical Academies. During this same period, the first moment of revision of the duration of the courses was carried out, with an increase from four to five years. In 1832, the institutions were transformed into Faculties of Medicine, adopting the rules and programs of the Medical School of Paris, with a duration of six years. The students received the title of "Doctor of Medicine, Pharmacist and Midwife" (GONÇALVES; BENEVIDES-PEREIRA, 2009)

The National Curriculum Guidelines (DCN) for the training of physicians were the result of a process that involved political, institutional, cultural and educational aspects. Some of the educational values expressed in these guidelines can be found in the *New School movement* of the early twentieth century. In Brazil, this movement gained strength with the Manifesto of 1932, which opposed the exclusively passive, intellectualized and verbalist tendencies of the traditional school. This movement pointed to the need for change, aimed at an integral formation of the student, in order to develop the capacities of creation and active construction of knowledge. At the end of the 1950s, the 1959 manifesto brought favorable conditions for the elaboration of the Law of Guidelines and Bases of National Education (LDB) of 1961. The Federal Constitution of 1988 contributed with fundamental principles to the revision of the LDB of 1996. This revision valued the formation of citizenship, highlighting the flexibility of the curriculum and the frontiers of science in professional practice (AZEVEDO *et al.*, 2010).

In May 2001, Law No. 10,172 regulated the implementation of the National Education Plan and established the National Curriculum Guidelines (DCNs), in order to ensure "flexibility and diversity in the study programs offered by the different institutions of higher education" (BRASIL, 2001a, p. 33).

The DCNs constituted a general standard of orientation for the elaboration of political-pedagogical projects and curricula by Higher Education Institutions (HEIs) in Brazil. The first resolution with guidelines for the area of Health - Resolution CNE/CES No. 1,133/2001, of August 7, 2001 (BRASIL, 2001b), which provides for the DCN of Medicine, Nursing and Nutrition courses - presents elements on the profile, competencies and skills of the graduates, curricular contents, internships and complementary activities, course organization, monitoring and evaluation that meet the demands of the SUS.

In 2014, another reform of medical education began with the implementation of new DCN for



Undergraduate Courses in Medicine (BRASIL, 2014). According to the current National Curriculum Guidelines (DCNs), medical education must have a critical, reflective, ethical, humanistic and transformative character, to be translated through the articulation of knowledge, skills and attitudes in the areas of competence of health care, management and education. The knowledge to be constructed should be explored through the development of critical-reflective thinking and guided by a dialectical perspective of man's interaction in reality, and not only through transmission and memorization, as occurs in traditional educational models. Curricular training should articulate teaching and practice in the context of the Unified Health System (SUS) and health care should be guided by a comprehensive and humanized approach, including promotion, prevention, treatment, rehabilitation and palliative care, with social commitment and participation. In view of the speed with which new information is produced on health issues, the DCNs point out the importance of incorporating Information and Communication Technologies (ICTs) in educational activities and for access to remote databases.

## INSERTION OF NEW TECHNOLOGIES IN MEDICAL EDUCATION

For Brito and Purificação (2011), the reason why technologies are present everywhere reinforces the need and importance of their existence in education. For the authors, education and technology are tools that provide the subject with the construction of knowledge.

In recent years, medicine has witnessed a rapid adoption of innovative technologies that have the potential to significantly enhance medical training. These technologies include: 1. Virtual Reality (VR) and Augmented Reality (AR): allow for the creation of immersive simulation environments, in which students can practice procedures and diagnostics in controlled virtual environments. 2. Artificial Intelligence (AI): used for medical data analysis, disease diagnosis, patient triage, and complex clinical case simulations. 3. Virtual Patients: Computer simulations that represent real patients, allowing students to practice clinical interactions and decision-making in healthcare scenarios. 4. *E-learning* platforms: offer access to teaching materials, recorded classes, and interaction with teachers and classmates online.

New technologies can also bring a number of benefits to medical training. Hands-on training in Virtual Reality and Augmented Reality provides an immersive, hands-on training environment, allowing students to practice procedures and techniques realistically. The personalization of learning is being developed through the *E-learning* and Artificial Intelligence Platforms that allow for the customization of the curriculum to meet the individual needs of the students. Realistic simulations (SR) with so-called virtual patients (PV) and artificial intelligence (AI)-based simulations create realistic clinical scenarios, providing students with valuable experiences.

It should be noted that with the advancement of telemedicine, it has instituted the form of



providing medical services mediated by technologies for care, educational, research, disease prevention and health promotion purposes, Brazilian doctors can perform consultations at a distance. And it can be applied in teleeducation, telecare, telereports and telesurgery.

Technological development puts society in front of another period of change. Surprising innovations provoke reflections on interpersonal interactions, bring comfort, agility in accessing and processing information, and more effective problem solving. The internet makes it easy to access medical resources from around the world, including case studies, research, and expert classes with access to global resources.

## **FINAL THOUGHTS**

Despite the benefits that the integration of new technologies enables, the medical education curriculum is not exempt from current challenges. It is noteworthy that there is still much to explore with regard to the modification of the forms of teaching and learning, in order to make better use of these new technologies, especially within medical education.

The educational environment in the medical field lacks research and studies that develop methods to prove the effectiveness of the use of technological tools within the educational context.

Historically, the medical curriculum is characterized by the fragmentation of actions which, although they allow for changes in education, have been marked by the recognition of a curricular model still in traditional education.

After 9 years of the implementation and development of the last curricular guidelines of the Medicine course, the monitoring and evaluation of the proposed guidelines should allow the adjustments that are necessary for their contextualization and improvement.

As technologies continue to advance, medical training is likely to evolve further. Virtual reality, artificial intelligence, and machine learning can play increasing roles in simulating complex clinical scenarios.

However, it is important to address the ethical and privacy challenges that come with this evolution. As progress advances, it can be expected that medical training will become even more efficient, preparing the physicians of the future to meet the challenges of modern medicine.

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