TRANSFORMATIONS IN EDUCATION: TECHNOLOGICAL INNOVATIONS AND PEDAGOGICAL PRACTICES FOR INCLUSIVE AND PERSONALIZED TEACHING

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ABSTRACT

This work addresses the transformations in education driven by new technologies and pedagogical practices, to make teaching more inclusive, personalized and dynamic. The integration of Information and Communication Technologies (ICTs) has reconfigured the teaching-learning process, promoting interactive, collaborative and student-centered methods. The use of technologies such as artificial intelligence, augmented reality, and gamification makes it easier to adapt teaching to the individual needs of students, taking into account their learning pace and interests. Contemporary education also benefits from practices that connect theory and practice, contextualizing content to make it more relevant. However, the process of adopting new methodologies faces challenges, such as resistance from educators and inequality in access to technologies. Teacher training to integrate ICTs with pedagogical knowledge is essential to ensure the success of innovations. In addition, it

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is necessary to create interactive and collaborative learning environments that allow students to become protagonists of their learning. The text also highlights the importance of considering the sociocultural context of the students, evidencing the interaction between formal education and the family environment in the educational process.

INTRODUCTION

The field of education is always in the midst of a process of major transformations, in which it seeks to increase the integration between emerging technologies and new pedagogical approaches, which challenges conventional educational methodologies. Advances in technology, together with the emergence of new theories and pedagogical practices, have reconfigured the way we understand the teaching-learning process. In this scenario, the Educational Sciences are restructuring themselves to keep up with the rapid changes, with the aim of making it more inclusive, personalized and dynamic (Dede, 2009).

Innovations related to education seek to adapt teaching to the specific needs of each student, which takes into account individuality, such as the specific difficulties of each one, the pace of learning and the interests of the student. In addition, these innovations are focused on the continuous evolution of teaching methods, in the search for more interactive, collaborative, and student-centered activities. The use of technologies such as artificial intelligence, augmented reality, gamification, and adaptive learning tools has been essential to offer innovative solutions that enhance the educational experience (Siemens, 2005).

For Jonassen (1999), learning becomes more effective when students can see the practical application of what they are studying, which involves contextualizing the content, and can be obtained through specific scenarios and real cases, becoming more relevant and attractive to students. These adaptations emphasize the importance of recognizing that each student brings with them a unique set of experiences and needs that must be taken into account for a truly inclusive and effective education.

Overall, the transition from standardized models to customized approaches reflects a deeper understanding of students' needs and the demands of the labor market. Institutions that incorporate these practices tend to provide more effective and engaging learning experiences, and ensure that education serves an increasingly diverse and demanding audience.

Information and Communication Technologies (ICTs) are the main responsible for changes in social relations and in the educational field, whether in face-to-face or distance learning. They allow changes, both directly and indirectly, in the ways of teaching and learning, which continuously need to be reconfigured in order to seek to serve different generations of students in the most diverse environments.

The combination of traditional pedagogical practices with digital technologies, without adequate planning, can result in an experience that does not meet the expectations of modern training and professional development. An important point is to invest in the training

of educators and create learning environments that encourage interactivity, collaboration and personalization of teaching, and that allow students to become protagonists of their own learning. In addition, educators can guide students in the characterization, reconstruction and materialization of their knowledge through new languages (Silva *et al*., 2024).

The training of teachers in the use of ICTs is important, but it is necessary to have an integration with pedagogical and didactic knowledge, which allows discussions, debates and questions about their use, as well as in the teaching-learning process as a whole, and thus enrich the educational whole. By making this transition, the teaching-learning process can not only overcome the limitations of traditional approaches, but also prepare students for challenges in the labor market, which increasingly requires differentiated competencies and self-learning skills.

There is also a significant influence of the family environment in the educational process. Students from family backgrounds who support educational innovations and cultivate a culturally enriching environment tend to show faster academic progress. This finding emphasizes the interrelationship between formal education and the student's sociocultural context, and indicates that learning is also impacted by several external factors. This strategy reinforces the modern conception that education is a multifaceted process, which involves the interaction between students, teachers and the socio-family context.

In this context, the present work aims to explore and detail some of the main innovative approaches that are shaping contemporary education. It sought to discuss how these new approaches and technologies are being applied in classrooms and what is their impact on student development, educator training and educational management, through an analysis supported by scientific and academic references. The discussions are based on contemporary pedagogical theories and case studies that exemplify the effectiveness of these innovations in the current education scenario.

INFORMATION AND COMMUNICATION TECHNOLOGIES

The internet represents one of the most significant milestones in the cultural transformations driven by technological evolution. According to Castells (2002), the internet has been consolidated as the means of communication with the greatest insertion in society. While radio took thirty years to reach sixty million people, TV reached this level of diffusion in 15 years, and the internet reached this level in just three years. Despite its global diffusion, it is important to highlight that, in the year 2000, about 88% of internet

users were located in industrialized countries, which represented only 15% of the world's population (Castells, 2002).

While the internet is often perceived as a global technology and independent of geographic location, disparity in access remains a significant challenge (Lima and Araujo, 2021). In this context, discussions about the future of education must take into account the transformations in the relationship with knowledge (Guilherme *et al.*, 2024). Innovative technologies facilitate the expansion, expression and modification of students' cognitive functions, such as memory, imagination, perception and reasoning, through new forms of access to information (Castells, 2002).

Several decrees and guidelines have been drafted to regulate and promote Education in Brazil, such as the Law of Guidelines and Bases of National Education (LDB). More recently, Decree No. 9,057/2017 emphasizes the role of Information and Communication Technologies, highlighting that didactic-pedagogical mediation can occur with the use of ICTs, involving teachers and students in the development of educational activities in different places or times (Brasil, 2017). This decree also emphasizes the importance of ICTs in promoting learning and creating more dynamic and interactive educational environments.

Figure 1: Brief history of the use of ICTs in education in Brazil.
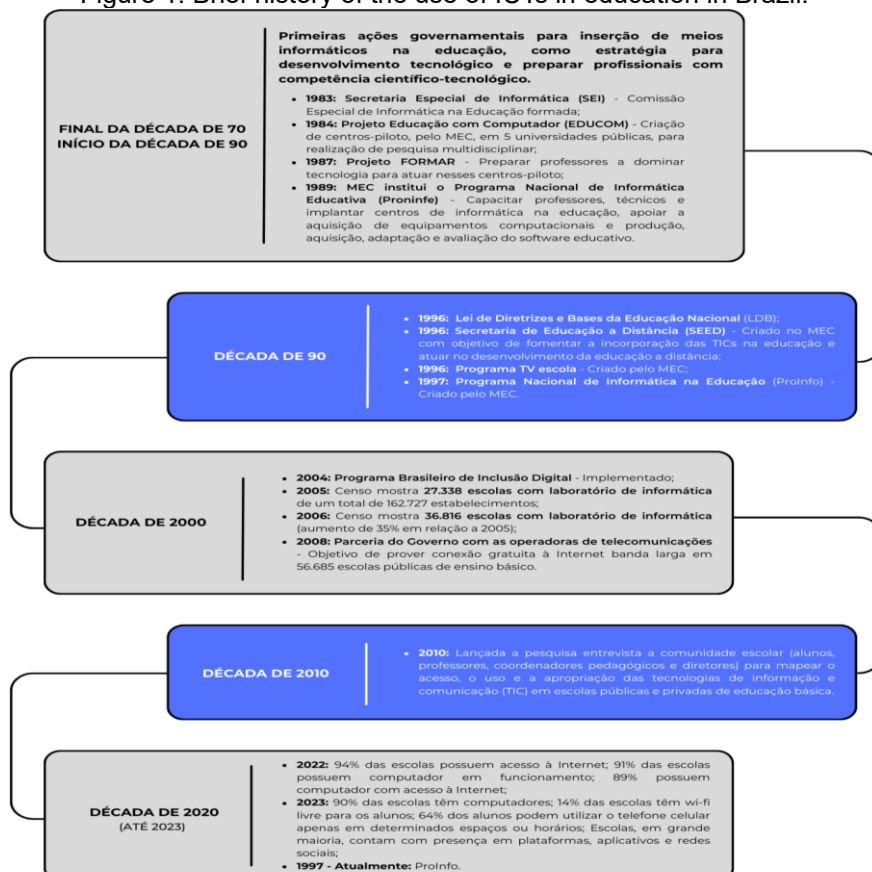
Source: Adapted from Almeida, 2008; Rosa, 2017; Cetic.br, 2023; Cetic.br, 2024.

ICTs provide opportunities for teachers to instruct students and create conditions for them to express their thoughts, so that they can reconstruct knowledge in other ways. In this scenario, students are encouraged to transform information into practical knowledge applicable in everyday life (Vieira, 2011). The interest in exploring this theme arises from the need to understand the relevance of the integration of Information and Communication Technologies in the teaching-learning process. ICTs make classes more attractive, allowing students to have the opportunity to build knowledge in an autonomous and meaningful way (Silva *et al.*, 2024).

Jonassen (1999) highlights that learning is more effective when students have the opportunity to see the practical application of what they are studying, involving the contextualization of the content, which can be obtained through specific scenarios and real cases, becoming more relevant to students. These adaptations emphasize the importance of recognizing that each student brings with them a unique set of experiences and needs that must be taken into account for a truly inclusive and effective education.

Countries from all continents make massive investments in the use of ICTs, in pedagogical processes, infrastructure and digital development. Compared to these countries, actions in this area in Brazil started late. Only in the last decade have public policies aimed at digital inclusion in the Brazilian population been instituted in the three governmental spheres (Soares-Leite and Nascimento-Ribeiro, 2012). Thus, only recently has public management observed the real value of ICTs as an instrument for building the future. From then on, public policies were adopted with the objective of boosting development based on new technologies (Pereira and Silva, 2020).

The use of ICT allows for the qualification of learning, through multimedia resources, simulation and synchronous and asynchronous communication tools, in addition to allowing students to develop skills for the use of technologies, which greatly contributes to their professional training (Kampff, 2012). This knowledge became important elements of the National Common Curricular Base. This is a guideline for basic education in Brazil, where at least three of the ten general competencies that the education system should provide to students deal specifically with the technological-digital component (Brasil, 2017).

With the significant technological advancement in recent years, it is possible to create a digital environment composed of virtual tools, providing a wider range of information and resources to the student, making the teaching process more dynamic, effective and innovative. New technologies become highly relevant instruments, acting mainly in the optimization of the teaching-learning process. In addition, the correct use of these tools responsibly and creatively brings numerous benefits to teachers. Technological

devices are very present in the daily lives of the new generation, so the school cannot ignore these influences (Oliveira and Costa, 2023).

Since ICTs are present everywhere, depriving students of this access is the same as limiting their training and performance in the world. In this sense, the real challenge is not to know and know how to handle technological resources, but to recreate a methodology that does not use these resources as a simple transfer from the traditional to the digital. It is essential to make effective use of the various tools currently available to build learning so that the student has interaction and knows how to receive and share knowledge autonomously (Azevedo *et al*., 2014).

The internet and other devices used in teaching should be used, together, with the objective of making transformations in the traditional pedagogical approach, and not to be an assertive means of communication, only. The use of computerized machines in the educational space must have the function of overcoming conventional barriers, allowing this environment to renew contents, objectives and, especially, methodologies. There are still pessimistic views on the use of ICTs in the classroom. These issues primarily concern the student's behavior in relation to the misuse of technology within the classroom environment. Still, on the other hand, there are views that support the careful and accompanied use of these tools. The proper or improper way of using all technologies depends on the user. Technologies in general give human beings great possibilities of access to information, which can later be transformed into knowledge (Pocinho and Gaspar, 2012).

Furthermore, the use of ICTs in the context of the teaching-learning process is not limited to knowledge of computer techniques. It is necessary that the use of these technologies is associated with the creation of favorable conditions for the appropriation of skills and concepts, by educators and students, so that it is related to a pedagogical content and sociocultural context. Therefore, it is necessary to use new technologies to promote transformations in pedagogical practices, leading to changes in the conception of knowledge and learning, as well as in the roles played by teachers and students in the teaching and learning process (Siqueira, 2013).

It is important to highlight that with the resources of the internet, different digital devices and other educational software, teachers have a wide range of tools and possibilities that were previously non-existent or scarce. A new way of teaching emerges, providing teachers with new ways of constructing knowledge, breaking old paradigms and providing students with better conditions for development. In this scenario, there is a new learning model, also centered on the student, giving him an active and autonomous role in learning (Locatelli, Zoch and Trentin, 2015).

Despite the use of technologies in the classroom and the emergence of advanced and refined methodologies, the student still remains the main individual in the process of knowledge construction. The teacher continues to be the transmitter of information, interacting through questions, leading the student to become an investigator who seeks considerable solutions. The differential, in this case, is the use of technological resources in a creative, careful and pedagogical way, linked to methodologies appropriate to the student's reality. In the classroom, teachers must be able to extract the most from the tools available for the exercise of the function. In view of this, ICTs can be used in different ways. Teachers can make use of documentaries, films, newspaper articles, magazines, website research, field research, visits to virtual and real laboratories, use software for educational content and develop a methodology that attracts the attention of students in an innovative way (Dourado *et al*., 2014).

PERSONALIZED EDUCATION AND ADAPTIVE LEARNING

In the twenty-first century, we observe the advances offered in favor of learning in the educational sphere, which are used as pedagogical strategies aimed at students and their specific needs. Technology as a tool has been widely internalized in the daily lives and work environments of citizens, gaining notoriety within schools and universities, where teachers and students benefit from the range of diversity of technological pedagogical methods. Over the years, the possibility of a more interactive education has demonstrated advances in the learning and inclusion of students, therefore, scientific and technological progress that does not fundamentally respond to human interests, to the needs of our existence, lose its meaning (Freire, 1996).

The term Adaptive Learning (AA) institutes an educational approach that seeks to favor individuals and their particularities, where the personalization of the student's needs is provided through the use of technological methods, thus contributing to the advancement of the student's development (Lamattina and Peralta, 2024). Education has flaws by comprehensively treating all students in the same parameter, the Adaptive Learning system would make it possible to monitor student performance and adjust the gaps that have their flaws, in this way having a report of each individual would bring effectiveness in the inclusion and observance of the particularity of each one. Adaptive learning is not just a technological innovation; it is based on solid scientific principles that combine the science of learning, cognitive psychology, and information technology (Lamattina and Peralta, 2024).

As an example of a digital platform in the field of Adaptive Learning, Knewton uses predictive analytics and AI evaluating student performance to provide a personalized form

of learning, providing the individual with effective methods according to their needs. Another example is the Moodle platform that incorporates basic tools for adapting learning, for example, the "activity locking" feature allows the author/tutor of a course to inhibit, or present certain resources and activities, thus adapting the course structure to its target audience (Bechara and Haguenauer, 2010).

However, such resources do not allow the registration of an inventory of styles and the automatic adaptation of the contents to the style of each learner. To implement adaptive learning, it is critical, regardless of the individual characterization model chosen, to start with an assessment that identifies the student's learning style. The Adaptive Mathematics Platform (PAM) is a tool that uses different educational processes for teaching mathematics and can be used by teachers and students. It works through a set of links that present a series of theoretically based activities, presenting tips and examples of mathematical problem solving.

The range of functional tasks solved with the help of the adaptive platform implemented in systems is extremely wide, from the organization of students' independent work and distance learning to the development of professional skills in the conditions of the modern trend in mathematics (Santos, 2022).

Personalization or personalized education in its deepest sense is not found in a new, more effective form or method of teaching, but in the transformation of learning into a more meaningful element of personal formation through the adaptation and choice of responsibilities by the student himself (Hoz, 2018).

The first mention of personalization was made in mid-1905, by Helen Parkhurst, who created the Dalton plan, in which, when she had to teach classes to several classes at the same time, she had to divide the classes into small groups and each group was dedicated to studying specific subjects. Thus, students could study at their own pace, always working in cooperation with colleagues (Oliveira and Leite, 2021).

Personalized education is evident in active methodologies, which aim to enrich and strengthen the teaching and learning process. In current terms, personalized education presupposes that the student must start from his own choices to learn, according to his interests, curiosities and criteria, selecting the resources he deems most advantageous according to his learning profile (Lima Júnior e Silva, 2021). The insertion of digital technologies in education, especially in hybrid teaching, has enabled their use in the classroom, allowing the customization (personalization) of various sectors to contribute to the teaching and learning process (Oliveira and Leite, 2021).

One of the great advantages of artificial intelligence in education is its ability to adapt educational content to each student. Based on the data collected, algorithms can suggest resources, activities, and teaching strategies that best meet the needs and individual learning pace of each student. Given the great diversity of behaviors that exist in a classroom, since each student has their own particularities, different skills and knowledge, in addition to experiencing different realities, it is important to establish personalized teaching, which focuses on each student, meeting their expectations and needs (Souza, 2023). It is in this context that AI stands out, as an innovative tool capable of providing improvements in the quality of education offered in the vast majority of school organizations.

Intelligent tutor systems or adaptive systems (ITS) emerged in the late 1970s, but only became popular in the 1990s, they are software that offers instructions and feedback to the student, while simultaneously organizing their knowledge bases, from the registration and analysis of user interactions with the system, adapting and managing the teaching and learning process in a dynamic way (De Lima, Silva and Da Silva, 2023). Three main components are considered in the traditional architecture of an ITS. The learner model, domain base, or domain model, and the tutor model. These components correspond to vital functions in the operationalization of the system. Therefore, they do not operate in isolation, but interact with each other, seeking to adapt the computerized environment to the user's needs.

Geekie is an adaptive learning platform that offers personalized teaching and large-scale learning, personalization is carried out through games to help students prepare for the ENEM (National High School Exam), allowing the student to improve their proficiency (Teixeira *et al.*, 2021). Through the algorithms present in the platform, it can identify the main difficulties of students in each subject, providing a better view of each student's development for the teacher, so that it can assist in pointing out and aligning the main problems encountered in learning.

Providing a personalized education aims at the future of students, ensuring that there is importance in all particularities. Data from the School Census in Brazil released by MEC in 2023 report that high school has the highest school dropout rate, contributing with 3.9% and 5.9% (Agência Brasil, 2024). When students are not interested in staying in school, they drop out and, when they do, they are sometimes limited to the logic of reproduction of traditional teaching models.

Consequently, they do not develop the skills and abilities necessary for the complexity of human, social and economic relations in contemporary times. In this scenario,

the concept of personalized education can contribute to the reconfiguration of teaching and learning (Lima Júnior and Silva, 2021). Assigning technology to the mercy of students in an adaptive way would be a great step towards beneficial changes in the school and university environment, aiming at the development and learning of students.

GAMIFICATION AND ACTIVE LEARNING

According to Fernandes *et al.* (2024), the changes that are taking place in education, especially the insertion of new technologies, contribute significantly to improving active learning, and place the student at the center of the learning process, based on the assumption that knowledge is not passively transmitted. In this case, the teacher acts as a mediator, assuming the role of advisor and facilitator. In addition, social interaction is critical for cognitive development.

According to Fernandes *et al*. (2024), we can mention some new technologies used in the active methodology: hybrid teaching, distance learning, problem-based learning, and gamification:

Hybrid Teaching: Pedagogical model that mixes face-to-face teaching and distance learning, providing students with a richer and more personalized learning experience. This approach allows students to interact with teachers and classmates both in the classroom and on online platforms, facilitating the exchange of knowledge and the development of skills (Fernandes *et al.,* 2024). To be successful, students and teachers need to be familiar with technologies and be able to produce, manipulate and interact with content within the virtual environment, because within the context of hybrid teaching this is fundamental (Castro *et al*., 2015).

Distance Education (DE): Teaching modality that uses digital technologies to connect students and teachers, regardless of their geographic locations. Distance education offers flexibility and autonomy to students, allowing them to organize their study schedules and access content on different devices (Fernandes *et al.,* 2024).

Problem-Based Learning (PBL): Problem-based learning consists of problem solving, values the content to be learned and especially the way learning occurs, placing the student as the protagonist in the educational process (Borges *et al*., 2014).

Gamification: Gamification consists of the use of elements and characteristics typical of games in order to contribute to the resolution of certain problems (Santos and Freitas, 2017). Gamification applies elements such as competition, scoring, and instant feedback, to engage students in learning activities. This approach is based on principles of

behavioral psychology and the intrinsic and extrinsic motivation of students, in order to increase participation and engagement.

The fun generated by gamified activities promotes greater ease of learning, in addition to contributing to the formation and improvement of the individual and collective skills of the individuals involved (Alves, 2015; Carvalho, 2016). In this sense, gamification can be understood as a learning strategy that benefits from sociocultural transformations and technological advancement (Caillois, 2017), has the potential to revolutionize several fields, including management. By integrating elements of games, toys, and playfulness (Brougère, 1998), gamification offers a range of possibilities that go beyond mere fun, also encompassing fantasy, imagination, and leisure (Fortuna, 2017).

By applying the logic of games in the construction of models, processes, and systems, there is the construction of a more humanized and people-centered approach. This approach, by considering the user's motivation, feelings, and active participation in building systems, promotes the creation of a collaborative and stimulating environment. According to Alves (2015), the engagement of different audiences with different age groups in different and gamified activities is directly linked to the relevance of the content and the way learning is motivated.

Ramos *et al.* (2024) highlights that, in the face of sociocultural transformations and technological advances, education needs to adapt to meet the demands of new generations. In addition, by offering a personalized and adaptive learning environment, gamification becomes a fundamental tool to engage students and promote the development of essential skills for the twenty-first century. In addition, by combining game elements with curricular content, gamification allows each student to learn at their own pace and according to their preferences, making the educational process more meaningful and effective.

The planning in the choice of educational strategies and technologies and their impacts on the stimulation of cognitive development must be constantly updated and rethought, always taking into account the different realities of the students (Signori and Guimarães, 2016), as can be seen in Chart 1.

Chart 1: Elements of Gamification and examples of how they can be used in teaching and learning.

Element of Gamification	Examples in Education	Objective
Points and Levels	On online learning platforms, students are motivated to complete tasks and challenges to earn points and level up. Each level unlocks new content and features, reflecting the user's progress and the difficulty of the activities (Zichermann and Cunningham, 2011).	Encourage continuous growth and active participation in activities, encouraging student progression and engagement.
Badges e Troféus	Virtual badges, trophies, and medals recognize students' achievements, offering a sense of accomplishment and motivating them to achieve new goals (Zichermann and Cunningham, 2011; Werbach and Hunter, 2012).	Increase students' self-esteem and sense of accomplishment by strengthening confidence in themselves and celebrating their achievements.
Challenges and Missions	The elements guide the user through the platform, defining the tasks and leading them to learning (Zichermann and Cunningham, 2011; Fadel et al., 2014), developing skills such as problem-solving and practical application of knowledge.	Stimulate critical thinking and problem-solving, developing analysis and decision-making skills.
Competitions and Rankings	It works as a social ranking, allowing users to compare their progress with that of others and encouraging active participation in the environment. (Klock et al., 2014).	Promote collaboration, healthy competition, and team spirit, as well as develop communication and leadership skills.
Virtual and Real Rewards	Virtual currencies, exchangeable for prizes, and certificates (digital or physical) recognize users' achievements. Extra and voluntary activities award bonus points, speeding up the achievement of rewards (Klock et al., 2014).	Reinforce positive behaviors and increase motivation by encouraging study habits and the desire to learn.
Custom Avatars	The creation of personalized avatars, inspired by games (Klock et al., 2014), makes the learning experience more personalized and engaging.	Increase the sense of belonging and motivation, stimulating the desire to participate and contribute.
Narratives and Stories	Use of storytelling elements to create engaging stories that contextualize learning, making content more attractive and memorable (Kapp, 2012).	Facilitate memorization and understanding of content, making learning more effective and lasting.
Virtual and Augmented Reality	Immersive simulations that allow students to explore virtual environments and perform experiments. Apps that overlay digital information on the real world.	Offer more interactive and memorable learning experiences, making the process more fun and engaging.

Various games and platforms can be used in the classroom, depending on the context and purpose. Platforms such as Kahoot!, Duolingo and Khan Academy can contribute positively to the educational formation process, bringing together school content and typical game elements.

ARTIFICIAL INTELLIGENCE (AI) AND EDUCATIONAL DATA ANALYSIS

In recent years, technological advances have contributed to various sectors of society, including education. Among them, Artificial Intelligence (AI) stands out, which is a computational field that has been providing significant changes within the educational process, especially in the teaching and learning process. This integration of AI in education

offers unprecedented opportunities to tailor learning to the individual needs of students, being a crucial factor in improving educational effectiveness (Zawacki-Richter *et al.,* 2019).

Artificial intelligence has the ability to personalize teaching, offer instant feedback, from an intelligent tutoring system that meets the individual needs of students (Drigas and Ioannidou, 2012). And these are one of the main points that AI promotes in education, enabling a more effective and accessible teaching process.

Another technological innovation applied in the educational context is the analysis of educational data or *Learning Analytics* (AL) which is a process of collecting, analyzing and interpreting data related to the performance and behavior of students within the educational environment, with the aim of improving both teaching and pedagogical practices. The use of *learning analytics* is highly useful in education, helping to monitor student performance, data analysis, identify risks of failure and/or dropout, teacher interventions, tutoring, assessment, content adaptation, teaching personalization, feedback, recommendations, and reflection (Cardoso *et al.,* 2022).

The combination of artificial intelligence and *learning analytics* enhances the benefits of both technologies, promoting a more effective and personalized educational approach. This integrated approach allows optimizing teaching and learning processes, offering individualized support and improving pedagogical decision-making.

Guimarães Júnior *et al.* (2023) states that the personalization of teaching is one of the most significant advantages of analyzing educational data in conjunction with technology. This can be seen in the association between the use of AI and AL, where *learning analytics* collects data on student performance, including students' specific learning patterns and difficulties, while AI uses this data to tailor teaching in ways that significantly improve student engagement and motivation (Costa Júnior *et al.*, 2024).

For educators, these technological applications offer tools that help in lesson planning, construction of assessments, and feedback, as described by Zhu (apud Santos *et. al.,* 2024). Additionally, educational institutions can utilize AI to improve resource management and inform their strategic decisions.

Some tools such as *Squirrel AI, Coursera, Century Tech,* and *Carnegie Learning* use AI to personalize teaching according to the individual needs of each student. These platforms collect data on students' performance and use algorithms to adjust course content according to each student's needs, offering personalized exercises to help improve their skills. Another platform is *IBM Watson Education* , which uses AI to personalize teaching, as well as to provide personalized feedback to students.

VIRTUAL REALITY (VR) AND AUGMENTED REALITY (AR)

Much is discussed about the use of technologies in the school environment, as there is a duality regarding this practice. The knowledge and use of devices already familiar to students could increase interest in classes and productivity during the learning path, thus facilitating the transmission of knowledge between student and teacher and generating questions to be researched more deeply later, however these devices can also promote a dispersion of students' attention, making them seek, at the time of learning, moments of leisure or interaction among themselves. A possible solution to this problem could be equipment provided by the school where the only sites and tools available would be those that added to learning.

Virtual reality is not as far away as it seems to be, the use of applications and websites that help students in work and studies are already widely used. Seeking a balance between the facilities that technology can provide and the desire to encourage curiosity, interest and interaction in students, virtual reality can make addiction to social networks and applications become a thirst for knowledge and the search for learning. Virtual reality is defined by its immersive quality, providing an experience where the user has the genuine feeling of 'being' in the virtual environment (Slater and Sanchez-Vives, 2016). Virtual Reality (VR) together with Augmented Reality (AR) is an innovation in education because it enables the expansion of sensory aspects of didactic resources (provided by sound and 3D animations), and consequently, because it favors meaningful learning by simulating real experiences through virtuality (Silva, 2017).

In this context, these new technologies bring benefits to the most diverse areas of knowledge, including education, due to its breadth of application possibilities, (Lopes, 2019), and provide resources that facilitate not only pedagogical practice in areas such as science, engineering, and physics, but also contribute to the creation of resources that can expand and facilitate the learning of Libras by making it possible to interact and improve the sign in Libras (Carvalho, 2017). In this way, the use of these innovative tools can facilitate the integration of students with disabilities or special needs, providing a welcoming and inclusive environment, enhancing the quality of education.

In the educational field, the virtual environment can provide the development of practical classes through, for example, training in highly dangerous situations, eliminating risks and facilitating learning, as the skills developed in a virtual reality can be applied naturally to the real environment (Lavalle, 2018). With these technologies, the individual experiences achieved are able to transcend barriers such as language, as they can facilitate communication and bring students from different cultures closer together (Pedrosa

and Zappala-Guimarães, 2019). For an effective application of these tools, it would be necessary to solve some of the main challenges that limit this pedagogical approach, such as equipment costs, operational and operating limitations, students' discomfort during their studies, and difficulty in applying them to specific subjects due to the lack of material (Boyles, 2017).

According to Forte *et al*. (2018), we can understand augmented reality as a technology that is inserted in virtual reality, with the main objective of enriching the real environment from representations of virtual objects. Mediating the teaching-learning process between students is a task that needs constant improvement, in order to keep up with technological and cultural development, to make the learning environment more dynamic and attractive to students (Lopes *et al*. 2019). In this way, the application of educational innovations, such as VR and AR, are able to improve and facilitate the learning of abstract concepts from the sciences in general that can often be counterintuitive (Forte *et al*., 2018). The characteristics of augmented reality allow this technology to be more accessible, as they depend on more common tools, such as cell phones, markers printed on paper, and webcam (Kirner *et al*., 2009).

The use of these means of simulation can be shaped and applied to a variety of fields of education. Using peripherals that stimulate the senses, students can be "transported" virtually to different scenarios, such as virtual laboratories, natural habitats that are normally difficult to access, such as the seabed, Earth orbit, etc. Some virtual tools can be used to support these applications, such as "*Google Arts & Culture*, which allows students to explore various museums, art galleries and historical monuments around the world through 3D reproduced environments" (Junior *et al*., 2021). In addition, the applicability of these immersive practices can educate beyond the classroom, and can play an important role in raising awareness among the population. As an example, one can mention virtual museums, digital caves, trips to environments in their past, etc.

In this way, the greater power of immersion acquired by the use of VR and AR technologies is able to provide greater opportunities for experiences and allow students the possibility of developing their knowledge, at their own pace.

INCLUSIVE EDUCATION AND ASSISTIVE TECHNOLOGIES

Educational inclusion is a central issue in modern pedagogical practices, reflecting a worldwide concern for the right of all students to equal access to learning, regardless of their abilities. Inclusive education has emerged as a movement that seeks to transform

educational practices and structures to ensure that all students, including those with disabilities, can benefit from quality education.

The proposal is to meet this diversity in a broad and democratic way, integrating individuals into an educational system that values their potential and favors the development of essential skills. This concept is clearly evidenced in the Salamanca Declaration (1994), which affirms the need for an education that promotes the participation and learning of any student as part of a basic right of citizenship, going beyond the exclusive care of students with special needs.

The debate on inclusive education still faces barriers, especially with regard to the role of special education. While some advocate maintaining the traditional model of special education as a separate service, others advocate the complete dismantling of this model, favoring an adaptive support approach within mainstream education. More moderate perspectives indicate that, rather than dismantling special education, the focus should be on its evolution into an inclusive system support model, where specialized professionals offer support within the mainstream education environment. This view is corroborated by Ainscow (2005), who argues that inclusion is a fundamental right and should be integrated into educational policies and practices so that all students, with or without disabilities, share the same learning environment.

The practical implementation of inclusive education, however, is complex and requires significant cultural and structural change. One of the biggest challenges is to overcome attitudinal barriers, derived from prejudices and stereotypes around the biological and functional differences of individuals. These stigmas, deeply rooted in the social imaginary, often hinder the development of a truly inclusive education that values and respects human diversity in all its forms. In order for the education system to truly become inclusive, it is necessary that education professionals are trained and sensitized to understand and address these barriers.

In this context, assistive technologies (AT) emerge as an essential component to facilitate school inclusion and educational accessibility. Defined as a set of resources, devices, and services that promote the functionality and independence of people with disabilities, AT aims to expand the possibilities of communication, mobility, and learning. Radabaugh's (1993) phrase sums up the role of assistive technologies well: "For people without disabilities, technology makes things easier. For people with disabilities, technology makes things possible." This concept, reaffirmed by Cook and Hussey (1995), broadens the understanding of the role of assistive technologies by encompassing not only products and

devices, but also practices and strategies that help to overcome functional limitations, allowing a more effective participation of individuals in the educational environment.

In Brazil, the concept of assistive technology was formalized by the Technical Aids Committee (CAT) in 2006, which defines AT as an interdisciplinary area aimed at promoting the functionality and inclusion of people with disabilities, through products and services that increase their autonomy and quality of life. This definition is in line with international conceptions, which consider AT an area that goes beyond the development of physical devices, encompassing practices and methodologies that favor inclusion and the development of competencies in a broad way.

There are two very important strands within AT. The first of these is Augmentative and Alternative Communication - AAC, this area of AT is responsible for serving individuals without functional speech or writing, and/or who have difficulty expressing their needs. The resources used by CAA are communication boards, built with graphic symbology, letters or written words that are used by users to express their questions, desires, feelings and understandings.

The second of the strands is Computer Accessibility. This area aims to enable access to the computer for students with disabilities, since its interface requires sensory and/or motor skills. This modality allows the computer to be adapted to the user's needs. With a simple tap on the "accessibility options" tab, the user can, for example, avoid repetition of letters, increase the size of the cursor, the font, promote key grip, making it easier to type with just one hand, with the option of using the number keys as a mouse, among other features existing in programming.

In the educational context, assistive technologies encompass tools that help in the teaching-learning process of students with various disabilities, such as dyslexia, hearing and visual impairment, among others. Reading software, such as Kurzweil 3000, and writing support applications, such as Read & Write, have been shown to be effective in facilitating the learning of students with specific difficulties, such as dyslexia, as discussed by Alper and Raharinirina (2006). In addition, in the case of students with hearing impairment, the role of the teacher is fundamental for integration and academic success, requiring not only the use of assistive devices, but also specialized training and close collaboration with specialized educational service professionals.
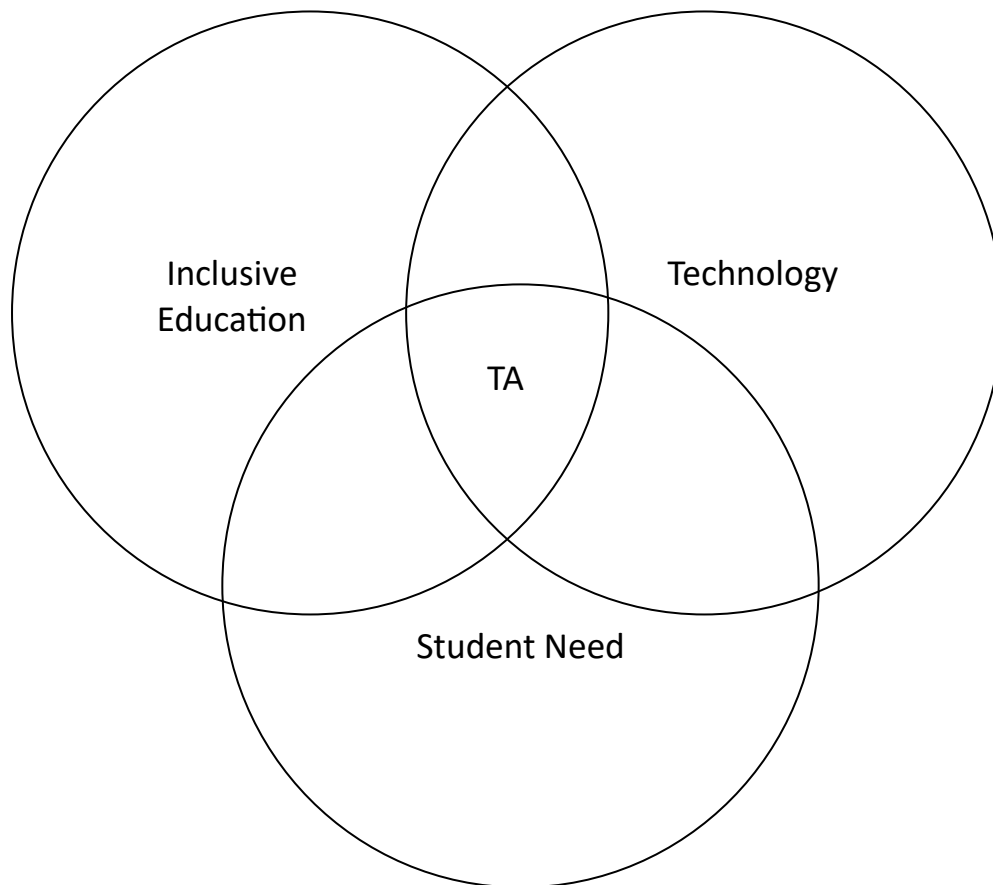
Through assistive technology, teachers have the opportunity to adapt curricular content and use methodologies that meet the specific needs of students with disabilities, promoting inclusion and socialization in the school environment. This scenario shows that school inclusion is not only a matter of rights, but also a practical need for curricular adaptation, teacher training and technological support. Assistive technologies, along with a change in the educational approach, become, therefore, an indispensable innovation for teaching in the twenty-first century, promoting an inclusive and transformative education.

FINAL CONSIDERATIONS

In summary, this paper discussed some of the main innovative approaches that are shaping contemporary education, detailing how these new approaches and technologies are being applied in classrooms and what impact they have on student development, educator training, and educational management. When dealing with the interaction between education and technology, its relevance in the modern educational context is highlighted. We live in a society in constant transformation, driven by technological advances, which requires an adaptation of educational practices to meet the demands of students who are immersed in an increasingly digital world.

One of the main obstacles is the resistance of some educators to adopt new methodologies and technologies, which can limit the potential of innovations in pedagogical practice. In addition, inequality in access to the internet and technological devices in different regions can result in disparities in student learning, compromising the effectiveness of teaching-learning.

In the midst of this search for advanced technologies, there is a need to integrate Information and Communication Technologies in school institutions, with the aim of improving the transmission of knowledge and enriching the learning process. In this way, it seeks to diversify teaching methodologies, creating a more interactive and participatory environment. With appropriate methodologies, the teaching and learning processes can be rethought, adapted to the current context and the reality of each place.

It is essential to consider that the integration of new technologies into the school routine of students and teachers can generate challenges, especially with regard to supporting pedagogical content. This scenario reveals a transformation in the teaching model, which is no longer centered exclusively on syllabus or on the figure of the teacher as the only center of the classroom. Traditional methodologies give way to more innovative changes, considering those imposed by society and the digital age. In this new context, the teacher is no longer the only holder of knowledge and assumes the role of facilitator, guiding students to face new situations in the classroom, in their daily lives and later in the job market.

It is essential to recognize that collaborative learning promotes the identification of new relationships, challenges established norms, stimulates creative actions, and introduces innovative elements into educational practices. ICTs offer students the possibility to build knowledge through communication and interconnection with a diverse environment, transcending social and cultural barriers. This process makes learning and experiences an ongoing and dynamic activity. Digital media emerge as facilitators of a more effective pedagogical approach, highlighting the importance of their proper use to strengthen and promote modern pedagogical practices in all school spheres (Silva *et al*., 2024).

The introduction of information technology has caused a transformation in the learning process, modifying the traditional dynamics of the classroom, based on chalk, blackboard and books, for an environment in which information can be accessed and shared virtually. In this new context, the computer is recognized as an essential tool for the process of acquiring knowledge, where educators and students can navigate in various information spaces, which allows sending and receiving various types of information in a virtual way. The advances in Digital Information and Communication Technologies expand

the possibilities of traditional teaching, both in material and methodological terms, resulting, already in various contexts, in advances in pedagogical practices.

In general, it is a challenge that requires continuous and combined efforts from all participants in the educational process. It represents an opportunity to reformulate and innovate pedagogical practices, preparing students for an increasingly digitized and competitive world. The future of education will depend on our ability to adapt to the new reality and use technologies effectively, for the benefit of students and society as a whole.

However, it is important to emphasize that educational technologies cannot and should not replace traditional tools in the teaching-learning process, but rather act as a means of interaction between student, teacher and knowledge. Thus, it is vital to adapt beyond traditional didactics, integrating modern aspects of digital education with conventional teaching.

In addition, it is crucial that institutions develop strategies to ensure that all students have access to these tools and that they can fully enjoy the benefits of new teaching methodologies. Future research should explore ways to overcome these challenges, seeking models that integrate technologies in an inclusive way and that promote a collaborative learning environment, taking into account regional particularities.

Therefore, while advances in educational technologies and approaches represent significant progress, it is essential that we continue to work towards truly accessible and quality education for all, preparing students for the contemporary challenges of the profession and society.

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