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INTEGRATING INNOVATIVE PEDAGOGICAL TECHNOLOGIES INTO EARLY CHILDHOOD EDUCATION TRAINING PROGRAMS: A COMPARATIVE ANALYSIS

INTEGRAÇÃO DE TECNOLOGIAS PEDAGÓGICAS INOVADORAS NOS PROGRAMAS DE FORMAÇÃO EM EDUCAÇÃO DE INFÂNCIA: UMA ANÁLISE COMPARATIVA

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ABSTRACT

The aim of this study is to analyze the integration of innovative pedagogical technologies into early childhood education training programs, focusing on play-based learning, project-based learning, augmented reality and virtual reality, and AI-powered tools. The comparative analysis aims to unveil the unique strengths, challenges, and opportunities associated with each approach. The study utilizes a systematic approach, drawing from diverse scientific literature, including articles, conference papers, and books. Through content analysis, the paper identifies key themes, theoretical frameworks, and implementation strategies, followed by a critical analysis of strengths and limitations. The results reveal distinctive strengths: play-based learning excels in holistic development, project-based learning in real-world skills, AR/VR in immersive experiences, and AI-powered tools in personalized learning. Challenges include guidance dependency in play-based learning, varying engagement levels in project-based learning, resource intensiveness in AR/VR, and ethical considerations in AI-powered tools. Opportunities arise in fostering creativity through play-based learning, encouraging critical thinking in project-based learning, providing realistic simulations with AR/VR, and offering adaptive learning experiences with AI-powered tools. In conclusion, the study underscores the immense potential of integrating technologies into training programs. It advocates for the establishment of national standards, comprehensive teacher training, resource facilitation, and international collaboration.

Keywords: Preschool teachers; Education; Digitalization; Artificial Intelligence; Innovative pedagogical approaches.

RESUMO

O objetivo deste estudo é analisar a integração de tecnologias pedagógicas inovadoras nos programas de formação da educação pré-escolar, centrando-se na aprendizagem baseada no jogo, na aprendizagem baseada em projectos, na realidade aumentada e na realidade virtual e nas ferramentas alimentadas por IA. A análise comparativa tem como objetivo revelar os pontos fortes, os desafios e as oportunidades únicos associados a cada abordagem. O estudo utiliza uma abordagem sistemática, recorrendo a diversa literatura científica, incluindo artigos, documentos de conferências e livros. Através da análise de conteúdo, o documento identifica temas-chave, quadros teóricos e estratégias de implementação, seguidos de uma análise crítica dos pontos fortes e das limitações. Os resultados revelam pontos fortes distintos: a aprendizagem baseada no jogo destaca-se no desenvolvimento holístico, a aprendizagem baseada em projectos nas competências do mundo real, a AR/VR em experiências imersivas e as ferramentas alimentadas por IA na aprendizagem personalizada. Os desafios incluem a dependência de orientação na aprendizagem baseada em jogos, níveis de envolvimento variáveis na aprendizagem baseada em projectos, intensidade de recursos em AR/VR e considerações éticas em ferramentas alimentadas por IA. Surgem oportunidades para fomentar a criatividade através da aprendizagem baseada em jogos, incentivar o pensamento crítico na aprendizagem baseada em projectos, proporcionar simulações realistas com AR/VR e oferecer experiências de aprendizagem adaptáveis com ferramentas alimentadas por IA. Em conclusão, o estudo sublinha o imenso potencial da integração das tecnologias nos programas de formação. Defende o estabelecimento de normas nacionais, a formação abrangente de professores, a facilitação de recursos e a colaboração internacional.

Palavras-chave: Professores do ensino pré-escolar; Educação; Digitalização; Inteligência artificial; Abordagens pedagógicas inovadoras.

Introduction

In the modern period, characterized by rapid technological progress and constant changes in the social and economic environment, the issue of integrating innovative pedagogical technologies into preschool education becomes a necessity and requires careful analysis. Preschool education is a key stage in the development of each individual, determining his future success and opportunities. In this context, pedagogical programs for preschool children should not only be adapted to modern challenges, but also actively use innovative methods and technologies for the most effective formation of cognitive, social and creative skills.

The integration of innovative pedagogical technologies involves the use of modern means and teaching aids, such as interactive computer programs, virtual reality, open access to online resources, which makes the educational process more exciting and effective (TSOLI, 2023). Such technologies can provide individualization of education, taking into account the individual characteristics of each child, his pace of learning and style of perceiving information.

Carrying out a comparative analysis of various approaches to the integration of innovative technologies in preschool education will allow us to determine the optimal models and methods that maximize the development of children at this stage. Consideration of aspects such as the influence of technology on psychophysical development, social adaptation and creativity of preschoolers will allow to determine the most effective and responsible approaches to the formation of the foundations of education at an early age.

The general purpose of this scientific article is to reveal the potential of innovative pedagogical technologies in preschool education through the systematization of existing approaches and the identification of their impact on the development of children. The results of this study will be useful for teachers, methodologists and scientists interested in improving the methods and programs of preschool education, as well as for parents who seek to provide their children with the best opportunities for development in the modern information society.

Literature review

In the foreseeable future, at least 90% of professional roles in Europe are expected to require basic digital skills, similar to the importance of basic literacy or numeracy. However, progress in this area has been slow. According to the DESI 2021 report, as of 2020, approximately 42% of the adult population still lacked basic digital skills, representing a marginal 1% improvement compared to 2015 BAŞOL and YALÇIN (2020). Compounding the issue is the revelation that 88% of workplaces have taken no measures to enhance their employees' digital skills, frequently attributing the high costs involved as the primary obstacle to addressing digital skills deficiencies. In light of the EU's ambitious target to ensure that a minimum of 80% of adults possess basic digital skills by 2030, it is evident that, alongside other stakeholders BAŞOL and YALÇIN (2020), the educational systems of EU nations are anticipated to play a crucial role in achieving this objective.

The obligation of educational systems to equip the youth with the requisites for the modern labor market, including imparting sufficient digital skills, has been a recurring discourse for several decades. Proposals to integrate Science, Technology, Engineering, Art, Math (STEAM) principles into standard curricula have been posited as a viable strategy to pique students' interest in professions demanding adept digital skills (which encompass the majority of future jobs) (BOICHENKO et al., 2022). However, the integration of STEAM into curricula necessitates a widespread acceptance of the tenets of technology-enhanced learning (TEL) by teachers – a task that, as indicated by various studies, has encountered challenges for diverse reasons, including the prevailing low levels of digital competences (SÁEZ, 2020). Given that teachers are expected to leverage technology to enhance their efficiency and furnish students with pertinent subject-related technological skills, it has become imperative to implement training programs with the improvement of teachers' digital competences as a primary objective.

Researchers have repeatedly turned to the analysis of this issue. (ALELAIMAT et al., 2020) focused on the preparation of future educators for integrating technology and digital media in early childhood education.

CHRISTOPOULOS and SPRANGERS (2021) analyzed the integration of educational technology during the Covid-19 pandemic, considering perspectives from both teachers and students. BULGAKOVA (2018) investigated the psychological readiness of students for social interaction, examining the strategic and tactical aspects. BAŞOL and YALÇIN (2020) explored the impact of the Digital Economy and Society Index (DESI) on labor market indicators in EU countries. (LASAUSKIENĖ et al., 2015) focused on the development of general competencies within the context of teacher training. MGONJA and KAMBUGA (2023) examines the perceptions and approaches related to the intertwining of play and learning in early childhood education. KONIARI and RAFTOULIS (2023) investigated the relationship between digital competence and school leadership in the context of Greece. MARIANO and SABAR (2023) explored the interplay between technology, teacher competence, and overall parental satisfaction. RAKHIMOV and MUKHAMEDIEV (2022) investigated the challenges and complexities associated with incorporating principles of future education. MOHEBI (2021) presented a systematic literature review on theoretical models of integrating interactive learning technologies into teaching. BEREZOVSKA (2021) focused on communicative and speech aspects of training future educators in preschool education institutions. NAIDA (2022) explored the foundational principles guiding the training of future educators in educational institutions. These diverse studies collectively contribute to the broader discourse on education, technology, and professional development, offering valuable insights for researchers, educators, and policymakers.

In addition to analyze of these works, there is a pressing concern regarding early childhood education. The current state of preschool education faces unresolved issues related to the integration of technology. The evolving landscape of digital skills further complicates the task of preparing young children for the demands of the modern world. Addressing digital literacy gaps in early childhood education is crucial for fostering a foundation of skills that will be essential as these children progress through their educational journey and future careers. The alignment of early childhood education with advancements in digital competences

is pivotal to ensure comprehensive preparation for the evolving requirements of the 21st-century workforce.

Nevertheless, in spite of the outlined policy endeavors, there exists limited knowledge concerning the degree to which educators in early childhood education, in collaboration with their students, engage with technology as multifaceted learning platforms. For instance, the exploration of applications or the creation of digital narratives related to specific scientific concepts has the potential to foster scientific inquiry (KEWALRAMANI & HAVU-NUUTINEN, 2019). When educators establish clear objectives for structuring science-related activities and subsequently make informed pedagogical choices to incorporate technology, it facilitates the assessment of whether, and to what extent, the educational goals can be realized. Concurrently, as children express and demonstrate their comprehension of objects and everyday occurrences, formulate and assess hypotheses, and participate in argumentation utilizing images, visuals, alternative and augmentative communication, alongside conventional statements, technology emerges as an indispensable educational instrument within the context of a diverse learning platform.

Several scholars have asserted that, given children's early exposure to digital technologies, it becomes the responsibility of both parents and educators to equip them with essential skills for their future societal and professional integration (KAIMARA, 2021). The existence of unresolved issues related to technology use in preschool learning environments, coupled with the nascent state of research on technology integration in early childhood science education, underscores the relevance and timeliness of the present study. The escalating prevalence of audio-visual media and technology in children's daily learning environments necessitates a thoughtful examination of how educators can judiciously employ technology for effective science instruction. While acknowledging the potential unintended impact of technology on impressionable young minds, finding a prudent equilibrium is paramount.

Methodology

The paper adopts a theoretical framework and employs a combination of research methods to systematically analyze and compare existing literature on the integration of innovative pedagogical technologies into early childhood education training programs. The primary methods employed in this study include content analysis, analysis, synthesis, and comparison.

Content Analysis of Scientific Literatures is used for comprehensively review and analyze the existing body of scientific literature related to the integration of innovative pedagogical technologies in early childhood education training programs. The procedures of its application consist of:

- Identify and select relevant scholarly articles, books, conference papers, and other publications through systematic literature searches.

- Conduct a content analysis of the selected literature to identify key themes, trends, and theoretical frameworks.

- Categorize and code information related to innovative pedagogical technologies, their integration strategies, and the impact on early childhood education training.

Analysis is used for critically analyze the identified literature and extract key insights, arguments, and theoretical perspectives. The procedures of its application consist of:

- Evaluate the strengths and limitations of different approaches to integrating innovative pedagogical technologies in early childhood education.

- Analyze the theoretical underpinnings of the identified studies to gain a deeper understanding of the conceptual frameworks guiding the integration efforts.

- Identify recurring patterns, emerging trends, and gaps in the literature to inform the comparative analysis.

Synthesis is used for synthesize the information obtained from the content analysis and individual studies into a coherent theoretical framework. The procedures of its application consist of:

- Integrate the findings from different sources to develop a comprehensive synthesis of the theoretical perspectives on integrating pedagogical technologies in early childhood education.

- Identify commonalities, contradictions, and areas requiring further exploration.

- Develop a theoretical model that encapsulates the synthesized knowledge and provides a conceptual framework for understanding the integration of innovative pedagogical technologies.

The main objective of Comparison is to compare and contrast the various theoretical models and approaches identified in the literature. The procedures of its application consist of:

- Conduct a systematic comparison of the integrated theoretical models and strategies for incorporating innovative pedagogical technologies into early childhood education training programs.

- Highlight similarities and differences in theoretical frameworks, implementation strategies, and outcomes.

- Analyze the implications of these comparisons for the effective integration of pedagogical technologies in the context of early childhood education.

The adoption of these research methods will facilitate a rigorous examination of the theoretical foundations of integrating innovative pedagogical technologies into early childhood education training programs, providing valuable insights for educators, researchers, and policymakers in the field.

Results

The integration of innovative pedagogical technologies into early childhood education training programs is a crucial aspect of educational development in the European context (BUDNYK, 2019). Ensuring a well-prepared stage for educators working with young children is vital for providing quality education and fostering children's development during this critical age. In this context, updating the content of early childhood education programs to incorporate modern pedagogical

technologies is essential. This includes integrating digital resources, online materials, virtual games, and other innovative tools to enhance the curriculum and training. Specialized courses and training sessions should be included in the education of early childhood educators, offering them competencies in utilizing innovative technologies. Partnerships with higher education institutions and experts in the field can facilitate the incorporation of such specialized training. At the same time, utilizing interactive platforms and online resources targeted at developing specific skills and knowledge for teachers is crucial. This may involve video lessons, webinars, interactive assignments, and other means of delivering effective learning experiences (FOJTIK, 2014). Moreover, incorporating practical experience with the use of innovative technologies into teacher training programs is essential. Collaborations with contemporary childcare centres and educational facilities can provide future educators with hands-on experience in implementing these technologies.

At the same time, modern scholars believe that, emphasizing the development of digital literacy among early childhood educators should be a focus of training programs (MASOUMI, 2020). This ensures their ability to effectively use innovative technologies and integrate them into their teaching practices. Establishing mechanisms for monitoring and assessing the effectiveness of technology integration in training programs is crucial. This may involve collecting data on teacher performance and assessing the learning outcomes of children. In addition, encouraging the creation and dissemination of innovative educational resources for teachers and children is essential. This could involve developing pedagogical programs, mobile applications, virtual games, and other digital tools to enhance the learning experience.

Therefore, the integration of innovative pedagogical technologies into early childhood education training programs in Europe is vital for preparing educators to meet the challenges of the modern world and ensuring children receive a quality and effective education (PINO-PERDOMO, 2023). Within modern European education, one of the most popular innovative technologies is play based learning – a pedagogical approach that plays a significant role in early childhood education,

particularly in preschool settings (UNDHEIM, 2021). It is a learner-centered method that recognizes the importance of play in children's cognitive, social, emotional, and physical development. Play-based learning acknowledges that play is not just a recreational activity but a fundamental process through which young children explore, make sense of their surroundings, and build essential skills. In preschool settings, educators leverage the power of play to create dynamic and interactive environments that spark curiosity and engagement. By fostering a sense of joy and excitement in learning, play-based education establishes a solid foundation for a child's lifelong love of exploration and discovery. Therefore, the play-based learning is a valuable pedagogical approach that holds significant importance in the context of early childhood education training programs (See Table 1).

Table 1 – Key aspects of play-based learning in the context of early childhood education training programs

Aspects	Description
Understanding the role of play	Early childhood education (ECE) training programs should emphasize the understanding of play as a central component of early childhood development. Future educators need to recognize the value of play in fostering cognitive, social, emotional, and physical skills in young learners.
Holistic development focus	Play-based learning in ECE emphasizes holistic development. Training programs should guide future educators on how play activities contribute to various aspects of a child's growth, including language acquisition, motor skills, problem-solving, and social interaction.
Observation and assessment skills	Future educators need to develop strong observation and assessment skills to understand the nuances of play-based learning. Training programs should provide guidance on how to observe children during play, assess their developmental progress, and tailor activities accordingly.
Creating playful learning environments	Training programs should equip future educators with the knowledge and skills to create environments that support play-based learning. This involves designing classroom layouts, selecting appropriate materials, and fostering a positive and engaging atmosphere for play.
Facilitating learning through play	Future educators must learn how to facilitate learning through play rather than direct it. Training programs should teach strategies for guiding and scaffolding play experiences, allowing children to explore and discover while providing support when needed.
Incorporating learning objectives	Play-based learning should align with learning objectives. Training programs should help students integrate educational goals into play activities, ensuring that children are exposed to age-appropriate content while engaging in enjoyable and meaningful experiences.
Understanding types of play	ECE training programs should cover the various types of play, including dramatic play, constructive play, and cooperative play. Students need to understand the benefits of each type and how to incorporate them into the curriculum.

Source: author's development.

By addressing these key aspects, early childhood education training programs can empower educators to effectively implement play-based learning strategies, creating enriching educational experiences for young children (KEWALRAMANI et al., 2020).

At the same time, assessment in game-based learning takes place through constant observation. Future educators must learn to monitor children's progress, identify strengths and areas for improvement, and use this information to shape their future teaching strategies. Thus, play-based learning in preschool education recognizes the inherent value of play in children's development. It provides a holistic and child-centred approach that nurtures a love of learning, social skills, creativity and the foundational knowledge needed for future academic pursuits.

Another important technology is project-based learning (PBL). It is a dynamic and student-centered pedagogical approach that holds significant potential in the integration of innovative pedagogical technologies into early childhood education training programs. In this context, PBL serves as a framework for educators to harness the benefits of technology in fostering critical skills and knowledge in young learners. Therefore PBL plays a crucial role in preparing future early childhood educators. This teaching method is actively incorporated into pedagogical training programs to create an effective environment where students have the opportunity to develop key skills and gain pedagogical experience (LUCENKO, 2022). Table 2 highlights the main aspects of using this technology in the preparation of early childhood educators.

Table 2 – Key aspects of using project-based learning in the preparation of early childhood educators

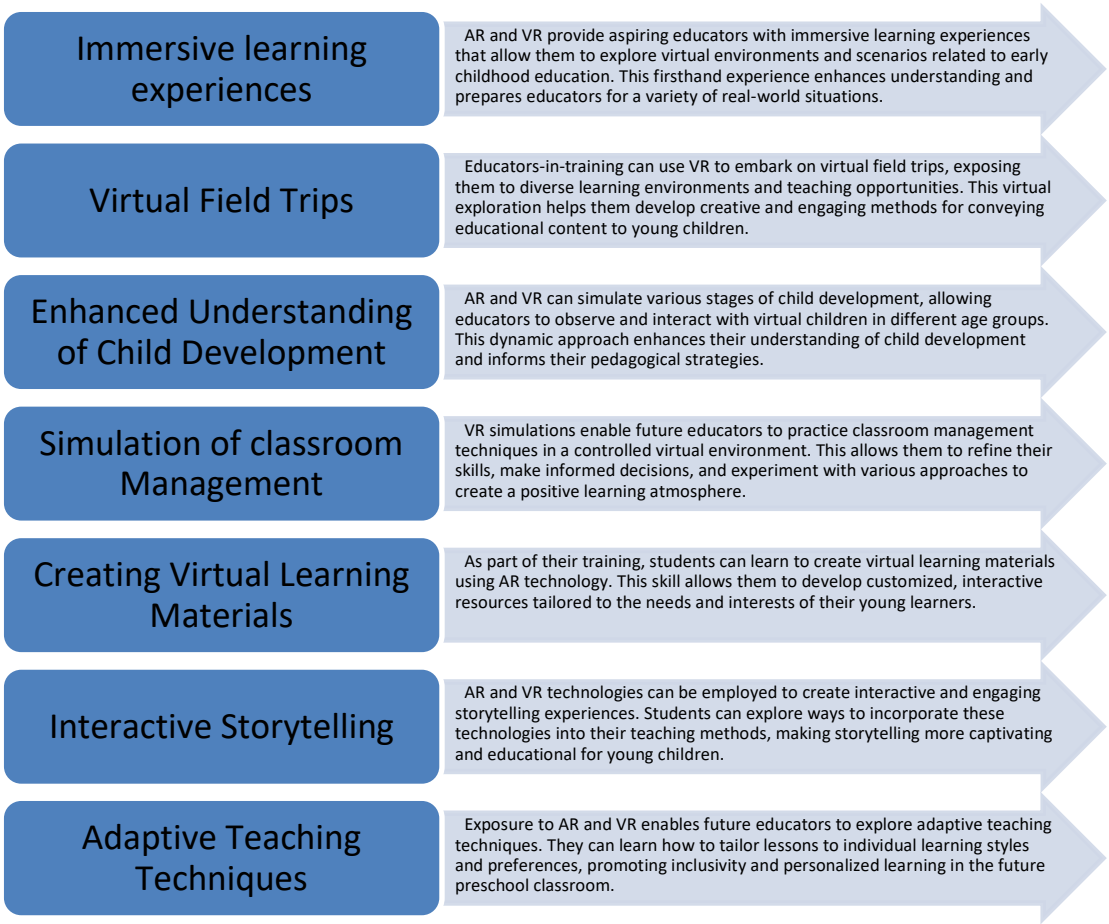
Aspects	Description
Real-world contextual tasks	PBL provides educators-in-training with the opportunity to create educational projects that replicate real-world situations they may encounter in their future roles. This helps students understand how to apply theoretical knowledge in practical pedagogical contexts.
Development of critical thinking	PBL fosters the development of critical thinking skills in students. They learn to analyze information, make decisions, and solve problems, essential skills for educators working with children.
Collaboration and communication	Project-based learning actively supports collaboration and communication. Students work in teams, exchanging ideas, and exploring pedagogical concepts together.
Adaptation to change	PBL develops students' skills in adapting to changes and unexpected situations, crucial in the field of education, particularly with younger children.
Preparation for innovation	Students engaging in PBL receive preparation for using innovative teaching methods, including the integration of technologies and other modern pedagogical approaches.
Experience in play-based environments	PBL allows students to gain experience in creating play-based environments, a critical element in early childhood education. They learn how to use play to stimulate learning and development in young children.
Integration of learning objectives	PBL ensures that learning objectives are integrated into projects, aligning theoretical knowledge with practical skills. This connection is essential for preparing educators who can effectively apply their learning in diverse educational settings.

Source: author's development.

Therefore, project-based learning in early childhood education training programs empowers students with practical skills, collaborative abilities, and the adaptability needed for successful careers as early childhood educators.

Augmented reality (AR) and virtual reality (VR) are cutting-edge technologies that hold immense potential in enhancing early childhood education training programs. These immersive technologies offer unique opportunities to engage learners in interactive and stimulating educational experiences. The integration of AR and VR in the preparation of early childhood educators represents a transformative approach to teacher training, offering immersive and innovative experiences (ROMERO-TENA, 2020). Figure 1 highlights a scheme of how AR and VR can be integrated into the training of preschool educators.

Figure 1 – Scheme of integration of AR and VR into the training of preschool educators

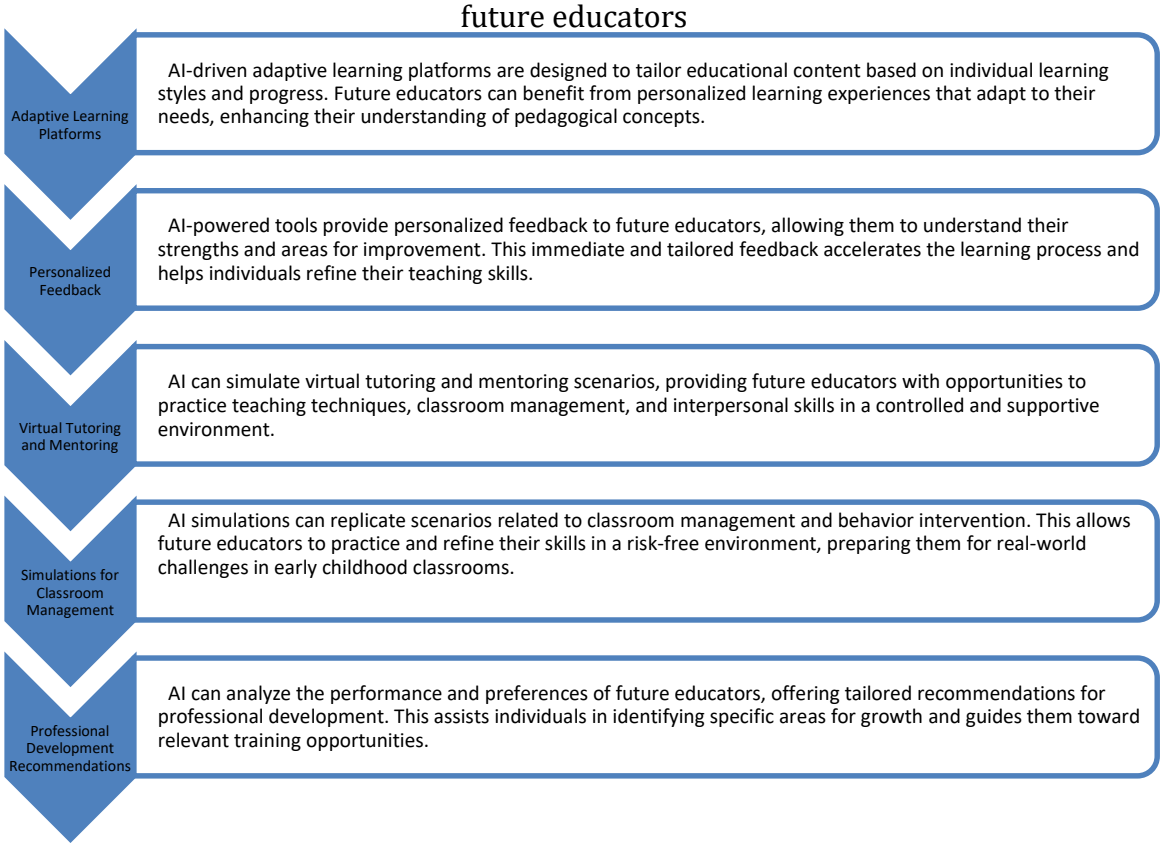


Source: author's development.

Incorporating AR and VR into the training of early childhood educators improves their skills, expands their creativity, and enables the use of new technologies to create engaging and effective learning environments for young children, positioning them to perceive the evolving educational technology landscape. By becoming adept at incorporating augmented and virtual virtuality into their teaching methods, these educators are better equipped to nurture a generation of digitally literate and inquisitive young learners who can thrive in the increasingly technology-enhanced real world (YI et al., 2024). Therefore, integrating this technology into the training program of future educators not only improves their teaching skills, but also gives them the opportunity to ignite curiosity, creativity and a love of learning in the hearts and minds of the children they will later teach in their classrooms.

Another important modern technology is artificial intelligence. Incorporating artificial intelligence – based tools into preschool teacher training curricula offers a number of advantages in using advanced technology to enhance the learning experience (HERRO et al., 2021). Thus, they contribute to the formation of an adaptive learning experience, the creation of new feedback, the use of personalized learning tools, data analysis, etc. Figure 2 presents an overview of the use of artificial intelligence in the system of training future educators.

Figure 2 – Overview of the use of artificial intelligence in the system of training future educators



Source: author's development.

While the integration of artificial intelligence into early childhood education training programs brings numerous advantages, ethical considerations, data confidentiality, and a thoughtful approach to technology implementation are crucial for ensuring responsible and effective use in the educational context. There are ethical questions associated with the use of artificial intelligence in education. Educators need to be aware of the impact of technology on children's development and consider ethical norms in the selection and use of digital tools. Given that the collection and processing of personal data are integral to the use of artificial intelligence, educators must be familiar with how this data is utilized, ensuring that the confidentiality and privacy of children remain secure (NIKOLOPOULOU, 2021). Moreover, it is essential for educators to adopt a thoughtful approach to implementing digital technologies in the learning process. This involves not only

choosing appropriate tools but also creating effective strategies for using these technologies to achieve specific educational goals.

Thus, the integration of modern technologies into training programs for preschool teachers brings undeniable advantages. These technological tools offer innovative ways to enhance pedagogical skills, foster creativity, and prepare educators for the dynamic demands of early childhood education (PIRES PEREIRA et al., 2021). However, it is essential to acknowledge that none of these technologies is perfect, and their incorporation into the teacher training system necessitates a nuanced understanding of their strengths and weaknesses. Educators engaging with these technologies should be equipped with the knowledge to critically evaluate their effectiveness in various contexts (SULLIVAN and MCCARTNEY, 2017). Awareness of potential limitations is crucial to ensure that technology serves as a valuable complement to traditional teaching methodologies rather than a replacement.

The strengths of modern technologies lie in their ability to provide personalized learning experiences, simulate real-world teaching scenarios, and offer adaptive feedback. These tools can engage future educators in interactive and immersive learning, preparing them for the complexities of the classroom environment. On the other hand, it is imperative to recognize the potential weaknesses and challenges associated with technology integration. These may include issues related to data privacy, ethical considerations, and the risk of over-reliance on technology at the expense of human interaction and intuition. Table 3 shows the final comparative analysis of the integration of these technologies in training programs for future educators. This analysis considers the strengths, weaknesses, threats, and opportunities of each technology.

Table 3 – The final comparative analysis of the integration of these technologies in training programs for future educators

Play-based learning	
Strengths Holistic development Engagement	Addresses cognitive, social, emotional, and physical aspects simultaneously. Fosters active participation and enthusiasm in learning activities.
Weaknesses Guidance dependency Subjectivity	Requires effective guidance to align play activities with specific learning objectives. The interpretation of play activities may vary, making it challenging to measure learning outcomes objectively.
Opportunities Creativity enhancement Aocial interaction	Provides opportunities to enhance creativity and imaginative skills in both educators and children. Supports the development of social skills through collaborative play.
Threats Limited structure	Without proper guidance, play-based learning may lack structure, potentially leading to less focused educational outcomes.
Project-based learning	
Strengths Real-world skills Practical application	Cultivates critical thinking, collaboration, and problem-solving skills. Provides hands-on experience in applying theoretical knowledge.
Weaknesses Varying engagement levels Resource intensive	Engagement may vary based on the chosen project topics. Requires effective planning and resource management.
Opportunities Interdisciplinary learning	Encourages exploration across multiple disciplines, fostering a holistic approach.

Community engagement	Opens opportunities for community involvement and real-world application.
Threats Time constraints Limited resources	The time required for comprehensive project-based learning may pose challenges in a structured curriculum. Some projects may require resources that are not readily available.
Augmented reality and Virtual reality (AR/VR)	
Strengths Immersive learning Diverse learning styles	Provides interactive and immersive learning experiences. Caters to diverse learning preferences through visual and interactive elements.
Weaknesses Resource intensiveness Distraction potential	Can be technology-intensive, requiring access to specific devices. May pose distractions if not used judiciously.
Opportunities Simulation Remote learning	Realistic simulations for practical skill development, especially in areas like classroom management. Facilitates remote and virtual learning experiences.
Threats Limited access Ethical concerns	Disparities in technology access may create inequalities among trainees. Privacy issues and ethical considerations regarding virtual environments and data usage.
Artificial intelligence (AI)-powered tools	
Strengths Personalized learning Immediate feedback	Provides adaptive learning experiences tailored to individual needs. Offers immediate feedback, enhancing the learning process.

Weaknesses Privacy concerns Continuous updates	Raises concerns about data privacy and ethical considerations. Requires regular updates to keep up with evolving educational standards.
Opportunities Global collaboration	Enables collaboration with educators worldwide for knowledge-sharing.
Threats Resistance to change Bias in AI	Educators or institutions resistant to technological change may hinder the effective adoption of AI-powered tools. Potential biases in AI algorithms may impact the fairness of personalized learning experiences.

Source: author's development.

In navigating these nuances, training programs can maximize the strengths, mitigate weaknesses, capitalize on opportunities, and address threats, ensuring a comprehensive and balanced integration of these innovative pedagogical technologies into the preparation of future preschool teachers.

While integrating innovative pedagogical technologies is gaining traction in early childhood education, achieving widespread adoption encounters certain challenges, notably limited resources and the need for enhanced pedagogical training. However, encouraging progress is evident through initiatives such as pilot programs that leverage technology for educational content delivery and interactive learning platforms. In developed countries such as the United States, the United Kingdom, and Finland, innovative pedagogical technologies like project-based learning and AR or VR hold a more prominent place in educational practices. Governments and educational institutions in these countries are actively involved in providing essential resources and support mechanisms for teachers to effectively incorporate innovative pedagogical technologies into their teaching methodologies (RAHIEM, 2021). Therefore, it is important to single out the main recommendations for the use of educational programs based on modern technologies in the system of training teachers of preschool institutions. First, they should be oriented towards comprehensive pedagogical training. We are talking about the development of

specialized educational modules for future teachers, which involve the effective use of innovative pedagogical technologies. Practical seminars and practical classes are an important aspect. They should occupy an important part in the training of future educators. Another important aspect is the establishment of national standards for the integration of innovative technologies into training programs. It is proposed to implement standardized guidelines to ensure consistency, quality and a uniform approach across all educational institutions. Teacher training and professional development are also important. Comprehensive teacher education programs that focus on practical skills and knowledge related to the effective use of pedagogical technologies should be prioritized and continuing professional development opportunities should be provided to keep educators abreast of the latest advances in pedagogical technologies. It is also important to develop international cooperation, by establishing partnerships with countries that have successfully integrated technologies into their education systems and to promote the exchange of best practices, research results and innovative approaches to improve the effectiveness of this integration.

Discussion

The obtained results indicate that the integration of innovative pedagogical technologies into the training programs of preschool educators opens new perspectives for improving the quality of education and preparing future teachers for the challenges of the modern educational environment. With the help of a comparative analysis of key IPTs, the unique advantages and features of each approach are highlighted, as demonstrated in the works of other scientists.

Starting with the work of BOICHENKO (2022) on creative activity at higher education institutions, this study aligns with their emphasis on creativity in education. Both studies recognize creativity as a fundamental aspect of effective pedagogy, highlighting the importance of fostering innovative thinking in educational settings. This research builds upon their insights by specifically exploring how innovative pedagogical technologies contribute to nurturing

creativity in early childhood education training programs. This focused approach allows to delve deeper into the practical implications and strategies for incorporating creative elements into the training of future educators.

LUTSENKO (2022) in his work on using the project method for developing the creative potential of primary school children in Ukraine, is in agreement with the importance we attribute to creativity in early childhood education. Також варто погодитися із цим вченим, що project-based learning develops practical skills, critical thinking, and fosters collaboration by bringing learning into the real world (LUCENKO, 2022).

CHRISTOPOULOS and SPRANGERS (2021) focus on the integration of educational technology during the Covid-19 pandemic. While their study has a broader scope, we share common ground in acknowledging the pivotal role of technology in modern education. This research contributes to this discourse by specifically exploring the integration of innovative technologies in early childhood education training programs.

On the other hand, the results obtained confirm the confirmed CHRISTOPOULOS and SPRENGERS (2021) that even tools that can be customized may be inappropriate or inadequate for widespread (national) adoption. This statement seems to suggest a generalization based on an analysis of students' views on adoption. digital education systems. Although research recognizes the diverse benefits and needs of students in using digital learning tools, it is important to consider that the appropriateness and adequacy of such tools may depend on many factors, including the specific context, educational goals, and the evolution of technology.

At the same time, it is worth agreeing with Undheim's opinion about the importance of digitalization in modern preschool education. These introduced claimed that digital technologies are an integral part of the educational process. However, the author of this study proved that it is impossible to idealize digitalization changes in education, since the use of digital technologies in preschool education can have both its advantages and certain difficulties (in particular, the perception of the technologies themselves or the unpreparedness of teachers).

LASAUSKIENĖ's (2015) work on the development of general competencies within the context of teacher training aligns with our consideration of pedagogical technology's impact on overall competency development. The correlation between our findings and their emphasis on teacher training further supports the significance of our research in shaping effective early childhood education programs.

The benchmarking also highlights challenges, from dependence on leadership and the need for structure in play to varying levels of interest in project-based learning. AR/VR technologies can require significant resources and raise additional ethical issues. The use of AI requires careful consideration of privacy and ethical considerations, as outlined in the study MUMCU et al. (2022).

It follows from the recommendations that the establishment of national standards, comprehensive teacher training, access to resources and international cooperation are key elements for the successful integration of IET into teacher training programs (LASAUSKIENĖ et al., 2015; MUMCU et al., 2022). This deep and balanced approach allows realizing the great potential of IPT, preparing the pedagogical corps of preschool education for the development and use of modern technologies in the education of the new generation. By adopting these recommendations, education systems can nurture a generation of educators who can navigate the changing landscape of early education in a technological world.

Conclusions

In conclusion, the goal of integrating innovative pedagogical technologies into early childhood education training programs has been explored, revealing distinctive strengths and considerations for each approach. The study found that play-based learning excels in fostering holistic development and engagement, while project-based learning emphasizes real-world skills, AR/VR offers immersive experiences, and AI-powered tools provide personalized learning. However, resource challenges, ethical considerations, privacy issues, and resistance to change pose hurdles.

To address these challenges, the following recommendations are proposed:

1. It is neccessary to implement resource-efficient strategies for play-based learning, moderate resource management for project-based learning and AI-powered tools, and address technology-intensive needs for AR/VR.

2. It's better to Tailor guidance and planning requirements according to the nature of each pedagogical technology, recognizing the varying emphasis on social interaction.

3. Worth noting is the imperative to establish national standards for the integration of innovative technologies.

4. It is vital to provide comprehensive teacher training programs and facilitate resources to ensure the successful implementation of these technologies.

5. Additionally, fostering collaboration on a global scale is crucial to share best practices, provide access to technology, and promote ongoing professional development.

In acknowledging that the integration of innovative pedagogical technologies is a dynamic endeavor, continuous adaptation and commitment are essential for enriched learning experiences and the development of future-ready educators.

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