CONVERGENCE BETWEEN EMERGING TECHNOLOGIES AND ACTIVE METHODOLOGIES IN THE UNIVERSITY

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Abstract

In today's educational environment, the convergence of emerging technologies and active methodologies has become a fundamental driver of change in university education. Emerging technologies, such as artificial intelligence, virtual reality, machine learning, and data analytics, are redefining the dynamics of higher education. Active methodologies, such as problem-based learning, collaborative learning, and flipped learning, center the pedagogical focus on the student, encouraging active participation and problem-solving. The combination of emerging technologies and active methodologies creates a powerful synergy, enabling the effective implementation of personalized and immersive learning experiences. This convergence not only enhances learning, but also prepares students to be autonomous learners, critical thinkers, and 21st century problem solvers.

Keywords – Education, Pedagogy, Emerging technologies, Active methodologies, University education.

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1. Introduction

In today's dynamic educational landscape, the intersection between emerging technologies and active methodologies stands as a catalyst for transformation in university education. This phenomenon marks a significant milestone in the way we conceive and approach teaching and learning at the higher level. In this article, we will take a closer look at the convergence of these two driving forces, analyzing their definitions, applications, and the benefits and challenges associated with their implementation in the university setting. Emerging technologies, an ever-evolving set of innovations, are redefining the dynamics of higher education. They include advances such as artificial intelligence, virtual reality, machine learning, and data analytics. These technologies offer powerful tools that have the potential to personalize learning, enabling an educational experience more tailored to students' individual needs. Artificial intelligence, for example, has the power to personalize educational resources, adapting content and learning pace

according to each student's abilities and preferences. Virtual and augmented reality transport learners into immersive learning environments, offering experiences that go beyond what would be possible in a conventional classroom. Data analytics provides valuable insights into student performance and progress, allowing educators to intervene in a timely manner to provide additional support when needed. The implementation of emerging technologies in higher education carries several notable benefits. It personalizes learning, resulting in greater information retention and understanding of concepts. In addition, it increases student participation and engagement, while providing educators with valuable data for informed decision-making. However, it also presents challenges, such as the initial investment and maintenance of the technology, as well as the need to ensure equity in access to these tools.

On the other hand, active methodologies constitute a pedagogical approach centered on the student, where students become active participants and collaborators in their own learning process, including strategies such as problem-based learning, collaborative learning and flipped learning. These methodologies encourage active participation, problem-solving, and the practical application of knowledge. Problem-based learning, for example, challenges students with real-world scenarios that require investigation, analysis, and solution. Collaborative learning involves working as a team to achieve educational goals, promoting communication and collaboration skills. Flipped learning inverts the traditional model of teaching, allowing students to explore concepts before class and use class time for discussions and practical applications. The implementation of active methodologies has significant advantages: It stimulates active participation, critical thinking, and the acquisition of collaborative skills, all essential in today's learning environment. However, it can also present challenges, such as the need for careful planning and design of activities, as well as effective time management in the classroom.

The convergence of emerging technologies and active methodologies creates a powerful synergy. Emerging technologies provide the tools and environments to implement active methodologies effectively, enabling more personalized and immersive learning experiences. This convergence represents a significant step forward in the way education is approached. It facilitates the creation of dynamic learning environments, where students can explore concepts interactively and apply knowledge in meaningful ways. The convergence between emerging technologies and active methodologies not only optimizes learning, but also prepares students to be autonomous learners, critical thinkers, and 21st century problem solvers. This integrated approach represents the future of higher education, driving a more enriching and effective learning experience for everyone involved. Therefore, the convergence between emerging technologies and active methodologies in university education is reshaping the way we conceive and deliver education. By harnessing the power of technology to empower active, student-centered methodologies, we are creating a learning environment that prepares students for an increasingly digital and dynamic future. This approach represents a significant milestone in the evolution of education and promises a richer and more effective learning experience for generations to come.

2. Methodology

The convergence between emerging technologies and active methodologies in university education is a dynamic phenomenon that requires a solid documentary methodology to understand its impact and evolution. In this section, we will detail the methodology used to carry out the research that supports this article, as well as the importance of this methodology in the context of technological and pedagogical convergence. To address the issue of convergence between emerging technologies and active methodologies in university education, a documentary research design has been employed. This approach is justified by the need to collect and analyze information from various documentary sources, such as previous research, academic reports, books, scientific journals and specialized websites. The documentary design fits perfectly with the theoretical nature of the topic and allows for the synthesis and critical analysis of a wide variety of information sources. The convergence of tech and active methods in university education demands robust documentary methodology. Research design involves collecting and analyzing info from diverse sources for synthesis and critical analysis (von Feigenblatt & Peña-Acuña, 2022).

Data collection in this study is based on the search and selection of relevant documents related to the convergence between emerging technologies and active methodologies in university education. An exhaustive search strategy has been employed including keywords such as "emerging technologies", "active methodologies", "university education", "artificial intelligence", "virtual reality", "problem-based learning" and other related ones. Data collection has been carried out through academic databases, digital libraries and reliable academic repositories. The selection of documentary sources was based on criteria of relevance and quality. Documents that directly address the convergence between emerging technologies and active methodologies in the context of university education were considered. In addition, the documents were evaluated because of their scientific rigor, the topicality of the information and the reputation of the authors or institutions. On the other hand, data analysis has focused on the synthesis and interpretation of the information collected. Patterns, trends and key points related to the convergence between emerging technologies and active methodologies have been identified. Through a qualitative approach, the benefits, challenges and opportunities that this convergence offers in the university educational environment have been highlighted.

3. Emerging Technologies in University Education

Emerging technologies represent an invaluable resource that has the potential to transform multiple aspects of our lives, and a college education is no exception (Aparicio-Gómez & Ostos-Ortiz, 2021). These innovations, constantly being developed or recently introduced to the market, promise to revolutionize teaching and learning by offering innovative and effective opportunities. One of the most promising aspects of emerging technologies in higher education is their ability to personalize learning. Through continuous monitoring and analysis of each student's progress, these technologies can tailor educational materials and resources to each student's individual needs (Comesaña-Comesaña, Amorós-Pons & Alexeeva-Alexeev, 2022). This means that there is no longer a one-size-fits-all approach, but that each student can receive an education specifically designed to maximize their comprehension and retention of the material. Personalization of learning is essential, as it recognizes that students have different learning paces and learning styles and seeks to provide them with the right support in their educational journey.

In addition to personalization, emerging technologies encourage active learning (Wang & Wegerif, 2019). These tools create interactive educational environments that encourage active student participation. Rather than being passive recipients of information, learners engage in the learning process, explore concepts on their own, and actively participate in problem-solving. This active participation not only improves information retention, but also fosters critical skills such as critical thinking and informed decision-making. Another standout feature of emerging technologies is their ability to provide reality-based learning experiences (Gros, 2016). Virtual and augmented reality allow students to immerse themselves in learning environments that simulate real-world situations. Not only does this make learning more exciting, but it also helps students understand the applicability of what they are learning in real-world situations. For example, medical students can practice procedures in a virtual environment before facing real patients, which boosts their confidence and competence.

Equally, emerging technologies encourage collaborative learning. They facilitate interaction and collaboration between students, which is essential for the development of communication, teamwork, and problem-solving skills. Emerging technologies play a pivotal role in fostering collaborative learning environments, enabling student interaction and teamwork, crucial for honing communication and problem-solving abilities. (von Feigenblatt & Aparicio-Gómez, 2023). Online environments allow students to collaborate on projects, discuss ideas, and share knowledge more efficiently than ever before. While emerging technologies offer exciting opportunities, they also pose challenges that need to be addressed. The initial investment and maintenance cost of these technologies can be prohibitive for some institutions. Training faculty and staff is essential to maximize their potential, which involves extra effort in professional development (Domingo-Coscollola, Bosco, Segovia & Valero, 2020). In addition, the

disparity in access to these technologies among students can create inequities in learning, underscoring the importance of ensuring that all students have equal access to these tools.

3.1. Definition and Description of Emerging Technologies

Technological advancement has been a hallmark of human society throughout history (Griffiths, 2020). Every era has experienced a series of innovations that have radically transformed the way we live, work, and communicate. In the contemporary era, emerging technologies are a topic of great interest and debate. These technologies are constantly developing and have the potential to revolutionize multiple aspects of our lives. Emerging technologies refer to those technological innovations that are in the process of development and adoption, and that have the potential to fundamentally change the way we interact with the world around us (Tiwari, 2022). These technologies are often at the forefront of technological research and development and can span a wide variety of fields, from artificial intelligence and biotechnology to renewable energy and nanotechnology.

Emerging technologies stand out for their ability to address complex and urgent problems in society. Among the most prominent is Artificial Intelligence (AI), which pursues the creation of computer systems capable of carrying out tasks that require human intelligence, such as machine learning and natural language processing (Girasa, 2020). Its application ranges from virtual assistants to accurate medical diagnoses. Nanotechnology, on the other hand, focuses on the manipulation of matter at the nanometer level, which allows the creation of materials and devices with unique properties, used in medicine and the manufacture of advanced materials. Biotechnology uses living organisms to develop useful products and processes, including genetic engineering and gene therapy (Stucki & Woerter, 2019). In terms of renewable energy, emerging technologies such as solar and wind offer clean and sustainable sources, reducing dependence on fossil fuels. Finally, virtual and augmented reality provide immersive experiences, from entertainment to educational apps to simulations for job training (Rath, Satpathy & Patnaik, 2019). These emerging technologies are transforming our society, opening new possibilities in areas ranging from medicine to energy to entertainment, and promoting a more innovative and sustainable future.

Emerging technologies have a significant impact on society in several areas. On the one hand, they can improve the quality of life by addressing critical issues such as healthcare, education, and environmental sustainability. The application of artificial intelligence in medicine, for example, allows for more accurate diagnoses and personalized treatments, improving health and prolonging people's lives (Tegmark, 2017). In addition, in education, virtual reality and adaptive learning are revolutionizing the way knowledge and skills are acquired. However, these innovations also pose ethical and societal challenges, such as issues of privacy, inequality, and job displacement. The bulk collection of personal data and its misuse raise concerns about the privacy of individuals, while the automation of tasks can negatively impact certain job sectors (Cuzzocrea, 2014). The future of emerging technologies is promising and full of possibilities, but it requires careful attention to these ethical and social issues. Proper regulation, investment in education, and international collaboration are key elements in ensuring that these innovations are beneficial to humanity.

3.2. Applications of Emerging Technologies in Higher Education

In today's digital age, emerging technologies are leaving a deep mark on higher education (Mancebo, Santorum, Ribeiro & Léda, 2020). These technological innovations are revolutionizing the way students access information, interact with content, and engage in learning activities. The applications of emerging technologies in higher education are diverse and have the potential to significantly improve the quality of teaching and learning. One of the most notable applications of emerging technologies in higher education is adaptive learning (Mira-Giménez, 2017). Artificial intelligence (AI) is used to personalize each student's learning experience. Adaptive learning systems analyze student progress and adapt the content and difficulty of study materials accordingly. This allows students to progress at their own pace and focus on areas they need to improve, improving learning effectiveness.

Virtual reality (VR) and augmented reality (AR) also have exciting applications in higher education (Cabero-Almenara, Fernández-Batanero & Barroso-Osuna, 2019). These technologies enable the creation of immersive learning environments. For example, in medical education, students can use VR to explore three-dimensional anatomical models or practice virtual surgical procedures. In architecture and design, AR can overlay 3D models onto real-world environments, allowing students to visualize construction projects more accurately. Another essential application of emerging technologies is educational data analytics (Rajabi & Greller, 2019). Collecting and analyzing data on student performance and behavior provides educators with valuable insights. Data can reveal learning patterns, identify students who need additional support, and help teachers make evidence-based decisions to improve the educational process.

Educational robotics is another promising application. Robots are used in science, technology, engineering, and math (STEM) courses to teach students technical skills and encourage problem-solving (Kaloti-Hallak, Armoni & Ben-Ari, 2019). Students can program robots to perform specific tasks, giving them hands-on experience in programming and design. In addition, machine learning and natural language processing are used in higher education for various applications. These technologies can automatically assess students' responses on quizzes and exams, provide immediate and personalized feedback, and detect plagiarism more efficiently. They can also be used to create educational chatbots that answer students' questions and provide real-time assistance (Gill, Xu, Patros, Wu, Kaur, Kaur et al., 2024). While applications of emerging technologies in higher education offer numerous benefits, they also pose significant challenges. The initial investment and ongoing cost of maintaining these technologies can be prohibitive for some educational institutions. In addition, there is a digital divide that needs to be addressed, as not all students have equal access to high-speed devices and connections. Teacher training is essential to make the most of these technologies, which requires resources and time. In addition, data security and privacy are crucial concerns because the collection and storage of student information must be done responsibly and ethically.

3.3. Benefits and Challenges of Implementing Emerging Technologies

In today's digital age, emerging technologies are radically changing the way we live, work, and learn (Burkle & Cobo, 2018). These technological innovations, which include artificial intelligence, virtual reality, machine learning, and the Internet of Things, have proven their ability to revolutionize numerous sectors, from medicine to education. However, the implementation of emerging technologies is not without significant challenges. One of the most prominent benefits of implementing emerging technologies is efficiency (Simons, Abé & Neser, 2017). Automation powered by artificial intelligence and machine learning can lead to increased productivity and time savings in various tasks, from healthcare to supply chain management. This allows businesses and organizations to conduct their operations more effectively and focus resources on more strategic tasks. In addition, these technologies offer greater customization and adaptation.

Artificial intelligence can analyze data and patterns to deliver more personalized user experiences in fields such as online advertising and content recommendation (Tegmark, 2017). In the realm of education, personalization of learning gives students the opportunity to learn at their own pace and focus on areas where they need more support. Healthcare also benefits from emerging technologies, as connected medical devices and patient monitoring systems can provide more accurate, real-time tracking of people's health, leading to earlier diagnoses and better chronic disease management (Attenborough, Abbott, Brook & Knight, 2019).

However, the implementation of emerging technologies is not without its challenges. One of the most obvious challenges is data security and privacy. As we collect and share more information online, the protection of our personal data becomes a critical concern. Cyberattacks and data breaches are constant risks that require advanced security measures and robust regulations. In addition, automation and artificial intelligence raise concerns about the future of employment (Buergin, Minguillon, Wehrle, Haefner & Lanza, 2017; Wijenayake, De Silva, Alahakoon & Kirigeeganage, 2020). If machines can perform tasks more efficiently than humans, what will happen to workers whose jobs can be automated? Economic

restructuring and job training will be essential to address this challenge. Another major challenge is the digital divide. As we embrace emerging technologies, we must ensure that all people have access to them, regardless of geographic location or socioeconomic status. Lack of access to high-speed internet and digital devices can exclude certain groups from the benefits of these technologies. Ethics is also a crucial issue. Automated decision-making and artificial intelligence raise questions about accountability and transparency in algorithmic decision-making. It is critical to establish strong ethical standards and regulations to ensure that these technologies are used fairly and equitably.

4. Active Methodologies in University Education

University education is in a constant state of evolution, and one of the most notable changes it has undergone in recent decades is the increasing adoption of active teaching and learning methodologies (Gudmundsdottir & Vasbø, 2014). These methodologies represent a pedagogical approach that places the student at the center of the educational process, promoting active participation, critical reflection and the practical application of knowledge. Active teaching methodologies are a striking contrast to the traditional education model, in which the teacher plays a predominantly passive role in conveying information to students. On the other hand, active methodologies encourage the active participation of students in the learning process. This is achieved through various strategies, such as problem-based learning, collaborative learning, flipped classroom, and the use of interactive educational technology.

One of the main advantages of active methodologies is their ability to promote deeper and more meaningful learning (Goodfellow, Bengio & Courville, 2016). When students are actively involved in problem-solving, discussing real cases, or applying concepts to practice, they are more motivated and engaged with the material. In addition, by being challenged to think critically and work in a team, they develop fundamental cognitive and social skills. Collaborative learning is a concrete example of an active methodology that has proven to be especially effective in university education (Loureiro, De Souza, Bezerra & Rodrigues, 2014). In a collaborative environment, students work together to solve problems or complete projects, sharing knowledge and perspectives. This collaboration not only reinforces understanding of concepts, but also prepares students for teamwork, an essential skill in today's working world. Another significant advantage of active methodologies is their ability to adapt to different learning styles (Guevara, Aguilar & González-Eras, 2017). They recognize that students have different rates of knowledge acquisition and that some learn best through practice, while others prefer discussion and analysis. Active methodologies allow for a personalization of learning that can be beneficial for all students, regardless of their learning style. For teachers, implementing active methodologies can be challenging, as it requires a more flexible approach and a greater investment of time in lesson planning. However, the benefits are obvious. Teachers who use active methodologies experience greater student engagement, improved academic outcomes, and greater satisfaction with their teaching. In addition, these methodologies encourage continuous professional development, as teachers are constantly looking for new strategies and resources to enrich the learning process. Feedback and continuous evaluation are also central to this approach, allowing teachers to adjust and improve their pedagogical practices.

4.1. Definition and Explanation of Active Methodologies

In the constant quest to improve education and the learning process, active methodologies have emerged as an effective and transformative pedagogical approach (Nicolaou, Matsiola & Kalliris, 2019). These methodologies represent a significant shift in the way we conceive of teaching and learning, and their impact on student motivation and engagement is undeniable. Active methodologies, at their core, are teaching approaches that actively engage students in the learning process, rather than being passive recipients of information. Instead of adopting the traditional lecture structure in which the teacher transmits knowledge in a unidirectional manner, active methodologies promote active participation, critical thinking, and problem-solving by students.

A classic example of an active methodology is "problem-based learning" (PBL) (Dilger, Gommers & Rapp, 2019). In PBL, students are confronted with real-world problems or situations and work in groups

to investigate, analyze, and find solutions. This approach not only fosters knowledge acquisition, but also develops research, communication, and collaboration skills. Another active methodology is "collaborative learning," in which students work in teams to achieve shared learning goals. This reflects the idea that learning is a social process, and students can benefit from discussing ideas, sharing perspectives, and teaching each other.

One of the key principles of active methodologies is the "flipped classroom" (Kim & Kim, 2017). In this approach, students gain knowledge independently before class through materials such as videos, readings, or online activities. Then, in class, time is spent discussing, problem-solving, and applying what has been learned. This allows students to take a more active role in building their understanding and allows the teacher to provide personalized support when questions or difficulties arise.

4.2. Implementation of Active Methodologies

The successful implementation of active methodologies in the university carries several notable benefits (Moya, 2017). First, these methodologies promote the active participation of students. Through group discussions, debates, problem-solving, and hands-on activities, students become central actors in their own learning. Not only does this encourage a more in-depth understanding of concepts, but it also improves information retention. In addition, active methodologies promote the development of critical thinking and independent thinking skills. Students learn to question, analyze, and synthesize information more effectively, skills that are crucial in today's world. They also encourage collaboration and teamwork, essential skills in professional life, as well as improving motivation and interest in learning. By actively participating in the teaching-learning process, students find more relevance in what they are studying and are more willing to engage with the material.

While the benefits of active methodologies are undeniable, their successful implementation also faces significant challenges (Malone, 2018). One of the most common challenges is resistance to change. Teachers and students may be accustomed to traditional keynote lectures and may feel a certain apprehension towards more interactive approaches. Planning and designing active activities requires additional time and effort for teachers. This can be a hindrance, especially in academic settings where professors have considerable workloads. Managing time in the classroom can also be challenging. Active activities often require more time than traditional lectures, and teachers need to be efficient in their implementation to cover the necessary content. Assessing learning outcomes in an active methodology's environment can be more complex than in a keynote model. Measuring learning may require different assessment instruments and a more personalized approach.

To achieve a successful implementation of active methodologies in the university, it is essential to address these challenges effectively (Hinojo-Lucena, Aznar-Diaz, Caceres-Reche, Trujillo-Torres & Romero-Rodriguez, 2019). First, training and support should be provided to teachers to help them design and implement active activities effectively. This includes creating educational resources and promoting best practices. Careful time planning and structuring of activities are crucial to ensure that learning objectives are met. Teachers should be strategic in the selection and sequencing of active activities. Formative and summative assessment should be adapted to active methodologies and focused on continuous feedback. Teachers must be willing to adjust their approaches based on outcomes and student needs.

4.3. Advantages and Limitations of the Application of Active Methodologies

One of the main advantages of active methodologies is their ability to increase student participation and engagement in the classroom (Corujo-Vélez, Gómez-del-Castillo & Merla-González, 2020). By encouraging interaction and collaboration among students, these methodologies create a dynamic and motivating learning environment. Students are more likely to be actively engaged in class, which can improve their comprehension and retention of the material. In addition, active methodologies promote the development of critical skills such as critical thinking, problem-solving, and decision-making. By being

confronted with real-world situations and challenges, students learn to apply their knowledge in practical ways and to analyze and evaluate information more effectively. Another key advantage is the personalization of learning. Active methodologies make it possible to tailor teaching to the individual needs of students. Educators can identify each student's strengths and weaknesses and offer additional support when needed, improving the effectiveness of the learning process.

Despite their many advantages, active methodologies also present challenges and limitations. One of the main challenges is the time required for implementation. Active learning activities often require more time to prepare and execute than traditional classes (Comminiello & Principe, 2018). Educators should carefully plan activities and ensure that they fit within the curriculum. Another challenge is resistance to change for some students and educators. Some students may be accustomed to a more passive approach to learning and may feel uncomfortable taking on a more active role. Similarly, some educators may find it difficult to adapt to a more interactive approach to teaching. In addition, evaluation in active methodologies can be challenging. Measuring student learning effectively and fairly in active settings can be more complicated than in traditional assessments. Educators must design assessments that accurately reflect students' learning goals and skill development.

5. The Convergence between Emerging Technologies and Active Methodologies

The convergence between emerging technologies and active methodologies marks a paradigm shift in education (Llorente-Cejudo & Almenara, 2014). When these two forces come together, the result is an educational experience that is more than the sum of its parts. For example, artificial intelligence can tailor learning content in a personalized way in a collaborative learning environment, allowing students to work together on meaningful projects and receive feedback tailored to their individual needs. Virtual reality can immerse students in real-world scenarios to solve authentic problems, which complements perfectly the active focus on problem-solving.

The convergence between emerging technologies and active methodologies offers numerous benefits (Karabaevna & Raximovich, 2019). Students become more engaged and motivated as they experience more interactive and relevant learning. Educators have access to accurate data on student progress, allowing them to adjust their teaching approaches more effectively. Personalization of learning is more accessible, allowing for better attention to the individual needs of each student. However, there are also challenges. Successful implementation of this convergence requires investment in technology, teacher training, and careful curriculum planning (Chakuzira & Kadyamatimba, 2017). In addition, concerns about data privacy and the digital divide need to be addressed to ensure that all students can benefit. The convergence between emerging technologies and active methodologies is a transformative shift in education that is redefining the way students learn and educators teach. As these two forces continue to evolve and complement each other, the future of education looks brighter than ever. Education is in the process of becoming a more effective, personalized, and participatory experience, thanks to this powerful convergence.

5.1. Synergy between Emerging Technologies and Active Methodologies

In the digital age in which we live, education is in a process of constant and profound transformation. The rapid evolution of technology and the changing demands of society have put constant pressure on the education system. In this context, two of the main drivers of this change are emerging technologies and active methodologies. The convergence of these two forces is shaping a new paradigm in education, fundamentally redefining the way we teach and learn (Tran, 2019). The educational revolution we are witnessing goes beyond the mere adoption of technological tools in the classroom. The synergy between emerging technologies and active methodologies represents a crucial advance in this evolution. True educational innovation manifests itself when these two forces are combined. Technology provides the tools to personalize learning, tailoring content and activities to students' individual needs. Active methodologies, on the other hand, empower students, making them active participants in their learning process. This interplay between technology and active participation results in an interactive, personalized,

and effective learning environment that significantly improves retention and comprehension of the material.

The ongoing educational transformation not only impacts students and educators, but also society (Breanne & Lewis, 2018). It prepares students to be autonomous learners, critical thinkers, and 21st century problem solvers. In addition, it encourages the development of essential skills, such as adaptability, collaboration, and communication, which are increasingly important in the world of work and in everyday life. The convergence of emerging technologies and active methodologies is not just a passing trend; It's a paradigm shift that's defining the future of education. As we continue to explore and leverage this synergy, we are paving the way for more effective and meaningful education in the digital age. The synergy between emerging technologies and active methodologies represents an unprecedented opportunity to transform education. By harnessing the advantages of personalization, immersion, and data analysis from emerging technologies, and combining them with active methodologies that empower students, we can create a dynamic and effective learning environment. Not only does this convergence prepare students to succeed in a technology-driven world, but it also fosters essential skills such as critical thinking, problem-solving, and collaboration. As educators, we must embrace this synergy, explore new possibilities, and continue to adapt to meet the changing needs of our students and society at large.

5.2. The Convergence between Emerging Technologies and Active Methodologies

The convergence between emerging technologies and active methodologies represents a crucial milestone in the evolution of education. This synergy between technological innovation and student-centered pedagogical strategies has opened a range of possibilities that are redefining the way we teach and learn. By combining technologies such as artificial intelligence (AI) and virtual reality (VR) with active methodologies, a dynamic and highly personalized learning environment is being created (Marwala, 2021). One of the highlights of this convergence is its ability to make the learning process more participatory and engaging. AI, for example, can tailor learning content individually, considering the pace and needs of each student. Not only does this improve understanding of concepts, but it also encourages independence and self-direction in learning.

VR offers immersive learning experiences that transcend the barriers of time and space. Students can explore three-dimensional environments that simulate real-world situations, allowing them to learn through hands-on experience. This active methodology gives them a deeper and more memorable understanding of the content. In addition, the convergence of emerging technologies and active methodologies benefits both students and educators. Teachers can use these technological tools to gain a more accurate understanding of their students' progress. The data collected can help identify areas for improvement and allow for more timely and effective feedback. However, not everything is a smooth path in this educational revolution. The successful implementation of this convergence faces several challenges. Investment in technological infrastructure is essential, and not all educational institutions have the necessary resources. Likewise, educators must undergo meaningful professional development to take full advantage of emerging technologies and design effective learning experiences. Another critical aspect is ethical considerations related to data privacy and security (Aparicio-Gómez & Aparicio-Gómez, 2021). As more data is collected about students, it is critical to ensure that this information is handled responsibly and protected from potential privacy breaches.

The convergence between emerging technologies and active methodologies is in the process of redefining education. This synergy makes it possible to create dynamic and personalized learning environments that benefit students and educators alike. While there are challenges to overcome, such as infrastructure investment and professional development, the transformative potential of this convergence is undeniable. By combining technological personalization with the student-centered approach of active methodologies, we are empowering students to be more than mere receivers of information. We're empowering them as autonomous learners and critical thinkers, preparing them to succeed in an ever-changing digital world. This convergence is driving an educational transformation that agrees with the demands of today's and tomorrow's society.

5.3. Learning Optimized By Synergy and Convergence between Emerging Technologies and Active Methodologies

The synergy between emerging technologies and active methodologies is, therefore, an approach that promotes the interaction between the advanced capabilities of technology and the active participation of students in their own learning process. This symbiotic relationship has become a driving force in education today, as each component complements and empowers the other to achieve higher educational outcomes (Tamilarasan, Karthick & Anupama, 2019). The convergence of emerging technologies and active methodologies is characterized by their ability to personalize and adapt learning according to the individual needs of each student. Emerging technologies, such as artificial intelligence and data analytics, can gather accurate information about a student's progress and learning style. This information is used to deliver personalized learning content and appropriate activities, allowing for a student-centered approach.

On the other hand, active methodologies emphasize the active participation of the student rather than being passive receivers of information. Students actively engaged in their learning could explore, question, collaborate, and apply what they have learned in relevant contexts (Hai-Jew, 2010). Direct interaction with concepts and practical problem-solving fosters a more in-depth understanding and lasting retention of knowledge. The synergy between these two educational forces allows students to experience a more immersive and authentic learning process. Emerging technologies provide innovative tools and resources that can include interactive simulations, virtual learning environments, and adaptive assessments. These tools offer opportunities for experimentation and practice, which is essential in acquiring practical skills and understanding complex concepts.

Equally, the convergence of emerging technologies and active methodologies can overcome barriers of time and space. Students can access quality educational resources from anywhere, at any time. This allows for flexibility in learning, which is particularly beneficial for those who have busy schedules or need to learn at their own pace (Schulze, Blume, Herrmann & Thiede, 2019). However, despite the obvious benefits of this synergy, there are challenges that need to be addressed. Effective implementation of emerging technologies and active methodologies requires investment in educator training and the right technological infrastructure. In addition, data management and privacy should be primary considerations to ensure the security of student information. Finally, it should be stressed that the convergence of emerging technologies and active methodologies represents a powerful tool for optimizing learning in education. This synergy makes it possible to personalize learning, encourage active participation, and overcome limitations of time and space. As we continue to explore and leverage this complementary relationship, we are improving the quality and effectiveness of education, preparing students to meet the challenges of an ever-changing world. The combination of these two educational forces is enriching the learning experience and promoting a more student-centered approach in contemporary education.

6.Conclusions

Implementing emerging technologies in higher education offers a wide range of benefits. These innovations allow for the personalization of learning, which means that each student can receive an education tailored to their needs and pace of learning. However, the implementation of these technologies also presents challenges, such as initial investment, teacher training, and the need to ensure equitable access. Overcoming these challenges is essential to fully reap the benefits of emerging technologies in higher education and preparing students for a dynamic digital future. The implementation of emerging technologies, while full of promise, is not without ethical and societal challenges. One of the greatest challenges is data security and privacy, as the collection and sharing of information online raises concerns about personal data protection and cybersecurity. The digital divide is another major challenge, as not all individuals have equal access to these technologies, which can exacerbate inequalities. Ethics also play a crucial role, as automated and algorithmic decision-making must be transparent and fair.

Active methodologies in university education represent a significant change in the way teaching and learning is conceived. These methodologies promote active participation, critical thinking, and practical application of

knowledge, resulting in deeper and more meaningful learning for students; In addition, they encourage the development of essential skills, such as collaboration and teamwork, which are crucial in today's world of work. Despite the challenges posed by implementing active methodologies, such as resistance to change and investing time in planning, the benefits are undeniable. Educators who use active methodologies experience greater student engagement, improved academic outcomes, and greater satisfaction with their teaching. These methodologies also encourage continuous professional development, as teachers are constantly looking for new strategies and resources to enrich the learning process.

The convergence between emerging technologies and active methodologies represents a transformative advance in education. This synergy allows for unprecedented personalization of learning, tailoring content and activities to the individual needs of each student. Despite the obvious benefits of this convergence, there are challenges that need to be addressed. Investment in technology infrastructure and training of educators are critical for effective implementation. In addition, data management and privacy are critical considerations to ensure the security of student information. However, by overcoming these obstacles, the convergence between emerging technologies and active methodologies is enriching the learning experience and promoting a more student-centered approach in contemporary education. This synergy not only improves the quality and effectiveness of education, but also prepares students to be autonomous learners and critical thinkers in an ever-changing world.

The integration of emerging technologies in higher education promises personalized learning, addressing individual needs and learning paces. However, challenges like initial investments, teacher training, and ensuring equitable access need addressing for optimal results. Ethical dilemmas, especially regarding data security and privacy, pose significant concerns in the digital realm. The digital divide exacerbates inequalities, and transparency in algorithmic decision-making is essential. Meanwhile, active methodologies in universities revolutionize education by fostering critical thinking, practical application, and essential skills like collaboration. Despite challenges such as resistance to change, the benefits manifest in heightened student engagement, academic outcomes, and teacher satisfaction. The convergence of emerging technologies and active methodologies offers transformative progress, enabling unprecedented personalization and a student-centric approach. Overcoming challenges in technology infrastructure, educator training, and data management is crucial for a successful synergy, ultimately preparing students for a dynamic future.

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References

Aparicio-Gómez, O.Y., & Aparicio-Gómez, W.O. (2021). Referentes filosóficos del proceso educativo. *Revista Internacional de Filosofía Teórica y Práctica,* 1(2), 157-168. https://doi.org/10.51660/riftp.v1i2.37

Aparicio-Gómez, O.Y., & Ostos-Ortiz, O.L. (2021). Pedagogías emergentes en ambientes virtuales de aprendizaje. *Revista Internacional de Pedagogía e Innovación Educativa,* 1(1), 11-36. https://doi.org/10.51660/ripie.v1i1.25

Attenborough, J., Abbott, S., Brook, J., & Knight, R.A. (2019). Everywhere and nowhere: Work-based learning in healthcare education. *Nurse Education in Practice,* 36, 132-138. https://doi.org/10.1016/j.nepr.2019.03.004

Breanne K.L, & Lewis, W.E. (2018). Mobile augmented reality: Exploring a new genre of learning. *Virtual and Augmented Reality,* 22(3), 200-221. https://doi.org/10.1145/3308755.3308757

Buergin, J., Minguillon, F.E., Wehrle, F., Haefner, B., & Lanza, G. (2017). Demonstration of a Concept for Scalable Automation of Assembly Systems in a Learning Factory. *Procedia Manufacturing,* 9, 33-40. https://doi.org/10.1016/j.promfg.2017.04.026

Burkle, M., & Cobo, C. (2018). Redefining knowledge in the digital age. *Journal of New Approaches in Educational Research,* 7(2), 79-80. University of Alicante. https://doi.org/10.7821/naer.2018.7.294

Cabero-Almenara, J., Fernández-Batanero, J.M., & Barroso-Osuna, J. (2019). Adoption of augmented reality technology by university students. *Heliyon,* 5(5). https://doi.org/10.1016/j.heliyon.2019.e01597

Chakuzira, W., & Kadyamatimba, A. (2017). The perceived benefits and barriers to the application of mobile and social networking technologies in higher learning institutions. *Problems and Perspectives in Management,* 15(3), 343-351. https://doi.org/10.21511/ppm.15(3-2).2017.04

Comesaña-Comesaña, P., Amorós-Pons, A., & Alexeeva-Alexeev, I. (2022). Technocreativity, Social Networks and Entrepreneurship: Diagnostics of Skills in University Students. *International Journal of Emerging Technologies in Learning (IJET),* 17(5), 180-195. https://doi.org/10.3991/ijet.v17i05.28183

Comminiello, D, & Principe, J.C. (2018). *Adaptive Learning Methods for Nonlinear System Modeling.* Butterworth-Heinemann.

Corujo-Vélez, M.C., Gómez-del-Castillo, M.T., & Merla-González, A.E. (2020). Construtivist and collaborative methodology mediated by ICT in higher education using webquest. *Pixel-Bit, Revista de Medios y Educacion,* 57, 7-57. https://doi.org/10.12795/pixelbit.2020.i57.01

Cuzzocrea, A. (2014). Privacy and security of Big Data: Current challenges and future research perspectives. *PSBD 2014 – Proceedings of the 1st International Workshop on Privacy and Secuirty of Big Data, Co-Located with CIKM 2014* (45-47). https://doi.org/10.1145/2663715.2669614

Dilger, B., Gommers, L., & Rapp, C. (2019). The learning problems behind the seams in seamless learning. In *Lecture Notes in Educational Technology* (29-51). Springer International Publishing. https://doi.org/10.1007/978-981-13-3071-1_2

Domingo-Coscollola, M., Bosco, A., Segovia, S.C., & Valero, J.A.S. (2020). Fostering teacher's digital competence at university: The perception of students and teachers. *Revista de Investigacion Educativa,* 38(1), 167-182. https://doi.org/10.6018/rie.340551

Gill, S.S., Xu, M., Patros, P., Wu, H., Kaur, R., Kaur, K. et al. (2024). Transformative effects of ChatGPT on modern education: Emerging Era of AI Chatbots. *Internet of Things and Cyber-Physical Systems,* 4, 19-23. https://doi.org/10.1016/J.IOTCPS.2023.06.002

Girasa, R. (2020). Artificial intelligence as a disruptive technology: Economic transformation and government regulation. In *Artificial Intelligence as a Disruptive Technology: Economic Transformation and Government Regulation.* Palgrave Macmillan. https://doi.org/10.1007/978-3-030-35975-1

Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning.* MIT Press.

Griffiths, D. (2020). The Ethical Issues of Learning Analytics in Their Historical Context. In *Lecture Notes in Educational Technology* (39-55). Springer. https://doi.org/10.1007/978-981-15-4276-3_3

Gros, B. (2016). The dialogue between emerging pedagogies and emerging technologies. In *Lecture Notes in Educational Technology* (3-23). Springer International Publishing. https://doi.org/10.1007/978-3-662-47724-3_1

Gudmundsdottir, G.B., & Vasbø, K.B. (2014). Methodological challenges when exploring digital learning spaces in education. In *Methodological Challenges When Exploring Digital Learning Spaces in Education. Sense Publishers.* https://doi.org/10.1007/978-94-6209-737-7

Guevara, C., Aguilar, J., & González-Eras, A. (2017). The Model of Adaptive Learning Objects for virtual environments instanced by the competencies. *Advances in Science, Technology and Engineering Systems,* 2(3), 345-355. https://doi.org/10.25046/aj020344

Hai-Jew, S. (2010). The criticality of an ICT ethics backbone for transformation and social equality in e-learning. In *Handbook of Research on Transformative Online Education and Liberation: Models for Social Equality* (439-460). IGI Global. https://doi.org/10.4018/978-1-60960-046-4.ch025

Hinojo-Lucena, F.J., Aznar-Diaz, I., Caceres-Reche, M.P., Trujillo-Torres, J.M., & Romero-Rodriguez, J.M. (2019). Factors Influencing the Development of Digital Competence in Teachers: Analysis of the Teaching Staff of Permanent Education Centres. *IEEE Access,* 7, 178744-178752. https://doi.org/10.1109/ACCESS.2019.2957438

Kaloti-Hallak, F., Armoni, M., & Ben-Ari, M. (2019). The effect of robotics activities on learning the engineering design process. *Informatics in Education,* 18(1), 105-129. https://doi.org/10.15388/infedu.2019.05

Karabaevna, Z., & Raximovich, B. (2019). The use of innovation technologies in the formation of students' professional competences. *International Journal of Engineering and Advanced Technology,* 9(1), 6898-6902. https://doi.org/10.35940/ijeat.A2996.109119

Kim, K.Y., & Kim, Y. (2017). What are learning satisfaction factors in flipped learning? In *Lecture Notes in Electrical Engineering* (421, 750-755). Springer Verlag. https://doi.org/10.1007/978-981-10-3023-9_115

Llorente-Cejudo, M.C., & Almenara, J.C. (2014). Attitudes, satisfaction, academic performance and online communication in processes of university training through blended learning. In *Conceptual, Methodological and Practical Challenges on How and What People and Organizations Learn Across Time and Space* (27-36). Nova Science Publishers, Inc.

Loureiro, M.J., De Souza, F.N., Bezerra, A., & Rodrigues, A. (2014). Collaboration, knowledge sharing and digital environments: What about argumentation and questioning skills? In Zaphiris, P., & Ioannou, A. (Eds.), *Learning and Collaboration Technologies. Technology-Rich Environments for Learning and Collaboration. Lecture Notes in Computer Science* (8524, 440-449. https://doi.org/10.1007/978-3-319-07485-6_43

Malone, H.J. (2018). Introduction: The Role of Context in Scaling Up Educational Change. *Educational Research for Policy and Practice* (17(3), 189-193. Springer Netherlands. https://doi.org/10.1007/s10671-018-9234-6

Mancebo, D., Santorum, K.M.T., Ribeiro, C.V.S., & Léda, D.B. (2020). The work in higher education. *Education Policy Analysis Archives,* 28, 6. https://doi.org/10.14507/epaa.28.5158

Marwala, T. (2021). Rational Machines and Artificial Intelligence. *Rational Machines and Artificial Intelligence,* 1-257. https://doi.org/10.1016/B978-0-12-820676-8.09990-7

Mira-Giménez, M.J. (2017). COMALAT: Aprendizaje de idiomas adaptativo y móvil. *Cultura y Educacion,* 29(4), 863-870. https://doi.org/10.1080/11356405.2017.1370820

Moya, E.C. (2017). Using Active Methodologies: The StudentśView. *Procedia – Social and Behavioral Sciences,* 237, 672-677. https://doi.org/10.1016/J.SBSPRO.2017.02.040

Nicolaou, C., Matsiola, M., & Kalliris, G. (2019). Technology-Enhanced Learning and Teaching Methodologies through Audiovisual Media. *Education Sciences,* 9(3), 196. https://doi.org/10.3390/educsci9030196

Rajabi, E., & Greller, W. (2019). Exposing social data as linked data in education. *International Journal on Semantic Web and Information Systems,* 15(2), 92-106. https://doi.org/10.4018/IJSWIS.2019040105

Rath, D., Satpathy, I., & Patnaik, B.C.M. (2019). Augmented reality (Ar) & virtual reality (Vr) – A channel for digital transformation in industrialization fostering innovation & entrepreneurship. *International*

Journal of Innovative Technology and Exploring Engineering, 8(10), 3228-3236.
https://doi.org/10.35940/ijitee.J1167.0881019

Schulze, C., Blume, S., Herrmann, C., & Thiede, S. (2019). Energy Storage Technologies to foster Energy Flexibility in Learning Factories. *Procedia Manufacturing,* 31, 330-336.
https://doi.org/10.1016/j.promfg.2019.03.052

Simons, S., Abé, P., & Neser, S. (2017). Learning in the AutFab – The Fully Automated Industrie 4.0 Learning Factory of the University of Applied Sciences Darmstadt. *Procedia Manufacturing,* 9, 81-88.
https://doi.org/10.1016/j.promfg.2017.04.023

Stucki, T., & Woerter, M. (2019). The private returns to knowledge: A comparison of ICT, biotechnologies, nanotechnologies, and green technologies. *Technological Forecasting and Social Change,* 145, 62-81. https://doi.org/10.1016/j.techfore.2019.05.011

Tamilarasan, P., Karthick, S., & Anupama, C.G. (2019). Mobile learning challenges and capabilities. *International Journal of Recent Technology and Engineering,* 8(3), 5358-5361.
https://doi.org/10.35940/ijrte.C6883.098319

Tegmark, M. (2017). *Life 3.0: Being human in the age of artificial intelligence.* Knopf.

Tiwari, S.P. (2022). *Emerging Technologies: Factors Influencing Knowledge Sharing.* Available at:
https://papers.ssrn.com/abstract=4066078 https://doi.org/10.35542/osf.io/dwyqm

Tran, V.D. (2019). Does cooperative learning increase students' motivation in learning? *International Journal of Higher Education,* 8(5), 12-20. https://doi.org/10.5430/ijhe.v8n5p12

von Feigenblatt, O., & Peña-Acuña, B. (2022). *Aprendizaje personalizado y education maker: Nuevos paradigmas didácticos y otras aproximaciones.* Barcelona: Octaedro.

von Feigenblatt, O., & Aparicio-Gómez, O.Y. (2023). *Trascending the eternal debate between traditional and progressive education: A constructive scholary dialogue.* Barcelona: Octaedro. https://doi.org/10.36006/90020-0

Wang, M., & Wegerif, R. (2019). From active-in-behaviour to active-in-thinking in learning with technology. *British Journal of Educational Technology,* 50(5), 2178-2180. Blackwell Publishing Ltd.
https://doi.org/10.1111/bjet.12874

Wijenayake, P., De Silva, D., Alahakoon, D., & Kirigeeganage, S. (2020). Automated detection of social roles in online communities using deep learning. *ACM International Conference Proceeding Series,* 63-68.
https://doi.org/10.1145/3378936.3378973