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Redefining experiential learning: AI-Driven Virtual Reality (VR) Role Playing Games (RPGs) for personalized learning in Education

Christina Gatsakou [1, 3, *], Nikolaos Bardis [2], Charalabos Skianis [1] and Athanasios Drigas [3]

[1] *Department of Information and Communication Systems Engineering (ICSD) University of the Aegean, Greece.*
[2] *Hellenic Army Academy, Greece.*
[3] *Net Media Lab, IIT, NCSR "Demokritos", Greece.*

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Abstract

The purpose of this article is to explore an innovative teaching approach through the integration of Artificial Intelligence (AI) with Virtual Reality (VR) Role Playing Games (RPGs) to promote personalized learning, elevating experiential learning to a higher level. Based on the Experiential Learning Theory (ELT) and by leveraging AI's capabilities alongside VR's immersive environments in a gamified setting (RPGs), this approach will address the gaps in the traditional teaching methods. Moreover, this article examines the role of AI, VR-RPGs in Education separately and what are the benefits of combining the aforementioned technologies and gaming based setting respectively, creating a different perspective of teaching and learning. Through a comprehensive analysis, this article highlights the transformative potential of integrating AI, VR, and RPGs to redefine the educational landscape and the four-stage of Kolb's experiential learning theory.

Keywords: Experiential learning; Artificial Intelligence (AI); Virtual Reality (VR); Role Playing Games (RPGs); Personalized Learning

1. Introduction

In an era where education evolves to meet the demands of the 21st century, conventional teaching approaches often fall short in fostering meaningful and engaging learning experiences. The rapid growth of technology has revolutionized the field of education as it provides educators with innovative tools to enhance and empower the learning procedure at multiple levels. Technologies like Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), Gamification, Robotics, and Coding provide novel ways to engage learners, personalize learning experiences, and empower teamwork in both educators and learners [1]. The importance of all digital technologies in the field of education is highlighted at this point. ICTs support universal access to education, provide innovative approaches for effective teacher training, enhance learning retention, promote cooperation, increase openness, develop learner-centered approaches, and hasten the process of learning. Additionally, by using virtualization, mobilization, artificial intelligence, and new learning environments like virtual worlds, support educational activities and methodologies. More specifically, ICTs are very effective and productive in personalized training, facilitating and improving the assessment, intervention, and educational procedures via mobile devices that bring educational activities everywhere [29] and through a variety of ICT applications that serve as the backbone of education [30-33]. The use of AI, STEM, and robotics raises educational practices to new levels of flexibility, innovation, and performance [34-35], while games turn education into a multimodal, incredibly amiable, and pleasurable engagement [36]. Moreover, the adoption, improvement, and fusion of ICTs with theories and models of metacognition, mindfulness, meditation, and emotional intelligence cultivation [37-

* Corresponding author: Christina Gatsakou

43] places the development of mental abilities at the center of educational procedures and policies, which accelerates and improves educational practices and outcomes, particularly in experiential learning domain.

These technologies serve as invaluable tools for the new era of education not merely in teaching school or academic subjects but also providing opportunities for personalized and experiential learning. By integrating AI-driven VR RPGs into educational settings, it is possible to create dynamic, student-centered experiences that promote both cognitive and emotional development.

Experiential learning emphasizes the importance of active participation and reflection in the learning process [2] Recent studies suggest that gamified learning environments with immersive technologies, can significantly enhance motivation and knowledge retention. [3,4] The use of AI in these environments further allows for adaptive personalization , tailoring the content and challenges to individual learner's needs and abilities [5] . On the other hand VR provides a multisensory, immersive experience that transcends the limitations of traditional classrooms, enabling learners to explore complex concepts in a risk-free and engaging manner. [6]

In modern times, it is challenging for educators to effectively address and meet the individual educational needs of each student, as the demands placed on both teachers and learners have significantly increased. Acknowledging the individuality and diverse needs of each learner, a flexible and tailored approach to teaching and learning various subjects, skills and emotional intelligence becomes crucial, particularly when real-life experiences facilitate the achievement of desired outcomes. There are various factors that may affect students' learning but it is of utmost importance to understand differences in learning styles, approaches to learning, and levels of intellectual development. By recognizing these variations, educators can better address the unique needs of their students. [7]

The implementation of an approach that integrates Artificial Intelligence (AI) and Virtual Reality (VR) in a more engaging and immersive RPGs -based environments could be the trajectory of experiential learning in future education. By combining the aforementioned tools, a multisensory teaching tool is created that encourages deep understanding and the practical application of the desired outcomes in various fields.

The focal points of the Experiential Learning Theory (ELT) will be coarsely presented as well as the role of each of the two core technologies (AI and VR) and RPGs in education, investigating their synergistic potential. By exploiting the adaptability of AI and the immersive capabilities of VR, this approach aims to bridge the gap between theoretical knowledge and practical application.

Experiential learning theory

The Experiential Learning Theory is D.A. Kolb's theory posits that learners acquire knowledge through experience. D. A. Kolb based his work on three prominent approaches of John Dewey, Kurt Lewin, and Jean Piaget. ELT emphasizes the role that experience plays in the learning process and also pursues the intellectual and emotional stimulation of the learner as it aims to integrate the mental and emotional process. "Knowledge results from the combination of grasping and transforming experience"[2]. His theory operates on two axes: a four-stage cycle of learning and four separate learning styles.

The first axis is a four-stage cycle:

- Concrete Experience
- Reflective Observation
- Abstract Conceptualization
- Active Experimentation.

Therefore, there is a new experience of a situation or a reinterpretation of an existing experience that leads to a new experience and understanding while the reflection arouses new ideas or even the modification of an already existing abstract concept, so the learner applies them to the world around and sees the results. For instance, if a student is learning a new language, they might first immerse in a real conversation (Concrete experience), then reflect with the challenging phrases (Reflective Observation), devise strategies for improvement (Abstract Conceptualization)and finally practice again with new methods (Active Experimentation)

The second axis is a group of learning styles comprised of:

- Diverging (feeling and watching)
- Assimilating (watching and thinking)
- Converging (doing and thinking)
- Accommodating (doing and feeling)

Undeniably, in every classroom every educator will encounter learners with these learning styles and it would be ideal if there was an approach that could enclose and satisfy all of them. Educators often try a mixed methodology, incorporating digital tools and hands-on activities in order to embrace diversity and enhance inclusivity effectively.

David A. Kolb (1984), claims that "When learning is conceived as a holistic adaptive process, it provides conceptual bridges across life situations such as school and work portraying learning as continuous, lifelong process". To understand what learning is, we must first sense the nature and the forms of human knowledge and processes whereby this knowledge is created. He conjectures that "Knowledge is the result of the transaction between social knowledge and personal knowledge".

From an early age, we learn things and we acquire knowledge from the environment and everything that surrounds us. We never stop learning and everything that is a personal acquired experience is transforming into knowledge. In this context, it is important to note that experiential learning is not a molecular educational concept but rather is a molar concept describing the central process of human adaptation to the social and physical environment. [2]

In this context, this approach emphasizes 'learning by doing', making it especially effective for skill-based education and personalized learning. The integration of VR, AI, and gamification seems to align with ELT while these technologies facilitate experiences and encourage reflection and adaptation. AI-driven adaptive systems can dynamically tailor learning experiences to individual needs, while VR offers immersive, multi-sensory environments that promote experiential learning. [8]

2. Personalized learning: artificial intelligence's role in education

AI was first coined by John McCarthy in 1956 during the Dartmouth Conference, marking a notable beginning of a revolutionary era in computing and technology. The term was used to delineate the field of study and research that aimed to create machines which can behave with intelligence. AI has evolved into a transformative tool and its application in education in 1990's met success with the systems like Intelligent Tutoring Systems (ITS) breeding ground for personalizes experiences [9]

Personalized learning, a cornerstone of AI in education, is a pedagogical approach that tailors instructional content, pace, and assessment to meet the specific needs of each learner.[10] This allows customized learning and adaptability that ensures that learners are entirely engaged, remain challenged and the learning outcome is optimal.

AI empowers personalized learning by adapting educational content and delivery methods in order to meet the unique needs of each learner. For instance platforms like DreamBox and Carnegie Learning analyze student's performance in real time adjusting the lessons depending on the strengths or weaknesses.[11] Moreover, platforms like OpenEdX, developed by Harvard and MIT, offer personalized course recommendations by analysing learner data to identify strengths and areas for improvement. Similarly, Coursera uses AI to assess progress and adjust learning paths dynamically, enhancing focus and accelerating learning. Duolingo applies AI to customize exercises and lessons based on user performance, ensuring appropriate challenges. [12]

Ultimately, the use of Artificial Intelligence (AI) in education opens up vigorously multiple simultaneous possibilities such as personalization, real time feedback, automation of repetitive tasks, analysis of learners needs and the ability to adapt to the pace and needs of each learner. [8] Thus, one of the key AI's contributions, is its capability of real-time feedback. Systems as Grammarly, GPT Zero among others assist learners to evaluate and redefine their performance instantly, providing at the same time suggestions, repetitive tasks and explanations.

3. Virtual reality and immersion in education

Immersion is the key component of the experiential learning and Virtual Reality (VR) by simulating real-world scenarios creates immersive environments. VR enables learners to practice skills in a safe and risk -free setting.

More specifically, the use of VR boosts the educational process by providing realistic visualization and interactivity in any possible setting contextually depending on the specific educational objectives/goals. Furthermore, VR can allow the observation and analysis of learners' reactions for the purpose of training them for improvement. Finally, by its nature VR is immersive, helping to enhance focus and effectiveness of learning.

Virtual Reality (VR) technology has become increasingly popular teaching and learning support tool across different disciplines. [13]

4. VR -RPGs In education: a review of applications and potential

The integration of VR RPGs into educational procedure has emerged as an novel approach to experiential learning, increasing student engagement and comprehension. VR RPGs combine the immersive experience of virtual reality with the interactivity of RPGs, providing new opportunities for educational use in various fields and contexts.

A recent study introduces an immersive VR-RPG specifically designed to educate players about the behaviour of honeybees. Players assume the role of a honeybee while they navigate to a virtual environment that simulates real-world bee activities. This approach offers ecological awareness and understanding through experiential learning. [14] An experience that could only be possible via Virtual Reality.

Another interesting study investigate the educational potential of a VR-RPG developed to teach construction engineering concepts. Its findings propose that such kinds of games can enhance students' deep understanding of technical subjects and involve them actively in the learning procedure. [15]

Moreover, a review of trends in educational VR games emphasizes their potential to deliver interactive and immersive experiences to a range of different age groups. These games offer opportunities to students in order to engage in depth with content, taking into account both learning and enjoyment. [16]

Another systematic review analyses the incorporation of VR and Gamification in educational process and indicates that these technologies can boost students' engagement and facilitate personalised learning experiences. The study underscores the value of VR in creating tailors educational environments. [17]

Furthermore, in the past months a research on the impact of VR on student engagement in classroom points out how VR can improve cognitive, behavioural and emotional engagement, specifically benefiting students with learning disabilities. Also, some serious matters have been aroused such as the need for the improvement of digital literacy and teacher proficiency. [18]

As an additional point, another research examines design strategies for VR educational games from an instructional perspective. The findings indicate that VR can have a moderately positive impact on learning outcomes, especially when instructional design principles are applied effectively. This highlights the significance of aligning educational content with game mechanics. [19]

In light of the above, it is clear that implementing VR-RPGs in education provides the potential to reshape and transform traditional teaching methods by providing unique experiences through realistic simulations that enhance creativity and critical thinking. Educational system can exploit these tools to offer engagement, interactivity, motivation and deep understanding.

5. Implementation of AI-Driven VR-RPGs in Education

The integration of AI and VR in education is a promising field of research with significant potential. However, the development of AI-driven VR RPGs specifically designed for educational purposes seems to be still in its infancy. Current research and application focus on combining AI and VR to create immersive and personalized learning experiences, though not necessarily within the RPG framework.

A study published in 2022, explores the influence of AI and VR on students' interest in art education. The findings indicates that introducing these technologies into art education and encouraging students in deep learning can significantly improve their interest and engagement. [20]

Moreover, immersive learning technologies like VR, when combined with AI, allow for more personalized and engaging educational experiences, For instance, AI can take the form of a person in virtual simulations, offering interactive scenarios that evolve based in their responses. [21]

The integration of AI, VR- RPGs may represent the culmination of the use of technology in education. AI may analyze learner's data to personalize VR experiences, while RPGs enhance engagement and motivation. Literature has shown the positive impacts that these adaptive and immersive technologies could have on learning when applied in gaming contexts [22]. Furthermore, another recent research that was conducted concerning the application of AI in VR games concluded that the intervention of AI will transform VR games due to the explicit capabilities of AI. Firstly, AI can detect and analyze the behavior of the users and change the pace of the game accordingly. Secondly, AI has the capability to improve the game strategies in real time and automatically correct the defects based on data on game players. Thirdly, AI can gather any information on the content and assist with game improvements. Finally, AI technology can develop and improve to a lightweight equipment and more convenient designs. [23]

Under certain assumptions, and based on this context the combination of these adaptive and immersive technologies may lead to the rapid development of the field of education, in both learning and teaching. The transformative potential of AI-driven VR- RPGs in education is a promising research field where learning is not bound by traditional learning methods but driven by creativity, teamwork and innovation. [24] The development of AI-driven VR-RPGs for educational purposes remains a field open for further exploration.

6. Benefits of AI-drive VR-RPGs

Undoubtedly, the benefits of the adaptive immersive technologies in education are significant and multifaceted. By consolidating the positive impact and distinct benefits of each individual tool, we can conclude that the overarching advantages offered to education can be summarized as follows:

- Personalized Learning: Personalized education fundamentally departs from the traditional one-size-fits-all approach, prioritizing the unique needs and potential of each student. Delivering meaningful, engaging lessons that resonate on an individual level, it fosters deeper connections to learning. Leveraging advanced technology, educators can create adaptive experiences that enhance effectiveness, nurture growth, and prepare students for a lifetime of success.[25]
- Improved engagement: An AI driven VR in RPG framework undoubtedly will increase student motivation. A recent study [26] emphasized the positive correlation between gamification and learner engagement. Interactive VR environments captivate learners, making education more enjoyable and impactful.
- Risk -free skill development: Immersive technologies offer risk-free environments for practice. For instance, flight simulators allow aviation students to train under realistic conditions without real-world consequences. This fosters confidence and prepares learners for high-stakes scenarios [27]
- Inclusivity: It will definitely accommodate diverse learning styles, unique needs, preferences and abilities. Features like customizable difficulty levels and assistive technologies ensure that all students, including those with special needs, can benefit. This aligns with UNESCO's goals for inclusive education [20]

This comprehensive approach highlights the transformative potential of these technologies, underscoring their capacity to enhance learning experiences, foster innovation and address diverse educational needs.

Integration of KOLB's experiential learning theory with AI, VR - RPGs.

The potential educational platform will leverage AI, VR-RPG to apply in Kolb's four - stage cycle.

- Concrete Experience (CE): Learners will engage in realistic VR simulations via an RPG, in appropriate settings and they will experience scenarios as if they were real.
- Reflective Observation: Learners reflect on their VR experiences and AI assists by generating personalized feedback, data analysis, and guiding learners in identifying weaknesses and strengths.
- Abstract Conceptualization: The platform may uses AI to provide theoretical concepts from learner's experiences and learners may have access to resources and knowledge that fit to their needs.
- Active Experimentation: Learners through a gamified setting may apply their gained knowledge. VR as it was aforementioned offers a risk-free environment to act, while AI may adjust the difficulty or even context for further development.

7. Conclusion

The potential technology of AI-driven VR-RPGs outline a transformative approach to experiential learning. It redefines Experiential Learning by combining engagement, personalized learning and inclusivity and it addresses the limitations of the traditional educational methodology.

This approach not only enhances motivation and engagement but also empowers deeper learning and understanding as it offers a unique and holistic learning experience. AI-driven adaptive systems can tailor learning experiences to individual needs, while VR offers immersive multisensory environments that promote experiential learning. It empowers learners to thrive in a rapidly evolving world. Furthermore, the integration of AI and VR fosters innovation, and learners through virtual environments solve complex problems, and develop their skills and themselves.

By combining and integrating AI and VR-RPGs into Kolb's ELC, is a novel approach that redefines the experiential learning in future technological terms.

Ultimately, the synergy of these technologies connect the gap between theorical knowledge and practical application in cognitive and emotional development and provides personalized learning characteristics as well as engagement and effectiveness of the learning process. This paper presents a promising direction for ongoing research in this field. Future work will involve prototyping and evaluating a possible platform in educational environment.

Compliance with ethical standards

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Disclosure of conflict of interest

The Authors proclaim no conflict of interest.

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