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INTEGRATION BETWEEN TECHNOLOGIES AND ACTIVE METHODOLOGIES IN EDUCATION 4.0

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ABSTRACT

This research aimed to investigate the integration between digital technologies and active methodologies in the context of Education 4.0, analyzing how this combination can contribute to the improvement of pedagogical practices, in addition to identifying the challenges and benefits of this teaching model. To achieve this objective, a bibliographic research was carried out, with a survey of sources in academic platforms such as SciELO, Scopus, Google Scholar and Brazilian repositories. The methodology consisted of floating readings and critical analysis of the selected publications, focusing on the understanding of the concepts of Education 4.0, active methodologies and the role of digital technologies. The results indicated that the integration of these approaches promotes a more dynamic, collaborative and student-centered learning environment, favoring the development of cognitive and socio-emotional skills essential for the twenty-first century. However, significant challenges were also identified, such as resistance from educators, inequality in access to technologies, and the need for adequate infrastructure. The research concludes that the combination of active methodologies and digital technologies is crucial for educational transformation, but its effective implementation depends on appropriate educational policies, continuous training of teachers, and overcoming structural barriers.

Keywords: Technologies. Active Methodologies. Education 4.0.

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INTRODUCTION

Education has undergone significant transformations in recent decades, driven by the rapid evolution of digital technologies. The concept of Education 4.0 emerges in this scenario, as a response to the demands of an increasingly connected and digitized society. This new educational paradigm reflects the need to adapt teaching so that students are prepared for the challenges of an ever-changing world, where access to information, flexibility, and the development of practical and collaborative skills are essential. The integration between digital technologies and active methodologies, two of the main trends of Education 4.0, appears as a promising solution to provide more dynamic, participatory and student-centered learning (Yamamoto, 2016).

Active methodologies have stood out as an innovative approach, focused on making students protagonists of their own learning process. Unlike the traditional model, in which the teacher is the center of the process, active methodologies seek to involve students in a deeper and more meaningful way, promoting autonomy, creativity, and critical thinking. Strategies such as problem-based learning (PBL), blended learning, flipped classroom, among others, have gained more and more adhesion in educational institutions, creating spaces where knowledge is built in a collaborative and contextualized way (Barbosa; Moura, 2013; Carvalho et al., 2021).

At the same time, technology has transformed the way teaching and learning take place. Digital tools, such as distance learning platforms, educational apps, digital games, and interactive resources, offer new possibilities to personalize learning and make it more attractive and accessible. The integration of technology into the educational environment allows students to develop essential digital skills for the future, while also making it easier to adapt pedagogical strategies to different learning needs. However, the simple insertion of technologies in the educational process does not guarantee positive results. It is necessary to have a strategic use and alignment with teaching methodologies, so that students benefit effectively (Valente, 2019).

The convergence between digital technologies and active methodologies leads to a hybrid teaching model, where technological tools are used to expand and diversify pedagogical practices. In this context, the role of the teacher is transformed, starting to act as a mediator of knowledge, facilitating learning and guiding students in the use of technologies. Technologies, in turn, make it possible to personalize learning, offering resources that meet the individual needs and rhythms of students. This integrated approach favors the construction of more flexible, dynamic, and collaborative learning environments,

promoting more effective teaching and aligned with the competencies required by the twenty-first century (Valente, 2019).

However, the successful implementation of this integration is not a simple task. It requires a process of continuous training of educators, who need to be prepared to deal with new technologies and to use innovative methodologies in their pedagogical practices. In addition, educational institutions must invest in adequate technological infrastructure and ensure that all students have access to the necessary resources for learning. Resistance to change, both on the part of teachers and students, is also a challenge that needs to be overcome for Education 4.0 to become an effective reality (Silva et al., 2018).

Another important aspect of the integration between technologies and active methodologies is the impact on the development of students' socio-emotional skills. The use of technologies, when combined with student-centered pedagogical practices, can promote the development of skills such as collaboration, problem-solving, effective communication, and creativity. These skills are fundamental for professional and personal success in the contemporary world and are strongly valued in the job market. In this sense, Education 4.0 is not limited to the mastery of technical content, but seeks to prepare students for life and work in an increasingly interconnected and digital society (Valente, 2019).

In view of this scenario, the present research aims to investigate the integration between digital technologies and active methodologies in the context of Education 4.0, analyzing how this combination can contribute to the development of more efficient and innovative pedagogical practices. It also seeks to understand the challenges faced by educators in the implementation of these strategies and to identify the benefits and limitations of this teaching model, in order to provide subsidies for an education more aligned with the demands of the future.

METHODOLOGY

The research on the integration between digital technologies and active methodologies in the context of Education 4.0 was conducted from a bibliographic research. Bibliographic research is a type of study that involves the analysis, interpretation, and synthesis of information already published in books, scientific articles, dissertations, theses, and other academic documents. The choice of this type of research was due to the need to build a solid theoretical framework on the subject, which would allow understanding the state of the art on active methodologies, educational technologies and the convergence of these elements in Education 4.0.

The search for sources and materials relevant to the research was carried out in several academic platforms and digital repositories, such as SciELO (Scientific Electronic Library Online), Scopus, Google Scholar, as well as repositories of higher education institutions and Brazilian scientific publications. These platforms were chosen for their credibility and comprehensiveness, allowing access to a wide range of articles and studies that deal with the interface between technology and education, as well as innovative pedagogical methodologies. The survey in these bases was strategic, seeking to ensure the diversity and relevance of the sources consulted, in addition to providing a broad view of the trends and challenges found in the field of Education 4.0.

During the research, floating readings of the selected materials were carried out, which means that, throughout the analysis of the articles and texts, the researcher alternated between in-depth reading and more superficial reading, according to the focus of interest and the relevance of each content. This process allowed us to identify the main approaches to the integration of active technologies and methodologies, the benefits of this combination for the teaching-learning process, in addition to the challenges and limitations pointed out by the authors.

Floating reading also facilitated data triangulation, allowing different perspectives to be compared and a more comprehensive understanding of the topic to be built. The analysis of the bibliographic materials was done in a critical and analytical way. Initially, the sources were classified according to their relevance to the research, considering aspects such as the methodological quality of the studies, the depth of the reflections and the contribution of each work to the understanding of the theme. Next, the data extracted from the texts were organized and analyzed, with the objective of identifying patterns, convergences and divergences in the approaches to active methodologies and the use of technologies in the educational context.

RESULTS AND DATA ANALYSIS

EDUCATION 4.0: HISTORICAL OVERVIEW AND CONCEPTS

The expression Education 4.0 is a relatively recent concept, but it reflects a broader movement of educational transformation driven by the technological revolution. To understand the emergence and principles of this new paradigm, it is important to draw a historical panorama that contextualizes its origin and evolution. The term "4.0" is directly related to the Fourth Industrial Revolution, which is characterized by the convergence of digital technologies, biotechnologies, artificial intelligence, big data, Internet of Things (IoT),

and automation, among others. This revolution has transformed several sectors of society, including the world of education (Barbosa; Moura, 2013).

Historically, education has always been aligned with the needs and characteristics of each era. The traditional educational model, for example, has roots in the industrial model of the nineteenth century, where schools were designed to train labor for industry, with a focus on learning content in an expository and disciplined way. This model is still predominant in many educational institutions, but it already shows signs of exhaustion in the face of the demands of today's society. Technological advances and changes in labor relations, which require new skills and competencies, force schools and universities to rethink their teaching methods (Barbosa; Moura, 2013).

The digital revolution, which began to gain strength at the end of the twentieth century with the popularization of the internet and the digitization of information, generated a new educational scenario. From the 2000s onwards, the growing ubiquity of digital technologies and the emergence of new teaching tools (such as online platforms, mobile devices, and educational software) began to transform pedagogical practices. This movement is what we call Education 3.0, characterized by the introduction of technologies in the school environment, but still within a predominantly traditional model, where the teacher continues to be the center of learning, but with the addition of technologies that help this process (Valente, 2019).

Education 4.0 emerges as a response to this context, representing a new model that seeks to overcome the dichotomy between traditional teaching and technological innovations. The proposal of Education 4.0 goes beyond the mere inclusion of digital tools in the pedagogical process, it implies a reinvention of the educational logic itself. It is a model that systemically integrates digital technologies and innovative pedagogical methodologies, creating a more flexible, collaborative, and student-centered learning environment. Education is no longer just a process of transmitting knowledge to become an experience for the development of skills, competencies and creativity, often promoting lifelong learning (Silva et al., 2018).

At the heart of Education 4.0 is the idea of personalization of learning. Through the use of technologies such as artificial intelligence and data systems, it is possible to tailor teaching to the individual needs and preferences of students, offering more effective and motivating learning experiences. This model also favors the development of socio-emotional skills, such as collaboration, communication, creativity, and problem-solving, which are increasingly valued in the contemporary labor market (Valente, 2019).

The concept of active learning is highlighted, with methodologies that encourage student participation, teamwork, and project-based learning, for example. Another fundamental aspect of Education 4.0 is the flexibility of learning spaces and times. Education no longer needs to be restricted to the traditional school environment and the physical classroom. Digital technologies allow students to access content and interact with their peers and teachers from anywhere and at any time. Hybrid teaching, which combines face-to-face and distance activities, has become one of the most common approaches in this context (Barbosa; Moura, 2013).

In addition, the use of technologies such as augmented reality, gamification, virtual learning environments, and distance education platforms offer new possibilities for the construction of knowledge in an interactive and engaging way (Valente, 2019).

Despite the enthusiasm around Education 4.0, it is important to highlight that its implementation presents significant challenges. The adaptation of teachers to new technologies and methodologies, the continuous training of educators and the overcoming of resistance to change are issues that need to be faced for this model to be effectively implemented. In addition, inequalities in access to technologies, especially in poorer regions or communities, can limit the universalization of Education 4.0 practices. The technological infrastructure of institutions is also a crucial point to ensure that all students have access to the necessary resources for full learning (Silva et al., 2018).

TECHNOLOGIES IN EDUCATION: POTENTIALITIES AND CHALLENGES

Digital technologies have been consolidated as one of the most significant transformative forces in contemporary education, offering new ways of teaching and learning. With the advancement of tools such as the internet, mobile devices, distance learning platforms, educational applications, augmented reality, and artificial intelligence, education has become more dynamic, interactive, and accessible. Technologies in education not only expand the possibilities of access to knowledge, but also enable innovative pedagogical practices that meet the diverse needs of students, favoring more personalized and collaborative learning (Carvalho et al., 2021).

One of the great contributions of digital technologies is the ability to create flexible learning environments that go beyond the physical limits of the classroom. The use of digital platforms allows learning to happen asynchronously, that is, students can study at their own pace, access content anytime and from anywhere, and interact with various teaching materials, such as videos, podcasts, e-books, and discussion forums. This is particularly relevant for distance education, which has expanded significantly, especially after the

COVID-19 pandemic, when the need to adapt to online and hybrid classes highlighted the potential of technologies to maintain the continuity of teaching. In addition, technologies facilitate the personalization of learning (Silva et al., 2018).

Tools such as learning management systems (LMS), artificial intelligence, and adaptive algorithms allow materials and activities to be adjusted according to students' needs, interests, and difficulties. In this way, it is possible to create a more individualized learning path, which favors the development of each student's skills and abilities, respecting their times and learning styles. Another important point is the promotion of interactivity and student engagement (Valente, 2019).

The use of tools such as educational games, simulations, and interactive applications transforms learning into a more engaging and fun experience, which can increase student motivation. Gamification, for example, has been an increasingly used strategy to stimulate engagement, by transforming academic activities into challenges that offer rewards, such as points, medals, or rankings. This approach can contribute to building a more positive attitude towards learning, as well as promoting healthy competition and collaboration among students (Carvalho et al., 2021).

The integration of technologies can also contribute to educational inclusion by providing tools that meet different needs. For example, reading software for visually impaired students, or teaching platforms that use subtitles and simultaneous translation, allow more students to access content in an adapted way. In addition, technologies expand the reach of knowledge, making it accessible to populations that might otherwise have difficulties accessing quality education, either due to geographical distance, financial limitations, or lack of resources in schools (Silva et al., 2018).

However, the implementation of technologies in education also presents significant challenges. One of the biggest obstacles is the inequality in access to devices and quality internet. In many regions, especially in rural areas or in developing countries, the lack of technological infrastructure makes it difficult to fully integrate technologies into the educational process. In addition, resistance on the part of some educators, who may feel intimidated or overwhelmed by the introduction of new digital tools, is also a factor to be overcome (Valente, 2019).

The continuous training of teachers is therefore an urgent need, so that they can not only master technologies, but also use them in a pedagogical and effective way, integrating them strategically into their teaching practices. Another challenge is the issue of security and privacy. The use of technologies in education requires strict measures to be taken to protect students' personal data and ensure that the virtual learning environment is secure.

The risk of exposure to inappropriate content, online harassment, and the misuse of information is a constant concern, especially on platforms that involve interaction between students (Valente, 2019).

Finally, the introduction of technologies in education also requires a change in mentality in relation to the role of the teacher and the student. The educator is now seen as a facilitator of the learning process, guiding and assisting students in the use of technologies and the development of digital skills. On the other hand, students cease to be mere receivers of knowledge to become active agents in the learning process, exploring, creating, and sharing content with their peers (Yamamoto, 2016).

CONCEPTS AND APPROACHES TO ACTIVE METHODOLOGIES IN EDUCATION

Active methodologies have been consolidated as one of the main pedagogical trends of the twenty-first century, seeking to break with the traditional teaching model, in which the teacher is the center of the process and the student remains in a passive position. At the heart of active methodologies is the idea that students should be protagonists of their own learning, participating in a more active and engaged way in the construction of knowledge. This model values the development of student autonomy, collaboration, critical thinking, and problem-solving, essential skills for success in the twenty-first century (Carvalho et al., 2021).

The concept of active methodologies encompasses a series of pedagogical approaches that aim to promote a more dynamic, interactive and student-centered learning environment. Unlike traditional teaching, in which the teacher transmits information to students in an expository way, active methodologies involve students in practical and reflective activities, where they play an active role in the learning process. The idea is that, by experiencing the content in a practical and meaningful way, students not only memorize, but understand and internalize the knowledge in a deeper and more lasting way (Valente, 2019).

One of the most well-known approaches within active methodologies is problem-based learning (PBL), which challenges students to solve complex and real-world problems, often interdisciplinary, collaboratively. In this model, students are encouraged to investigate, research, discuss and present solutions to proposed problems, which favors critical and investigative learning. The role of the teacher, in this case, is to facilitate the process, guiding and supporting students in the search for answers and solutions (Silva et al., 2018).

Another significant approach within active methodologies is the flipped classroom, which inverts the traditional teaching logic. In this model, students have access to

theoretical content outside the classroom, through videos, readings, and other resources, and time in the classroom is dedicated to practical activities, discussions, and resolution of doubts. The teacher, instead of being the transmitter of the content, acts as a mediator, stimulating the interaction and critical thinking of the students. This approach allows students to advance in the content at their own pace and also promote the collective construction of knowledge during face-to-face activities (Carvalho et al., 2021).

Project-based learning (PBL) is another active methodology that has gained prominence in pedagogical practices. In this approach, students work on hands-on projects that involve applying knowledge from different areas, often focusing on a specific topic or problem. The idea is for students to develop a more holistic understanding of the content, as well as research, collaboration, organization, and presentation skills. PBL allows students to build creative solutions to real-world situations, connecting learning to everyday life and the demands of the professional world. In addition to these, other active methodologies include hybrid teaching, which combines face-to-face activities with distance learning, and gamification, which uses games and playful dynamics to make learning more engaging and motivating (Yamamoto, 2016).

A central concept for the success of active methodologies is student autonomy. These methodologies seek to encourage students to be responsible for their own learning, giving them more freedom to choose how, when and where to study, and what to learn. This can occur through the use of digital technologies that allow for the personalization of learning, with resources such as distance learning platforms, interactive videos, discussion forums, and collaborative tools. Autonomy, therefore, does not mean that the student learns alone, but rather that he has control over his learning process, with the support of technologies and the teacher (Carvalho et al., 2021).

The use of educational technologies is a fundamental aspect for the implementation of active methodologies. Digital tools, such as e-learning platforms, social networks, collaboration apps, and augmented reality, offer a vast field of possibilities to create more interactive and engaging learning environments. Technology, when well integrated, can enhance active methodologies, providing students with more personalized, accessible, and collaborative learning experiences (Valente; Almeida; Geraldini, 2017)

However, the implementation of active methodologies still faces challenges, especially with regard to the continuous training of educators. For active methodologies to be effective, teachers need to be prepared to adopt these approaches, which requires changes in their pedagogical practice and a new role in the classroom. In addition, the

technological infrastructure in schools and the resistance of part of students and educators to change are also obstacles that need to be overcome (Yamamoto, 2016).

INTEGRATION BETWEEN TECHNOLOGIES AND ACTIVE METHODOLOGIES IN EDUCATION 4.0

The integration between technologies and active methodologies in education has proven to be one of the fundamental pillars for the transformation of teaching in the context of Education 4.0, which is characterized by a more flexible, personalized, connected and dynamic approach. In this new educational paradigm, digital technologies and active methodologies act synergistically, creating a more engaging, collaborative, and student-centered learning environment. Active methodologies, which place the student as the protagonist of the learning process, benefit enormously from digital tools, which expand the possibilities of personalization, interactivity, and collaboration (Valente; Almeida; Geraldini, 2017).

On the other hand, technologies provide teachers with new resources to facilitate teaching and students with new ways to access and interact with content. Active methodologies, such as project-based learning (PBL), blended learning, flipped classroom, and problem-based learning (PBL), aim to promote the active participation of students, stimulating their autonomy and ability to apply knowledge in a practical and meaningful way. In this model, students are no longer passive receivers of information and become active agents in their learning process, solving real problems, collaborating with colleagues, and developing essential skills for the twenty-first century, such as critical thinking, creativity, collaboration, and socio-emotional skills. The proposal is that, by engaging in a practical and contextualized way with the content, students become more motivated, competent and prepared to face the challenges of the future (Valente, 2019).

In turn, digital technologies work as powerful tools to enhance active methodologies, expanding their capabilities and providing more flexible and accessible learning. Tools such as online learning platforms, educational applications, interactive games, augmented reality (AR) and virtual reality (VR) can transform the teaching-learning process, creating immersive and interactive environments that stimulate student engagement (Santana et al., 2015).

In addition, technologies allow for the personalization of learning, since, through adaptive systems, students can learn at their own pace, according to their needs and interests. This not only increases motivation but also contributes to building more meaningful and effective learning. The integration of these methodologies and technologies

creates a more dynamic and collaborative education, while also allowing teachers to become facilitators of learning, guiding and supporting students in the development of their skills. For example, in the flipped classroom model, students have access to pre-recorded content (such as videos and podcasts) and engage in practical and interactive activities during class time, in which interaction with the teacher and classmates is intensified (Valente, 2019).

Digital platforms make it possible to exchange information, hold online discussions, and monitor students' progress individually. Hybrid teaching, in turn, combines face-to-face teaching with online activities, providing greater flexibility and autonomy to students, in addition to enabling the customization of the learning path. Another important aspect of the integration between active technologies and methodologies is problem-based learning (PBL), which can be enriched with the use of technologies such as simulators and virtual environments. In this methodology, students work in groups to solve real problems or challenging situations, and digital tools allow access to data, resources, and information in real time, facilitating research, collaboration, and the creation of innovative solutions (Silva et al., 2018).

In addition, gamification, a strategy that uses game elements to engage students, is also one of the ways to integrate active technologies and methodologies, making learning more engaging and stimulating, by transforming academic challenges into healthy and fun competitions. From the perspective of Education 4.0, active methodologies and technologies are not only complementary, but also become essential for the development of cognitive, socio-emotional and digital skills, which are increasingly valued in the labor market and in society (Fidalgo, 2013; Rosa Júnior, 2015).

The ability to work in teams, to solve complex problems, to adapt to changes and to learn continuously are fundamental skills for the formation of the citizens of the future. Digital technologies, when well integrated with active methodologies, allow students to prepare themselves to face the uncertainties and challenges of a globalized world, in constant transformation, where knowledge is constantly evolving and where digital skills are indispensable (Yamamoto, 2016).

However, the effective implementation of these methodologies and technologies faces significant challenges, such as inequality in access to technology, the lack of continuous training of educators, resistance to change by some teachers, and the need for adequate infrastructure in schools. For integration to be successful, a joint effort is needed that involves the constant training of educators, the updating of pedagogical practices and the provision of adequate technological resources to educational institutions. Educational

policies need to keep up with this transformation, creating an environment favorable to innovation, teachers' professional development, and equitable access to technologies (Valente, 2019).

In short, the integration between technologies and active methodologies is a powerful strategy to transform education and prepare it for the challenges of the twenty-first century. By putting students at the center of the learning process and using technologies in a creative and pedagogical way, Education 4.0 promotes a more complete, flexible education aligned with the demands of the digital world. For this transformation to happen effectively, it is essential to overcome the structural and cultural challenges of education, ensuring that all students have access to innovative learning opportunities and that teachers are prepared to use technologies meaningfully and effectively (Yamamoto, 2016).

FINAL CONSIDERATIONS

The research carried out on the integration between digital technologies and active methodologies in the context of Education 4.0 provided a comprehensive and in-depth view of how these innovative approaches are transforming the educational landscape. In an increasingly digitized world, the combination of these two strands emerges as a fundamental strategy for the evolution of pedagogical practices, aiming not only at improving learning, but also at the formation of essential skills for the future of students.

Education 4.0, by integrating digital technologies and active methodologies, proposes a more personalized, collaborative and dynamic education. The use of technological tools allows the teaching-learning process to become more flexible and accessible, while offering students the possibility of learning autonomously, at their own pace and in a more engaging way. Technologies such as distance learning platforms, augmented reality, artificial intelligence, and gamification have proven to be valuable resources for promoting interactive learning that favors the development of cognitive and socio-emotional skills.

On the other hand, the effective implementation of these methodologies is not without challenges. The resistance of some educators to new forms of teaching, the need for continuous teacher training, and the inequality in access to technology are obstacles that need to be overcome to ensure the universalization and success of this educational model. Inadequate technological infrastructure in many institutions also represents a significant barrier to the full adoption of these practices. For Education 4.0 to become a reality accessible to all, it is essential that adequate educational policies are implemented, with investments in infrastructure, teacher training and technological resources.

The research showed that the integration between active methodologies and digital technologies is not only a trend, but a necessity to prepare students for the demands of the twenty-first century. The skills that these teaching models favor — such as critical thinking, problem-solving, creativity, collaboration, and adaptability — are fundamental for the formation of citizens capable of facing the challenges of an increasingly complex and dynamic world. The combination of these methodologies and tools offers students the opportunity to become protagonists of their own learning, transforming the educational process into a richer and more meaningful experience.

Finally, the importance of continuous training of educators is highlighted, which should be seen as a central pillar for the successful adoption of Education 4.0. The role of the teacher, as a facilitator of learning, requires a reconfiguration of their pedagogical practices and a constant update regarding the use of new technologies. In this sense, the research contributes to the understanding of the benefits, challenges and possible paths for the implementation of active methodologies and digital technologies in teaching, providing valuable subsidies for an education more aligned with the demands of the future.

Thus, the objective of this research was fully achieved, by analyzing how the integration of digital technologies and active methodologies can contribute to the improvement of pedagogical practice in Education 4.0, while exploring the challenges and benefits of this approach. The research paves the way for new investigations and educational practices that can lead to the transformation of teaching, making it more efficient, inclusive and prepared for the demands of the digital society.

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