

Digital Games in Education: An interdisciplinary view

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Abstract

Digital games have emerged as a promising tool in educational settings, offering engaging and interactive experiences that improve student motivation and learning outcomes. This paper explores the interdisciplinary nature of the use of digital games in education, highlighting their potential impact across disciplines and subject areas. Drawing on literature from fields such as psychology, education, computer science, and game design, we examine the key elements of game-based learning, including serious games, gamification, game mechanisms, and player experience. We also discuss the criteria for selecting games in educational contexts and provide practical recommendations for finding and modifying games to meet specific learning objectives. We also provide examples of games that can be used effectively across disciplines, including science, mathematics, computer science, and social science. Through this interdisciplinary lens, we emphasize the importance of integrating digital games into educational practices to foster student engagement, critical thinking, problem solving, and collaboration skills. By embracing the potential of digital games, educators can harness their transformative power to create dynamic and immersive learning environments that prepare students for the challenges of the 21st century.

Keywords: Classroom, digital games, education, gamebased learning, gamification, puzzle games, serious games, simulation games, role-playing games, strategy games, language learning games, sandbox games

1. Introduction

In recent years, digital games have received considerable attention as a promising tool for improving education. The interactive and immersive nature of games has the potential to engage students, promote active learning, and foster a range of skills and competencies. This paper examines the

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multifaceted role of digital games in education, exploring their interdisciplinary nature and their impact on student engagement, motivation, and learning outcomes.

The integration of digital games into educational settings represents a paradigm shift in traditional pedagogical approaches. By leveraging the inherent elements of games, such as challenges, rewards, and interactivity, educators can create dynamic learning environments that resonate with today's digitally native students. Games have the ability to transform learning into an engaging and meaningful experience that transcends disciplinary boundaries and provides opportunities for experiential and inquiry-based learning.

To fully understand the potential of digital games in education, it is essential to explore the various concepts and frameworks that underpin their effectiveness. This paper draws on research from a variety of fields, including psychology, education, computer science, and game design, to provide a comprehensive overview of the interdisciplinary nature of game-based learning. We explore the concept of serious games, which are designed with a primary educational purpose, as well as gamification, which involves incorporating game-like elements into non-game contexts to increase user engagement.

In addition, this paper examines the importance of game mechanics and player experience in designing effective educational games. We explore how game mechanisms, such as points, levels, and feedback, can be used to motivate and engage learners, and we explore the concept of player experience, which encompasses the overall perceptions, emotions, and satisfaction that players derive from their interaction with games. By understanding these elements, educators can make informed decisions about selecting and modifying games to meet specific learning objectives and the needs of their students.

In addition, the paper discusses key criteria for selecting games in educational contexts. Factors such as educational goals, age appropriateness, engagement, challenge, feedback, usability, accessibility, cost, content appropriateness, and safety and privacy considerations are examined to ensure that games are appropriate and effective for their intended audience. In addition, this paper presents examples of games that can be used effectively in various disciplines, including science, mathematics, computer science, and social science. By highlighting these examples, we demonstrate how digital games can be seamlessly integrated into various subject areas to promote subject knowledge acquisition, critical thinking, problem solving, and collaboration.

Overall, this paper highlights the transformative potential of digital games in education. By embracing game-based learning approaches and adopting an interdisciplinary perspective, educators can harness the power of games to create engaging, immersive, and impactful learning experiences. By exploring key concepts, criteria, and examples, this paper aims to inspire educators to harness the educational benefits of digital games and prepare students for the challenges and opportunities of the digital age.

2. Why Games in Education?

We often hear about the potential of using games in the classroom, but it is important to understand why digital games should be incorporated into educational settings and what opportunities they bring to the learning environment. The purpose of this chapter is to explore the reasons for using digital games in education and the benefits they offer to students (Clark et al. 2023).

One of the key benefits of using digital games in education is their ability to engage and motivate learners. Games have an inherent appeal that captures students' attention and encourages their active participation in the learning

process. The interactive and immersive nature of games keeps learners engaged and focused, fostering a positive and enjoyable learning experience. Digital games also encourage active learning. Unlike traditional teaching methods that rely on passive reception of information, games require learners to actively participate and make decisions, which can improve their understanding and retention of new concepts. By actively engaging with game mechanisms and challenges, students become active contributors to their own learning process (Huang & Schmidt 2023).

Personalization is another advantage of digital games. Many games can be customized to meet the individual needs and preferences of learners. This customization allows students to progress at their own pace, receive personalized feedback, and address their specific learning gaps. By tailoring the learning experience to each student, digital games can foster a sense of ownership and empowerment in the learning process.

Collaboration is a critical skill in today's connected world, and digital games can foster this skill in students. Many games provide opportunities for teamwork and collaboration, encouraging students to work together, communicate, and solve problems collectively. By promoting collaboration, digital games not only enhance social skills, but also create an environment conducive to discussion, peer learning, and shared experiences.

Problem solving is another area where digital games excel. Games often present complex challenges and require critical thinking and problem-solving skills to progress. By engaging in gameplay, students develop these cognitive skills in an interactive and engaging way. Digital games provide a safe space for students to explore different solutions, learn from their mistakes, and develop resilience in tackling problems.

Finally, digital games provide intrinsic motivation for students. Games provide a sense of accomplishment, achievement, and progress as students overcome challenges and reach milestones. This intrinsic motivation fuels

students' desire to learn and encourages them to persevere in their educational journey.

In summary, digital games offer a number of benefits to students in the classroom. They increase engagement, improve retention, encourage collaboration and competition, allow for customization, and simulate real-world situations for practice. These benefits enhance students' skills, knowledge acquisition, and motivation to learn.

3. Serious Games

Serious games are designed specifically for educational, training, or social impact purposes. In this chapter, we will explore the key characteristics and potential benefits of serious games in various fields.

Serious games cover a wide range of applications in a variety of industries, including healthcare, education, defense, and business. These games are designed to leverage the engaging and interactive nature of digital games to create meaningful learning experiences. By integrating game mechanisms such as challenges, rewards, and feedback, serious games can effectively capture and maintain player attention and motivation.

One of the most notable benefits of serious games is their ability to provide a safe and controlled environment for players to practice skills, test hypotheses, and explore complex systems and scenarios. In a serious game, learners can experiment and make decisions without real-world consequences, allowing them to develop and refine their skills in a risk-free environment. This immersive and interactive nature of serious games enables learners to acquire knowledge and skills through hands-on experience (Peterson & Jabbari 2023).

Serious games can be tailored to meet specific learning objectives and outcomes. They can be designed to improve knowledge retention, problem solving, decision-making, and collaboration among players. By incorporating instructional strategies and learning principles into the game design, serious games provide a targeted and focused approach to learning that addresses the individual needs and learning styles of players (Min et al. 2022).

In summary, serious games are digital games designed for educational or training purposes to enhance learning through engaging and interactive experiences. They provide a unique platform for learners to acquire knowledge, develop skills and explore complex concepts in a controlled and enjoyable environment.

4. Gamification

Gamification is a powerful approach that integrates game-like features and mechanisms into non-game contexts to engage and captivate users. In this chapter, we will explore the key concepts and components of gamification, including its underlying motivations, game mechanisms, feedback systems, user experience, and the desired outcome of behavior change (Dai et al. 2023).

At its core, gamification uses the principles and elements of games to increase user engagement and motivation. By incorporating game-like features such as leaderboards, badges, points, and levels, gamification transforms mundane tasks or activities into interactive and enjoyable experiences. The goal is to tap into people's intrinsic and extrinsic motivations to actively participate and achieve desired outcomes (Harms 2022).

Game mechanisms play a critical role in gamification, providing the structure and rules that govern the gamified system. These mechanisms include elements such as points, badges, levels, challenges, and feedback

mechanisms. They serve to create a sense of progress, accomplishment, and competition that motivates users to continue their engagement and strive for improvement (Sotos-Martinez et al. 2023, Tay et al. 2023).

Feedback is an essential component of gamification because it provides users with information about their progress and performance. Positive feedback, such as rewards or recognition, reinforces desired behaviors and encourages users to continue their engagement. Conversely, negative feedback can serve as a corrective measure, guiding users toward more effective strategies or actions. By using feedback systems, gamification can shape user behavior and promote skill development and learning (Rüth et al. 2022).

User experience is a critical aspect of gamification, as it encompasses the overall experience and satisfaction that users derive from interacting with a gamified system. Factors such as usability, aesthetics, interactivity, and fun all influence the user experience. Designing an engaging and intuitive user interface, providing clear goals and challenges, and ensuring a seamless and immersive experience are key considerations when implementing gamification (Vnucko & Klimova, 2023, Fadda et al. 2022).

The ultimate goal of gamification is to drive behavioral change. By incorporating game-like elements, gamification aims to influence users' attitudes, motivations, and behaviors. Whether it is increasing engagement in a learning environment, promoting healthy habits, or improving productivity in the workplace, gamification can effectively shape and reinforce desired behaviors (Oliveira et al. 2023, Vrclj et al. 2023).

In summary, gamification harnesses the power of game-like features and mechanisms to increase user engagement, motivation, and behavior change. By understanding underlying motivations, implementing effective game mechanisms, providing meaningful feedback, ensuring a positive user experience, and targeting desired behavioral outcomes, gamification has the

potential to transform various domains, from education to healthcare and beyond (Ullah et al. 2022, Wang et al. 2022, Hallifax et al. 2019).

5. How to Select Games in Education

Selecting appropriate games for educational use requires careful consideration of several criteria that align with learning objectives and are appropriate for the intended audience. In this chapter, we will explore ten key criteria to help educators make informed decisions when selecting games for educational use.

Educational Goals: The first criterion is to evaluate whether the game aligns with the intended learning objectives. The game should provide opportunities for students to develop and reinforce the specific knowledge, skills, or competencies targeted in the curriculum.

Age Appropriateness: It is critical to assess whether the game is appropriate for the intended age group of students. Games should be age-appropriate in terms of content, complexity, and potential challenges to ensure an optimal learning experience.

Engagement: The ability of the game to capture and maintain student attention is an important consideration. Engaging games can motivate learners, increase their active participation, and foster positive attitudes toward the learning process.

Challenge: Games should strike a balance by providing an appropriate level of challenge for students. They should neither be too easy, leading to boredom, nor too difficult, leading to frustration. The level of challenge should be well matched to students' abilities and learning goals.

Feedback & Assessment: Effective educational games should provide timely and constructive feedback to students, allowing them to gauge their progress

and understand areas for improvement. Incorporating assessments or evaluation mechanisms within the game can further facilitate learning outcomes.

Ease of Use: The usability and navigability of the game play a significant role in its effectiveness as an educational tool.

Accessibility: The game should be accessible to all students, including those with disabilities. The game should provide options for customization, accommodate different learning styles, and adhere to accessibility standards to ensure inclusivity.

Cost: Evaluating the cost of the game and its value proposition is essential. Educators need to determine whether the investment in the game is commensurate with the expected educational benefits and available budget.

Content: The content of the game should be appropriate to the subject matter and grade level of the intended learners. It should present accurate and relevant information, reinforce concepts covered in the curriculum, and provide opportunities for meaningful engagement and learning.

Safety and privacy: Finally, it is important to ensure that the game complies with safety and privacy standards and regulations. Educators should consider issues such as data security, protection of personal information, and adherence to ethical guidelines to ensure the well-being and privacy of students.

By considering these ten criteria, educators can make informed decisions when selecting games for educational use. Evaluating games against these criteria ensures that the games selected are aligned with learning objectives.

6. How to Find Games

When it comes to finding appropriate games for educational purposes, there are several avenues to explore. In this chapter, we will look at different methods and platforms that can help educators discover games that align with their instructional goals.

One effective strategy is to search online game databases that specialize in educational games. These databases offer a wide range of games categorized by subject, grade level, and learning objectives. Educational game sites provide a convenient platform for educators to explore and select games that meet their specific instructional needs.

Many educational resource websites, such as Teachers Pay Teachers and Teachers First, have sections devoted to educational games. These sites serve as valuable repositories of educational materials, including games, developed and shared by other educators. Exploring these sections can provide educators with a diverse collection of games covering a variety of subjects and grade levels.

Educational institutions often develop games to supplement their curricula, especially in the sciences. Searching the Web sites of universities, research centers, and educational organizations can reveal games specifically designed to enhance learning in particular subjects. These institutionally developed games are often rigorously tested and closely aligned with educational standards.

Connecting with other teachers in your school or professional network can be an excellent way to discover recommended games. Collaborating with colleagues who have already used games in the classroom can provide insights and recommendations based on their experiences. Connecting with other educators through workshops, online forums, or professional

development events can lead to valuable recommendations and fruitful discussions about game-based learning.

Attending conferences, workshops, and professional development events that focus on game-based learning can be a fruitful endeavor. These gatherings often feature presentations, demonstrations, and exhibits of educational games. By attending these events, educators can gain first-hand exposure to new games, insights from experts in the field, and opportunities to engage in discussions with other educators.

By exploring these avenues, educators can discover a wide range of games suitable for teaching different subjects and for different grade levels. The combination of online resources, collaboration with peers, and participation in professional development events allows educators to tap into a wealth of educational games and stay informed about the latest advances in game-based learning.

7. Modifying Games?

One question that often arises among educators when considering the use of games in the classroom is whether games need to be customized or adapted before they can be effectively integrated into the instructional process. In this chapter, we will explore the concept of game modification and discuss the various tools and techniques that instructors can use to tailor games to their specific educational needs.

Essentially, game modification involves making changes to a game to better align it with the preferences and goals of the players. There are two primary forms of modification: customization and adaptation.

Customization refers to the process of making minor changes to a game to accommodate individual player preferences and needs. This can include

adjusting the game's difficulty level, changing the appearance of characters or environments, or personalizing game settings. Customization allows players to have a more personalized and engaging gaming experience, increasing their motivation and enjoyment.

On the other hand, adaptation involves making more significant changes to a game to align it with specific educational objectives or curriculum requirements. This may involve changing the game rules, incorporating additional learning resources into the game, integrating assessment tools to measure student progress, or even creating new game elements to reinforce desired learning outcomes. Game adaptation ensures that the game becomes a purposeful educational tool designed to address specific learning goals and outcomes.

When deciding whether to customize or adapt, the instructor plays a critical role in determining the level of modification required. Some instructors may find that minor modifications are sufficient to meet their instructional goals, while others may choose to make more substantial adjustments to ensure seamless integration with the curriculum and targeted learning outcomes.

To facilitate customization and adaptation, instructors have several tools and techniques at their disposal. These tools allow instructors to add or remove elements from the game, change the game rules to align with specific learning objectives, incorporate additional learning resources such as readings or multimedia, and even include assessment tools to track student progress and performance.

By using these modification tools, instructors can create a more personalized and effective game-based learning experience for their students. The ability to customize or adapt games to meet the specific needs of learners increases engagement, promotes active learning, and ensures that games become valuable tools for achieving educational goals.

9. Which Games for Which Disciplines?

When considering the integration of games into educational settings, an important question arises: Which games are appropriate for particular disciplines? In this chapter, we will explore different categories of games and provide examples of games that can be used in different disciplines to enhance the learning experience.

Puzzle games are designed to challenge players with various puzzles and obstacles that must be solved in order to progress in the game. These games encourage problem solving and critical thinking skills. Examples of puzzle games include: DragonBox, a series of math-based puzzle games that teach algebraic concepts in an engaging and interactive way; Prodigy, a math-based game that combines role-playing with math challenges, encouraging students to solve problems in a fantasy world; and Math Duel, a two-player game that presents players with math problems, encouraging friendly competition and quick thinking.

Simulation games replicate real-world scenarios and allow players to experience and interact with complex systems. These games provide opportunities to learn about decision making, resource management, and problem solving. Examples of simulation games include Foldit, a protein-folding game that challenges players to fold proteins and contribute to real-world scientific research; Planet Zoo, a simulation game that allows players to design and manage their own zoo while learning about animal biology, ecology, and conservation; and Universe Sandbox, a physics-based simulation game that allows players to explore and experiment with the laws of the universe, gaining insight into celestial mechanics and astronomical phenomena.

Role-playing games immerse players in virtual worlds where they assume the roles of characters and engage in various quests and adventures. These games can be adapted to teach a variety of subjects and skills. Examples of role-

playing games include HistoryCraft, a game that combines history and Minecraft, allowing students to explore historical settings and events while building and creating; LanguageQuest, a language learning game that immerses players in interactive environments to practice vocabulary, grammar, and cultural understanding; and BioExplorer, a biology-themed game that puts players in the role of a scientist as they conduct experiments, study organisms, and explore the natural world.

By categorizing games as puzzle games, simulation games, and role-playing games, educators can identify games that align with disciplinary content and learning objectives. It is important to note that these examples are illustrative only, and there is a wide range of games available for different disciplines and educational purposes.

Strategy games present players with a range of options and require decision-making skills based on short-term and long-term goals, resource management, and overcoming obstacles. These games often involve commanding troops, managing resources, and building structures. Examples of strategy games for various disciplines include Screenshot, a strategy game that introduces players to programming and artificial intelligence concepts through real-time strategy gameplay; Civilization VI, a popular strategy game that allows players to build and manage their own civilization while learning about historical and cultural aspects; and Democracy, a simulation game that challenges players to manage a country and make policy decisions, providing insights into political science and governance.

Language learning games are specifically designed to improve language skills through engaging and interactive experiences. These games provide vocabulary acquisition, grammar practice, and other language-related activities. They can take various forms, including quizzes, puzzles, role-playing games, and simulations. Examples of language learning games include CodeCombat, a multiplayer game that teaches coding and computer science concepts through interactive gameplay and coding challenges;

Duolingo, a popular language learning app that gamifies the language learning process with bite-sized lessons, quizzes, and rewards; and Rosetta Stone, a language learning program that provides immersive and interactive language experiences to help learners develop language skills.

Sandbox games give players a high degree of autonomy and freedom to explore and create their own goals and experiences within a virtual world. These games provide a wide range of tools, resources, and challenges that encourage creativity and self-directed learning. Examples of sandbox games include Minecraft Education Edition, an educational version of the popular sandbox game Minecraft that can be used to teach a variety of subjects including history, math, and environmental science; SimCity, a city-building simulation game that allows players to understand urban planning, environmental impact, and economic principles; and Universe Sandbox, a physics-based sandbox game that allows players to explore and experiment with the laws of the universe, fostering curiosity and scientific exploration.

By considering strategy games, language learning games, and sandbox games, educators can find appropriate options for different disciplines that promote engagement and meaningful learning experiences. It is important to explore specific game features and learning objectives and align them with educational goals to ensure effective integration.

10. Challenges and Future Directions in Game-Based Learning

As game-based learning continues to gain popularity in educational settings, it is important to recognize the challenges and consider the future directions of this approach. This chapter examines key challenges in implementing game-based learning and discusses potential avenues for future development and improvement.

One challenge is effectively integrating game-based learning into the existing curriculum. Educators need to ensure that games are aligned with learning objectives and seamlessly complement curriculum content. Strategies for integrating game-based learning across subjects and grade levels can be explored.

Another challenge is assessing and evaluating the learning outcomes achieved through game-based learning. Traditional assessment methods may not fully capture the skills and knowledge acquired through gameplay. Developing innovative and reliable assessment approaches that measure the effectiveness of game-based learning is critical.

Creating high-quality educational games that are engaging, effective, and aligned with educational goals is a significant challenge. The field of game design and development needs to evolve to meet the specific needs of educational contexts. Collaboration among educators, game designers, and researchers can help create more effective educational games.

Ensuring that all students have equal access to game-based learning opportunities is essential. The availability and accessibility of devices, Internet connectivity, and appropriate learning environments can vary across schools and communities. Efforts should be made to address these inequities and make game-based learning accessible to a diverse range of students.

Supporting teachers in the effective use of game-based learning in their classrooms is critical. Providing professional development opportunities, resources, and training programs can equip educators with the skills and knowledge necessary to realize the potential of game-based learning. Collaborative communities and networks can also facilitate the sharing of knowledge and best practices.

Looking ahead, several promising directions may shape the future of game-based learning:

Advances in technology can enable personalized and adaptive game-based learning experiences tailored to the needs, abilities, and interests of individual students. Adaptive learning algorithms and intelligent systems can increase the effectiveness and engagement of game-based learning.

The integration of augmented reality (AR) and virtual reality (VR) technologies into game-based learning has immense potential. These immersive technologies can create realistic and interactive learning environments that allow students to explore and experience subjects in new and engaging ways.

Expanding the application of gamification beyond traditional games can further enhance the learning experience. Incorporating game elements such as points, badges, and leaderboards into non-game settings can increase motivation and engagement in various educational activities and tasks.

Overcoming the challenges and embracing the future directions of game-based learning will contribute to its continued growth and effectiveness in education. By addressing the challenges of integration, assessment, design, accessibility, and professional development, and by exploring personalized learning, AR/VR integration, and gamification in non-gaming settings, game-based learning can reach its full potential as a transformative approach to education.

11. Conclusions

Throughout this exploration of the use of digital games in education, we have gained valuable insights and identified key lessons. One of the most important lessons is that digital games have proven to be a powerful tool for increasing student engagement and motivation in the classroom. By leveraging the inherent qualities of games, such as interactivity, challenge

and reward, educators can create immersive learning experiences that capture students' attention and encourage active participation. The element of fun and enjoyment in games can have a significant impact on students' willingness to learn, leading to increased motivation and ultimately improved learning outcomes.

However, it is critical to recognize that the effectiveness of digital games in education depends on careful alignment with educational goals and learning objectives. Games must be intentionally designed and developed to address specific educational needs and fit within the curriculum. This alignment ensures that games not only engage students, but also contribute to meaningful learning experiences. By integrating games that directly support desired learning outcomes, educators can create a cohesive and purposeful learning environment.

In addition, customization and adaptation of games can play an important role in optimizing their effectiveness. Customization allows for minor modifications to suit individual preferences, while adaptation involves more significant changes to align the game with educational objectives or curriculum requirements. By tailoring games to meet the unique needs of students and educational contexts, educators can maximize their instructional potential and ensure a more focused and effective learning experience.

In conclusion, digital games offer immense potential in education, providing a platform to engage and motivate students while supporting their learning journey. By using games that are aligned with educational goals, educators can create dynamic and interactive learning environments that increase student engagement and promote meaningful learning outcomes. However, careful consideration must be given to the design, customization, and adaptation of games to ensure their effectiveness in supporting educational goals. By harnessing the power of digital games and integrating them thoughtfully into the classroom,

educators can unlock new opportunities to enhance the teaching and learning experience.

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References

- Clark, D. B., Hernández-Zavaleta, J. E., & Becker, S. (2023). Academically meaningful play: Designing digital games for the classroom to support meaningful gameplay, meaningful learning, and meaningful access. *Computers & Education*, 194, 104704.
- Dai, C. P., Ke, F., Pan, Y., & Liu, Y. (2023). Exploring students' learning support use in digital game-based math learning: A mixed-methods approach using machine learning and multi-cases study. *Computers & Education*, 194, 104698.
- Fadda, D., Pellegrini, M., Vivinet, G., & Zandonella Callegher, C. (2022). Effects of digital games on student motivation in mathematics: A meta-analysis in K-12. *Journal of Computer Assisted Learning*, 38(1), 304-325.
- Hallifax, S., Serna, A., Marty, J. C., & Lavoué, É. (2019). Adaptive gamification in education: A literature review of current trends and developments. In *Transforming Learning with Meaningful Technologies: 14th European Conference on Technology Enhanced Learning, EC-TEL 2019, Delft, The Netherlands, September 16–19, 2019, Proceedings 14* (pp. 294-307). Springer International Publishing.
- Harms, S. W. (2022). A Systematic Mapping Study on Gamification Applications for Undergraduate Cybersecurity Education. *Journal on Cybersecurity Education, Research and Practice*.
- Huang, R., & Schmidt, M. (2023). A systematic review of theory-informed design and implementation of digital game-based language learning. *Digital Games in Language Learning*, 14-34.
- Min, A., Min, H., & Kim, S. (2022). Effectiveness of serious games in nurse education: A systematic review. *Nurse education today*, 108, 105178.
- Oliveira, W., Hamari, J., Shi, L., Toda, A. M., Rodrigues, L., Palomino, P. T., & Isotani, S. (2023). Tailored gamification in education: A literature review and future agenda. *Education and Information Technologies*, 28(1), 373-406.

- Peterson, M., & Jabbari, N. (2023). Digital games and foreign language learning: Context and future development. In *Digital Games in Language Learning* (pp. 1-13). Routledge.
- Rüth, M., Birke, A., & Kaspar, K. (2022). Teaching with digital games: How intentions to adopt digital game-based learning are related to personal characteristics of pre-service teachers. *British Journal of Educational Technology*, 53(5), 1412-1429.
- Sotos-Martinez, V. J., Tortosa-Martínez, J., Baena-Morales, S., & Ferriz-Valero, A. (2023). Boosting Student's Motivation through Gamification in Physical Education. *Behavioral Sciences*, 13(2), 165.
- Tay, J., Goh, Y. M., Safiena, S., & Bound, H. (2022). Designing digital game-based learning for professional upskilling: A systematic literature review. *Computers & Education*, 104518.
- Vnucko, G., & Klimova, B. (2023). Exploring the Potential of Digital Game-Based Vocabulary Learning: A Systematic Review. *Systems*, 11(2), 57.
- Vrcelj, A., Hoic-Božic, N., & Dlab, M. H. (2023). Use of Gamification in Primary and Secondary Education: A Systematic Literature Review. *International Journal of Educational Methodology*, 9(1), 13-27.
- Ullah, M., Amin, S. U., Munsif, M., Safaev, U., Khan, H., Khan, S., & Ullah, H. (2022). Serious games in science education. A systematic literature review. *Virtual Reality & Intelligent Hardware*, 4(3), 189-209.
- Wang, L. H., Chen, B., Hwang, G. J., Guan, J. Q., & Wang, Y. Q. (2022). Effects of digital game-based STEM education on students' learning achievement: a meta-analysis. *International Journal of STEM Education*, 9(1), 1-13.