Journal of Research in Education and Teaching
(ISSN: 2146-9199)
https://jret.elapublishing.net
Received: 30.03.2026 / Accepted: 11.06.2026
Published: 30.06.2026
Review Article

Educational Digital Game Development Process: A Conceptual Review, Model Proposal, and Application Analysis

Serdar Çiftçi[1]

Abstract

This study comprehensively examines the game development process from both pedagogical and technological perspectives. The research is based on a literature review approach, a qualitative research method. Within the scope of the study, current literature in the field of game-based learning and educational digital games was analyzed, and an Educational Digital Game Development Model (EDOGM) was proposed based on the findings. The model consists of five main components: learning objectives, game mechanics, interaction design, feedback, and measurement and evaluation. Furthermore, to test the explanatory power of the model, seven different educational digital game environments were analyzed comparatively. The findings reveal that, for educational digital games to be an effective learning tool, a balanced structure must be established between pedagogical suitability, game design, and evaluation processes. This study contributes to theoretical and applied studies in the field by providing a holistic framework for the educational digital game development process.

Keywords: educational digital game, game-based learning, educational game design, model development, EDOGM, learning mechanics

Introduction

The rapid development of digital technologies over the last two decades has significantly altered the nature of teaching and learning processes. With the diversification of ways to access information, the proliferation of mobile devices, and the strengthening of an online interaction culture, students' expectations of their learning experiences have also transformed (Dilekçi & Karatay, 2023). One of the most visible areas of this transformation is digital games. Initially viewed primarily as a leisure activity, digital games are now considered learning environments associated with higher-order cognitive processes such as problem-solving, strategic thinking, collaboration, quick decision-making, and lasting learning (Maiorca et al., 2020; Norris et al., 2023). This paradigm shift has propelled digital games into the pedagogical discourse as potent tools for fostering inclusive and engaging learning experiences across diverse educational contexts (Jonáš & Ogodo, 2025).

The game-based learning approach is noteworthy for enabling students to actively participate in the learning process, learn through making mistakes, and visibly monitor their progress. This approach leverages the inherent engagement of games to foster deep learning and skill acquisition,

[1] Assoc. Prof. Dr., Aydın Adnan Menderes University, e-mail: sciftci@gmail.com, ORCID: 0000-0001-5282-1861

moving beyond traditional didactic methods (Kucher, 2021). Digital Game-Based Learning specifically integrates digital games into instructional contexts with the primary objective of learning rather than mere entertainment, distinguishing it from broader game-based learning applications (Çiftci & Yıldız, 2024). These educational digital games are specifically designed to meet distinct pedagogical and ludic criteria, ensuring both their effectiveness as learning tools and their appeal as interactive experiences (Martínez et al., 2022).

In this context, educational digital games are considered not only as tools that provide content but also as integrated systems that structure learning, support motivation, and provide feedback (Manesis, 2020; Tokarieva et al., 2019). This evolution necessitates a structured methodological framework for their design and development to ensure pedagogical efficacy and engaging player experiences (Panskyi & Rowińska, 2021; Santos, 2018). Various methodologies and frameworks have been proposed to guide the creation of serious games and educational digital games, emphasizing the need for a balanced integration of learning objectives and game mechanics (Pacheco-Velázquez et al., 2023). This integration is crucial for maintaining student engagement and ensuring that the educational content remains aligned with contemporary pedagogical practices (Naidoo, 2024). This entails a deliberate design process that harmonizes educational outcomes with intrinsically motivating gameplay elements, reflecting a constructivist approach where learners actively construct knowledge through interactive experiences (Darvishinia & Goodson, 2024).

The transformation of students from passive recipients to active participants is considered one of the strongest pedagogical aspects of games. This active engagement, facilitated by features such as immediate feedback, interactive challenges, and opportunities for experiential learning, can significantly enhance intrinsic motivation and lead to improved learning outcomes (Jeanette et al., 2022; Patiño et al., 2023). Numerous empirical and meta-analytic studies in the literature demonstrate that educational digital games have positive effects on academic achievement, class participation, motivation, and lasting learning (Boyle et al., 2015; Calderón & Ruiz, 2015; Clark et al., 2015). These studies show that game-based learning environments support learning, particularly through elements such as interaction, repetition, immediate feedback, and goal-oriented progress (Deliyannis et al., 2019; Djelil et al., 2014). However, it is also emphasized that these positive effects are not automatically valid for every game; they vary depending on factors such as design quality, pedagogical suitability, and user experience (Stoddard, 2015).

For educational digital games to be effective, it is not enough for them to be merely fun or technically functional. Instead, a meticulous alignment between pedagogical objectives, game mechanics, and user engagement strategies is essential to create impactful learning experiences (Zuo, 2023). This requires a comprehensive understanding of how game elements can be purposefully integrated to support learning outcomes, fostering not only cognitive development but also enhancing

critical thinking and problem-solving skills (Kurt & Dindar, 2024; Wang et al., 2022). Games that are not aligned with learning objectives, limit user interaction, or lack adequate feedback mechanisms cannot provide the expected educational contribution (İlkay & Atik, 2024). Therefore, the educational game development process should be considered a multi-layered design process that addresses pedagogical, technical, and experiential dimensions together (Arnab et al., 2014).

The educational digital game development process is not limited to software development steps alone. Learning theories, instructional design principles, audiovisual design, user experience, measurement and evaluation, and the application context must be considered together in this process (Aydoğan & Karabağ, 2020). This multi-component structure necessitates an interdisciplinary approach (Sobota et al., 2023). When the fields of educational sciences, game design, and software development are not integrated, either pedagogical goals weaken or the game experience remains superficial (Mavromihales et al., 2018). This fragmentation often leads to inconsistent literature and referencing patterns across sub-disciplines, complicating the synthesis of knowledge in this rapidly evolving field (Freitas, 2018). A holistic framework is therefore essential to bridge these disciplinary divides, providing pragmatic guidance for optimizing learning outcomes and addressing the design variations inherent across different educational disciplines (Huo, 2019).

While interest in educational digital games has increased in some applications, a significant portion of the developed applications still contains limited interactive elements and are largely based on test logic (Erümit et al., 2022). Such designs often fail to fully leverage the potential of digital games to create immersive and motivating learning experiences, frequently resulting in low-level visuals and basic applications akin to digital worksheets rather than engaging educational tools (Erümit et al., 2022). This often leads to a disconnect between the interactive potential of digital games and their actual implementation in educational contexts, hindering their capacity to foster deeper learning and engagement (Putri et al., 2023). In contrast, exemplary applications are characterized by deeper narrative structures, open-ended problem-solving environments, and adaptive systems (Davis et al., 2023). This situation demonstrates that the educational game development process should consider not only content production but also high-quality design approaches.

This study aims to gather the scattered knowledge regarding the educational digital game development process within a more systematic framework. To this end, the concept of educational digital games and their related theoretical foundations are first examined; then, a usable model for developers and researchers is proposed. Finally, selected applications are analyzed to demonstrate the explanatory power of the model. In this context, the study focuses on the following questions:

(a) What are the basic components of the educational digital game development process?

(b) How can pedagogical and technological elements be integrated into this process?

(c) To what extent do the example applications reflect these components?

The answers to these questions are expected to contribute to theoretical discussions in the field and guide practitioners.

Conceptual Framework

Educational digital games are interactive digital environments designed to integrate game mechanics with pedagogical elements, aligned with learning objectives (Gee, 2003; Prensky, 2003). These games aim not only to transfer information but also to support the student's active participation in the learning process, the development of problem-solving skills, and learning through experience (Petri & Wangenheim, 2017; Tsekleves et al., 2014). In this respect, unlike traditional teaching approaches, they transform learning into a more dynamic and student-centered structure (Bakhsh et al., 2022; Coleman & Money, 2019). Despite the theoretical recognition of their potential, the practical implementation of digital games in formal educational settings often faces significant challenges, including educators' unfamiliarity with game interfaces and game-based learning concepts, as well as a notable gap between theoretical claims and actual classroom integration (Tokarieva et al., 2019).

Educational digital games are often confused with the concept of gamification. However, there is an important difference between these two concepts. While gamification refers to the application of game elements to non-game environments, educational digital games offer a direct game experience (Deterding et al., 2011; Kapp, 2012). In this context, they position the user within a game world and carry out the learning process within this context (Shelton & Wiley, 2007). When the theoretical foundations of educational digital games are examined (Petri & Wangenheim, 2017), different learning theories contribute to this process. The behavioral approach emphasizes the reinforcement of learning through reward and feedback mechanisms. The point, badge, and level systems used in games can be considered a reflection of this approach (Calderón & Ruiz, 2015). The cognitive approach, on the other hand, addresses learning within the framework of information processing processes and emphasizes the individual's mental structures (Anderson, 2000). Problem-solving tasks and strategy development processes involved in games can be evaluated within this context (Eck, 2008).

The constructivist learning approach is considered one of the strongest theoretical foundations for educational digital games (Felicia, 2009). This approach argues that learning occurs through the active participation and experiences of the individual (Moore & Piaget, 1971; Vygotsky, 1978). Educational games create constructivist learning environments by offering users opportunities for exploration, trial and error, and meaning-making (Marone, 2016). Open-ended and exploratory games, in particular, allow students to construct knowledge through their own experiences (Petri & Wangenheim, 2017). This pedagogical orientation underscores the importance of student-centric interactive experiences and authentic task engagement within a specific context (Chartofili & Fokides, 2019). Consequently, these games are frequently conceptualized from a moderate constructivist

perspective, where learners actively construct knowledge through interaction with their environment, rather than passively receiving information (Muenz et al., 2023).

Motivation is one of the most important components of educational digital games (Ilić et al., 2024; Leuchter & Kurtz, 2022). Games increase intrinsic motivation for learning through goals, rewards, feedback, and progress mechanisms that engage the user in the process (Deci & Ryan, 2000). This engagement allows students to remain engaged in the learning process for longer periods and demonstrate a higher level of participation (Ding et al., 2016; Huizenga et al., 2017). Furthermore, games reduce students' anxiety about making mistakes by making failures a natural part of the learning process (Petri & Wangenheim, 2017). This aligns with behaviorist theories, where reward mechanisms in digital educational games enhance students' motivation by providing immediate feedback and reinforcement, thereby encouraging continued engagement and exploration (Li et al., 2024).

In educational digital game design, the relationship between learning mechanics and game mechanics is critically important. Even if the game is enjoyable, learning outcomes remain limited if a direct link is not established between learning objectives and in-game tasks (Tsekleves et al., 2014). Therefore, various models have been proposed in the literature for matching learning mechanics and game mechanics (Arnab et al., 2014; Plass et al., 2015). These models emphasize that pedagogical goals should not be overlooked in the game design process. However, the evaluation of educational digital games is also a crucial issue. Traditional measurement and evaluation methods may not adequately reflect the process-oriented data that game-based learning environments offer (Stanciu & Stănescu, 2019). Therefore, in-game data analysis, learning analytics, and adaptive assessment systems have come to the forefront in recent years (Berta & Moreno-Ger, 2018; Hauge et al., 2014). This integrated approach allows for a more nuanced understanding of learner progress and the effectiveness of diverse game elements in fostering cognitive skill development and intrinsic motivation (Alexiou & Schippers, 2018; Proulx et al., 2016). These systems allow for more comprehensive and process-oriented evaluations by analyzing students' behavior within the game.

In conclusion, educational digital games have a multi-dimensional structure, and understanding this structure is critical for developing effective game designs. When pedagogical theories, motivational elements, game mechanics, and evaluation processes are considered together, the impact of educational digital games on learning becomes more meaningful and sustainable. In this context, the conceptual framework is considered a crucial component forming the foundation of the educational game development process.

Essential Components of Educational Digital Games

The effectiveness of educational digital games as a learning tool depends on the systematic and balanced combination of certain fundamental components. The literature emphasizes that these components are not limited to technical or visual elements; rather, they form a multi-layered structure

encompassing pedagogical, cognitive, and interactive dimensions (Arnab et al., 2014; Plass et al., 2015). In this context, learning objectives, game mechanics, interaction design, feedback systems, and assessment processes stand out as critical elements in the design of educational digital games (Kalmpourtzis & Roméro, 2020). These elements must be carefully integrated to ensure the game effectively facilitates knowledge acquisition and skill development while maintaining an engaging and motivating user experience (Narayanan & Kumaravel, 2024). A comprehensive design framework for educational games should incorporate learning objectives, a compelling narrative, an immersive 3D environment, engaging gameplay, and robust evaluation mechanisms to ensure both pedagogical efficacy and player enjoyment (Ahmad, 2019).

Among these components, one of the most crucial is the learning objectives. The fundamental aim of an educational game is to impart specific knowledge, skills, or attitudes. Therefore, learning objectives need to be defined clearly, measurably, and pedagogically sound. When learning objectives are not integrated into the game design process, the game may offer an enjoyable experience but remain limited in terms of learning outcomes (Gee, 2003). Effective educational game frameworks, therefore, emphasize the integration of learning theories and pedagogical approaches into the core game design from the outset, ensuring that educational goals are intrinsically linked to game mechanics and user experience (Deliyannis et al., 2019; Ishak et al., 2021).

Game mechanics constitute the structural components of educational digital games that support learning objectives. Elements such as tasks, levels, scoring systems, and rewards guide the user's progress within the game and motivate the learning process. However, these elements should not be solely entertainment-focused but should be designed to support the learning process. Otherwise, a mismatch may arise between the game and pedagogical goals (Kapp, 2012). Therefore, the integration of compelling narratives, clear objectives, and adaptive feedback within the game design is essential for fostering positive learning environments and ensuring the game's purpose is reflected in its components (Esteban, 2024; Fokides et al., 2019). Furthermore, the strategic application of ongoing feedback components and adaptive challenges within game mechanics ensures continuous engagement and tailored learning experiences (Ahmad et al., 2015).

Interaction design and feedback systems are other important components that directly affect the quality of the learning process. Effective interaction design ensures the user's active participation in the game and transforms learning into an experiential process. Instant and meaningful feedback provided in this process allows students to recognize their mistakes and adjust their learning strategies. This plays a significant role, particularly in increasing intrinsic motivation (Deci & Ryan, 2000; Hamari et al., 2014). The table below summarizes the above section.

Table 1
Essential Components of Educational Digital Games

	Definition	Role in the Learning Process	Literature
Learning Objectives	The knowledge, skills, and attitudes that the game aims to impart should be clearly and measurably defined.	They guide the entire design process and defines the pedagogical framework.	Gee (2003)
Game Mechanics	Structured game elements such as tasks, levels, scoring, rewards, and progression systems.	It motivates the learning process and ensures progress aligned with goals.	Kapp (2012)
Interaction Design	The way a user interacts with the game and the overall user experience design.	It increases active participation and supports experiential learning.	Plass et al. (2015)
Feedback System	Instant and guiding feedback mechanisms provided to the user.	It helps identify mistakes and reinforces learning.	Deci & Ryan (2000); Hamari et al. (2014)
Measurement and Evaluation	Evaluation systems based on in-game performance and process data.	It analyzes both the process and outcome dimensions of learning.	Wouters et al. (2013)

Finally, measurement and evaluation processes are considered one of the most critical components of educational digital games. Unlike traditional assessment approaches, digital games have the potential to generate rich data regarding the learning process. More comprehensive and process-oriented assessments can be made by analyzing in-game performance, progress level, and user behavior. This makes it possible to consider not only the outcome but also the process dimension of learning (Wouters et al., 2013). This aligns with contemporary educational assessment theories advocating for authentic tasks that reveal what students genuinely know and can do, rather than merely focusing on summative results (Kim & Shute, 2015). The efficacy of these embedded assessments is paramount for providing performance-based insights into student actions, thereby offering a more authentic evaluation of learning (Udeozor et al., 2023). Furthermore, the integration of iterative testing and feedback from both educators and students is vital for refining these assessment mechanisms, ensuring their validity and reliability in gauging student comprehension and progress (Zhou, 2024).

Method

This study employs a Systematic Literature Review methodology, a qualitative research approach aimed at investigating the development processes of educational digital games. Grounded in a comprehensive conceptual framework, this research delineates the pedagogical, technical, and structural dimensions inherent in educational game development. The analysis transcends simple summarization; instead, it utilizes a rigorous thematic approach—involving open coding, categorization, and synthesis—to uncover prevailing trends and identify existing gaps within the field. The investigation encompasses national and international scholarly output concerning educational digital games, game-based learning, and gamification. To ensure relevance and contemporary validity,

the scope of the literature search was constrained to prioritize influential, peer-reviewed studies published within the preceding decade.

The literature review was performed using the Web of Science, Scopus, and Google Scholar databases. The search strategy employed keywords such as “educational digital games,” “game-based learning,” “serious games,” “gamification,” “learning mechanics,” and “game mechanics.” Retrieved studies were systematically appraised for topical relevance, academic validity, and timeliness prior to inclusion. Subsequently, duplicate and irrelevant studies were excluded from the final analysis.

This research examined not only theoretical sources but also practical examples. Accordingly, seven different examples of educational digital game environments were identified. The selection process considered criteria such as widespread use of the games, their development for educational purposes, and their representation of diverse design approaches. In this context, the selected examples allow for a comparative analysis of different aspects of educational digital games.

Firstly, the basic components of the educational digital game development process were determined in line with the literature. These components were classified as learning objectives, game mechanics, interaction design, feedback, and measurement-evaluation. Then, selected application examples were examined within this framework, and a comparative analysis was performed.

The Educational Digital Game Development Model (EDOGM) developed in this research aligns with theoretical approaches and analysis findings in the literature. Studies addressing the relationship between learning mechanics and game mechanics particularly considered during the model development process (Arnab et al., 2014; Plass et al., 2015). This approach ensures that the model offers not only a theoretical but also a practical structure.

To enhance the reliability of the research, data sources were diversified, and studies from different databases were examined comparatively. Furthermore, the categories used in the analysis were created based on the literature, and a systematic analytical framework was developed. However, the review nature of the study and the limited number of application examples examined are among the main limitations of the research. In conclusion, this methodological approach allows examination of the educational digital game development process in both its theoretical and practical dimensions and supports the explanatory power of the developed model.

Educational Digital Game Development Model

The EDOGM model is a direct product of the findings derived from the systematic literature review. The reviewed literature highlighted a persistent limitation: existing models frequently compartmentalize pedagogical objectives and entertainment mechanics, often resulting in games that are either academically rigorous but unengaging, or entertaining yet instructionally deficient. To reconcile this disparity and provide a coherent framework for developers and educators, the EDOGM model conceptualizes the educational digital game development process within a holistic, systematic

structure.This model synthesizes insights from game-based learning paradigms, the nexus between learning mechanics and game mechanics, and foundational instructional design principles extracted from the literature (Arnab et al., 2014; Plass et al., 2015). The EDOGM model consists of five main components: learning objectives, game mechanics, interaction design, feedback system, and measurement and evaluation. These components are not independent of each other; rather, they are designed as a dynamic system that constantly interacts and operates within a cyclical structure.

The first and most critical component of the model is the learning objectives. The success of an educational game is directly related to the clarity and measurability of the defined learning objectives (Jaccard et al., 2021). Learning objectives determine the direction of the game design process and form the fundamental point of reference in structuring all other components. Therefore, the objectives must be pedagogically consistent and achievement-oriented (Jaccard et al., 2021). These objectives should ideally be broken down into specific learning mechanics that translate pedagogical aims into actionable in-game behaviors (Hawthorn et al., 2021). This translation necessitates a careful alignment between instructional goals and the intrinsic motivations fostered by game mechanics, moving beyond mere "pointification" to genuinely integrate educational content within engaging gameplay loops (Kocadere et al., 2019; Li et al., 2023).

The second component, game mechanics, should be designed to support learning objectives. Game mechanics encompass elements such as tasks, levels, scoring systems, rewards, and progression structures (Gaweł, 2019). These elements need to be structured not only for entertainment but also to support the learning process. Otherwise, a disconnect can occur between the game and the learning objectives. Thus, effective game mechanics should foster active engagement and provide challenges commensurate with the learner's skill level, thereby promoting a state of flow that optimizes the learning experience (Kiili, 2005). This integration ensures that the essential behaviors linked to learning or assessment activities are intrinsically embedded within the game, rather than being an extrinsic overlay (Plass et al., 2015).

Interaction design constitutes the third component of the model. How the user interacts with the game directly affects the quality of the learning process (Fotouhi-Ghazvini et al., 2009). In this context, user-friendly interfaces, meaningful feedback, and guiding interactions become important. Interaction design is one of the fundamental mechanisms that ensures the student's active participation in the learning process (Daud et al., 2024). It should also provide sufficient instructional guidance and opportunities for communication between the player and the game system to facilitate understanding and skill acquisition (Cezarotto & Chamberlin, 2021). The fourth component, the feedback system, is crucial for reinforcing learning and guiding players through challenges.

The fourth component, the feedback system, is a crucial element in ensuring the continuity of the learning process. The immediate feedback provided allows students to recognize their mistakes

and adjust their learning (Kopniak, 2018). In this context, feedback needs to be timely, clear, and guiding. This iterative feedback loop, integral to pedagogical effectiveness, helps learners internalize concepts and refine their understanding (Imran, 2019; Pan, 2019). Both immediate and cognitive feedback mechanisms should be incorporated, with the former maintaining engagement and the latter stimulating reflective processing and sense-making (Kiili et al., 2021). Finally, the measurement and evaluation component serves to assess the achievement of learning objectives and the overall effectiveness of the game (Watanapokakul, 2018).

The final component of the model is the measurement and evaluation process. Unlike traditional assessment approaches, educational digital games have the potential to provide process-oriented data (Stănescu et al., 2020). Analyzing in-game behaviors allows for more comprehensive assessments, progress data, and performance indicators (Liu et al., 2024). This ensures that not only the outcome but also the process dimension of learning is taken into account. This data-driven approach to assessment aligns with principles of constructive alignment by providing objective evaluation of individual progress rather than mere comparison of student indicators (Lobanova et al., 2022). This holistic evaluation encompasses not only the acquisition of knowledge but also the development of critical thinking, problem-solving skills, and adaptive learning strategies (Savitska et al., 2025).

One of the most important features of the EDOGM model is its cyclical structure. Rather than a linear process, the model is designed as a system incorporating continuous feedback and improvement mechanisms, which allows for the continuous updating and development of the games. In conclusion, the EDOGM model offers a holistic approach to the educational digital game development process and aims to strike a balance between pedagogical goals and game design. In this respect, the model serves as a guide for both researchers and practitioners. The EDOGM model is a cyclical one that addresses the educational digital game development process holistically. Its components are in constant interaction with each other and work together to support the learning process.

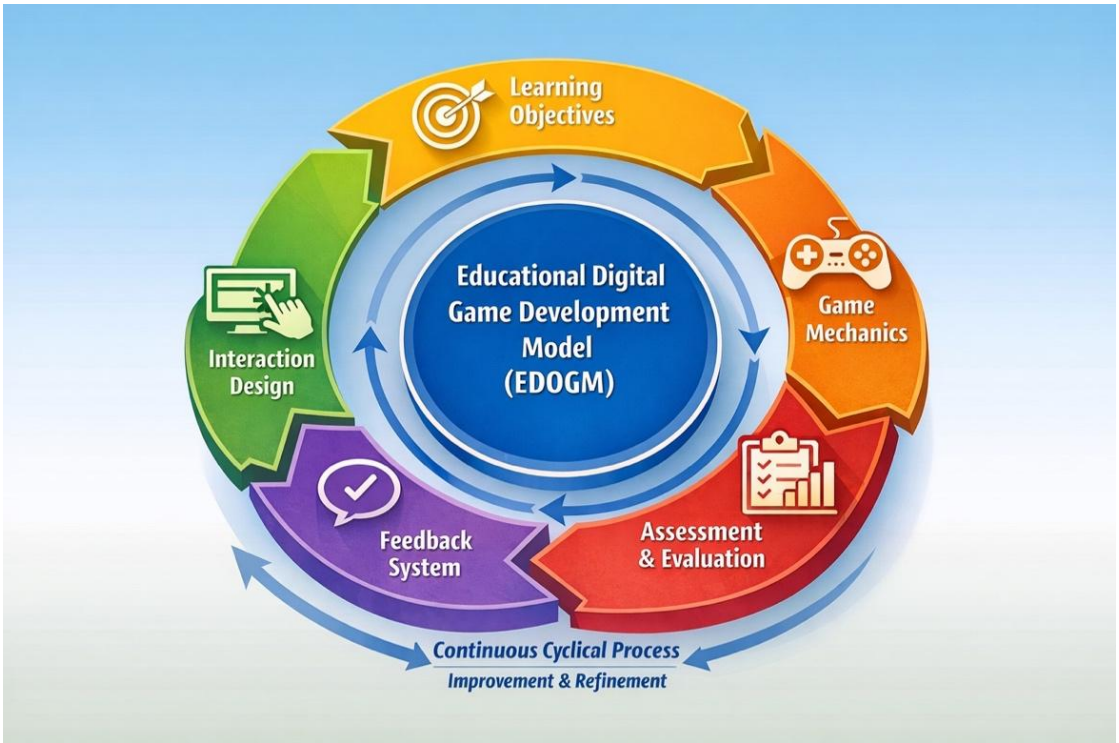

Figure 1. Educational Digital Game Development Model. (EDOGM)

In this model, learning objectives play a central role, while game mechanics form the structure that supports these objectives. Interaction design shapes the user experience, and the feedback system reinforces learning. Measurement and evaluation analyze the entire process, ensuring the continuous improvement of the model. This structure is not linear but cyclical, based on a logic of continuous improvement. This cyclical nature facilitates an iterative development process, allowing for real-time adaptation and refinement of game elements based on empirical data derived from learner interactions. This systematic approach to development allows for the integration of learning analytics, which can further customize personalized educational games for students and provide visual reports on learning profiles and problem areas (Wang & Deng, 2025).

The fundamental feature that distinguishes the EDOGM model from existing models is its equal treatment of pedagogical goals and game design, and its continuous linkage of these two structures to the measurement and evaluation process. While many models focus either on technical design or the pedagogical dimension, EDOGM integrates them in a balanced way, offering a practical framework (Kalmpourtzis & Roméro, 2020). This integrated approach facilitates the development of endogenous educational games, where learning content is intrinsically woven into the game mechanics rather than being an exogenous overlay (Czauderna & Guardiola, 2019). This contrasts with many current digital educational game development practices that often lack robust user-centered design, despite the availability of frameworks that tend to prioritize technical and instructional aspects (Maxim & Arnedo-Moreno, 2025).

Analysis

This section analyzes selected examples of educational digital games within the proposed analytical framework to reveal different dimensions of the educational digital game development process. The games were evaluated during the analysis in terms of learning objectives, game mechanics, interaction design, feedback system, and measurement and evaluation. The study did not limit itself to a small number of examples; researchers created a diversified sample to represent different design approaches and learning scenarios. In this context, different types of educational digital games, such as open-world, gamified systems, role-playing-based learning environments, and adaptive learning applications, were included. Thus, their functioning within different design paradigms was examined comparatively.

Table 2

Educational digital game environments examined within the scope of the research.

Game	Structure of Learning Objectives	Characteristic of the Game Mechanics	Interaction Style	Feedback Approach	Measurement and Evaluation Structure
Minecraft Education Edition	Open-ended, exploration and problem-solving oriented.	Open world, task-based, flexible structure.	Based on exploration, collaboration and production.	The process involves indirect and teacher-supported interventions.	Based on performance and process observation.
Duolingo	Microlearning objectives, gradual structure.	Progression based on level, points, and repetition.	Individual and directed interaction.	Instant, automatic, and directive.	Continuous, data-driven, and adaptive.
EBA Games	Directly linked to curriculum outcomes.	Quiz and short task-based structure.	Limited and directed interaction.	True-false based feedback	Results-oriented, test-based
Kahoot!	Concept reinforcement and rapid assessment.	Competition and time-limited question structure.	Competition and group interaction.	Instant and comparative feedback	Real-time performance measurement
Classcraft	A combination of behavioral and academic goals.	Role-playing game (RPG) and mission system	Continuous and social interaction.	Indirect and progressing through the process	Based on process and behavior tracking.
DragonBox	Conceptual learning (especially in mathematics).	Puzzle and intuitive learning-based.	Individual and exploratory.	Intuitive and implicit feedback	Indirect performance indicators

Prodigy	Adaptive mathematics learning goals.	RPG + adaptive system.	Individual but dynamic interaction.	Instant and personalized.	Adaptive and continuous data analysis.

Table 2 shows that educational digital games reflect the model components at different levels and with different weightings. Open-world and exploration-based games (e.g., Minecraft Education Edition and Classcraft) offer strong structures for interaction and experiential learning (Alawajee & Delafield-Butt, 2021); however, they have limitations in monitoring learning outcomes due to a lack of systematic measurement and evaluation processes (Faas & Lin, 2017). Conversely, highly structured, curriculum-aligned games often excel in systematic assessment but may inadvertently constrain exploratory learning and intrinsic motivation (Valentová & Brečka, 2023). This highlights a critical dichotomy in current educational game design: a trade-off between scaffolding free exploration and implementing robust, quantifiable assessment mechanisms.

In contrast, gamified and adaptive systems like Duolingo and Prodigy have highly advanced mechanisms for feedback and assessment, enabling them to continuously monitor user performance and offer personalized learning experiences (Bernal, 2024). However, these types of applications appear to offer a more structured and limited experience in terms of interaction depth and discovery-based learning opportunities (Webb et al., 2020). This suggests a gap in the current landscape where the integration of rich, exploratory interaction with sophisticated, continuous assessment remains an underexplored design space. Bridging this gap requires a design methodology that intrinsically links game mechanics to learning objectives, enabling real-time adaptive feedback and performance assessment without compromising the experiential richness of the game (Nadolny et al., 2020). Such an approach would move beyond merely evaluating learning outcomes to encompass comprehensive assessments of engagement, usability, and the complex interplay of skills challenged within the game environment, aligning with systematic review findings that identify a prevalence of learning assessments over other critical evaluation metrics (Petri & Wangenheim, 2016).

Games with strong pedagogical designs, such as DragonBox, exhibit a more balanced structure by establishing harmony between learning objectives and game mechanics (Clark et al., 2015). In contrast, applications like Kahoot!, while strong in terms of instant feedback and motivation, focus more on short-term information reinforcement processes and may be limited in deep learning (Forsström et al., 2025). This further underscores the necessity of integrating robust cognitive theories into gamification design to ensure that interventions foster lasting improvements in complex cognitive processes, rather than focusing solely on surface-level engagement (Lee et al., 2025). This necessitates a transition from "shallow" gamification, which often relies on extrinsic rewards, to "deep"

gamification, which integrates motivational frameworks that support intrinsic drive and long-term learning outcomes (John et al., 2023).

EBA content evaluated within the Turkish context offers a significant advantage in terms of pedagogical suitability, but exhibits limitations in game mechanics variety and user experience (Çobanoğlu & Çam, 2022). This situation indicates that pedagogical accuracy is prioritized in local applications; however, game design and interaction depth are not sufficiently developed. This highlights a critical area for improvement, where the integration of advanced game design principles could significantly enhance the efficacy and engagement of pedagogically sound digital learning environments (Rokhmat et al., 2025). To fully leverage the potential of gamification in education, future implementations must integrate robust instructional design principles, comprehensive teacher training, and culturally relevant applications, alongside advanced analytics and AI-driven adaptive elements to personalize learning trajectories (Prasetya et al., 2025).

When all these findings are considered together, it becomes clear that focusing on a single component is insufficient in the educational digital game development process; learning objectives, game mechanics, interaction design, feedback, and assessment processes must be addressed holistically and in a balanced manner. This result is consistent with studies in the literature that emphasize the importance of the relationship between learning and game mechanics (Arnab et al., 2014; Plass et al., 2015). This comprehensive approach is essential for creating effective educational games that promote deeper cognitive engagement and sustained learning outcomes, moving beyond simplistic reward systems to genuinely integrate pedagogical objectives with engaging gameplay (Coelho et al., 2025; Dobroskok et al., 2020). Indeed, the successful integration of digital games into educational paradigms necessitates a multi-faceted design philosophy that transcends mere superficial gamification to cultivate genuinely transformative learning experiences (Reyerson, 2002).

Discussion

The findings of this study largely coincide with the existing literature on the effects of educational digital games on learning processes. In particular, that game-based learning environments increase students' academic achievement, motivation, and level of participation in learning are consistent with previous meta-analytic studies (Boyle et al., 2015; Clark et al., 2015; Wouters et al., 2013). However, it appears that these positive effects are not directly related to the use of games themselves, but rather to how the games are designed and the extent to which they align with pedagogical goals. An effective educational game, therefore, must incorporate appropriate challenges that reinforce students' perceptions of success, integrating conceptual evidence that elucidates the underlying mechanisms of game-based learning's effects (Soriano-Sánchez et al., 2026). This necessitates a sophisticated understanding of cognitive psychology and instructional design principles

to craft game mechanics that directly facilitate knowledge acquisition and skill development (Gui et al., 2023).

An examination of the application analysis findings revealed that educational digital games reflect model components at different levels. Open-world games, particularly Minecraft Education Edition, demonstrate strength in interaction and exploration, but their lack of systematic assessment processes limits the monitoring of learning outcomes (Sena & Stachoň, 2023; Steier & Davidsen, 2021). In contrast, applications like Duolingo offer a highly developed structure in terms of feedback and evaluation processes; however, they are more limited regarding interaction depth and exploration-based learning opportunities (Essafi et al., 2024; Finardi et al., 2016). This clearly demonstrates that focusing on a single dimension is insufficient in educational digital game design. Therefore, a comprehensive design framework is crucial, one that integrates robust pedagogical theories with advanced game mechanics to create immersive and effective learning experiences (Bakhsh et al., 2022; Cano et al., 2024). Such a framework should balance explicit learning objectives with intrinsic motivation, ensuring that game elements are purposefully integrated to support educational goals rather than merely superficially applied (Bruun-Pedersen & Kofoed, 2015; Govender & Arnedo-Moreno, 2021). The efficacy of game-based learning environments is further substantiated by evidence demonstrating their positive impact on motivation, self-efficacy, and academic performance, particularly when pedagogical practices are integrated effectively (Soriano-Sánchez et al., 2026).

EBA content, when evaluated within the Turkish context, shows potential for pedagogical suitability, though some studies highlight inadequacies (Çobanoğlu & Çam, 2022; İskender, 2016; Maltepe, 2022; Tanrıkulu, 2017). However, the fact that this content is generally test and exercise-based limits the depth of the game experience (Akçay, 2024; Maden & Önal, 2020). This finding indicates that pedagogical accuracy is prioritized in local applications; however, the dimensions of game design and user experience are not sufficiently developed. This situation once again highlights the importance of interdisciplinary collaboration in educational digital game development processes. Specifically, the integration of advanced game design principles, informed by psychological and pedagogical research, is essential to transcend conventional "lecturer" formats and foster more dynamic, personalized learning models (Sevindik, 2025). This necessitates a refined approach where game developers collaborate closely with educational theorists to ensure that game mechanics are intrinsically aligned with learning objectives, thereby fostering engagement while simultaneously achieving measurable educational outcomes (Morawski & Wolff-Seidel, 2023).

One of the key findings of this study is the necessity of balancing three fundamental components in the educational digital game development process: pedagogical suitability, game mechanics, and assessment. Many studies in the literature focus on one or two of these components, but applications that integrate all components in a balanced way are limited (Arnab et al., 2014; Plass

et al., 2015). In this context, the proposed EDOGM model offers a holistic approach to addressing this imbalance. By systematically addressing the interplay between learning objectives, immersive gameplay, and robust evaluative measures, the EDOGM model aims to provide a comprehensive framework for designing effective and engaging educational digital games (Jonáš & Ogodo, 2025). This integrated model, therefore, moves beyond the simple incorporation of digital elements into learning, instead advocating for a deep, symbiotic relationship between educational theory and game design (Laoha et al., 2025).

The cyclical structure of the EDOGM model not only defines a development process but also proposes a dynamic framework that enables continuous improvement. In this respect, the model differs from static design approaches by offering an adaptive and improvable framework. In particular, the central role of feedback and measurement-evaluation components within the model allows for the continuous monitoring and improvement of learning processes. This iterative refinement process, driven by empirical data and pedagogical insights, ensures that educational digital games evolve to meet the nuanced needs of learners and educators. Such an adaptive framework is crucial for developing sophisticated game-based learning environments that can effectively address complex thinking skills and real-world problem-solving scenarios (Patiño et al., 2023). This iterative process, encompassing cycles of analysis, design, evaluation, and refinement, allows for the development of both practical and theoretically grounded frameworks (Kara et al., 2025). The emphasis on iterative design, informed by robust assessment mechanisms, underscores the model's potential to bridge the existing disconnect between educational goals and game design strategies, thereby enhancing student engagement and learning outcomes (Kucher, 2021).

However, this study has some limitations. Firstly, the study is a review, and the analysis was conducted on a limited number of application examples. This limits the generalizability of the findings. Furthermore, the fact that the model has not been tested empirically constitutes an important research area for future studies. In conclusion, the findings of this study demonstrate that the educational digital game development process is multi-dimensional and should be addressed with a holistic approach. The proposed EDOGM model is expected to make a significant contribution to filling the theoretical gap in this field and to provide a framework for future research.

Conclusion and Recommendations

This study examines the educational digital game development process within a conceptual and analytical framework. Based on the literature, an Educational Digital Game Development Model (EDOGM) is proposed, and its explanatory power is evaluated through selected application examples. The findings reveal that for educational digital games to be effective learning tools, pedagogical design, game mechanics, and measurement-evaluation processes must be addressed with a balanced and holistic approach (Bellotti et al., 2011; Steiner et al., 2015). Despite these theoretical advancements,

practical implementation often encounters challenges such as insufficient scientific rigor in evaluations, small sample sizes, and a lack of systematic methods for integrating key design factors (Dallaqua et al., 2023; Laoha et al., 2025; Petri & Gresse von Wangenheim, 2017; Zhu et al., 2024). Future research should focus on mitigating these limitations through comprehensive longitudinal studies involving diverse populations and rigorous empirical validation of proposed models like EDOGM to ascertain their broader efficacy and generalizability in varied educational settings (Hare et al., 2024; Holly et al., 2024). Additionally, further studies are needed to evaluate the proposed framework across all four levels of artifact assessment: response, learning, behavior, and outcomes, to provide a more comprehensive understanding of its real-world applicability (Bunt et al., 2024).

In addition to the broader insights derived from existing literature, the specific analytical evaluation of the diverse game sample provided several concrete findings. First, our analysis uncovered a persistent structural disconnect between pedagogical intent and game mechanics: applications developed primarily from a technical standpoint exhibited sophisticated environments but lacked necessary instructional scaffolding, whereas those designed with a pedagogical focus often devolved into superficial "pointification" lacking engaging gameplay loops. Second, the evaluation highlighted a critical neglect of process-oriented assessment, as the majority of analyzed applications relied exclusively on summative, post-game testing rather than integrating continuous, stealth assessment mechanisms. Finally, the feedback systems within the sampled games were predominantly binary and corrective, failing to function in a formative or adaptive capacity to systematically support the learner’s cognitive progression.

These empirical gaps underscore the imperative for the EDOGM model proposed in this study. By synthesizing the critical shortcomings identified during our evaluation, the model provides a comprehensive framework to ensure that learning objectives, interaction design, and cyclical feedback function as an integrated, dynamic system. Accordingly, the findings of this study extend beyond a synthesis of existing literature to delineate precise design vulnerabilities that the EDOGM framework is specifically engineered to address.

The applications examined in this study show that while educational digital games exhibit strengths in various components, these components are often not integrated in a balanced way. This highlights the clear need for an interdisciplinary approach in the educational digital game development process. Combining fields such as educational sciences, software development, and user experience design will contribute to the creation of more effective and sustainable learning environments (Exter, 2018; Kaimara, 2023). Moreover, future endeavors should prioritize empirical validation of integrated design models, employing randomized controlled trials to systematically evaluate the impact of game mechanics and pedagogical strategies on cognitive skills and academic achievement (Bertram, 2020; Erümit et al., 2022). This interdisciplinary research is crucial for providing a deeper and more holistic

understanding of how gamification shapes cognitive and motivational outcomes (Al-khresheh, 2025). Such rigorous validation is essential to address the documented methodological limitations and over-reliance on computer science skills often seen in gamification research, thereby strengthening the reliability and generalizability of findings in this emerging field (Hao et al., 2023; Orsoni et al., 2023).

In this context, the proposed EDOGM model offers a systematic and applicable framework for the educational digital game development process. The model's cyclical structure reveals a dynamic framework that includes not only a design process but also a continuous evaluation and improvement mechanism. In this respect, the model serves as a guiding tool for both researchers and practitioners.

Based on the research findings, the following recommendations can be developed:

- In the development of educational digital games, a clear and direct relationship should be established between learning objectives and game mechanics.
- In game design, equal importance should be given not only to entertainment elements but also to pedagogical suitability.
- Feedback systems should be designed to be immediate, explanatory, and guiding in order to support learning.
- Measurement and evaluation processes should be structured to provide process-oriented data, not just outcome-oriented data.
- Interdisciplinary collaboration should be increased during the development process, and different areas of expertise should work together.

Given the limitations of this research, some suggestions can be made for future studies. Firstly, empirical studies should be conducted to test the applicability of the proposed model at different educational levels and disciplines. Furthermore, it is recommended that research be increased on the integration of technologies such as AI-powered adaptive learning systems, augmented reality, and virtual reality into educational digital games.

In conclusion, educational digital games, when developed with the right design principles, have the potential to make significant contributions to learning processes. The model proposed in this study is considered an important step towards more effectively realizing this potential.

References

Ahmad, M. (2019). Categorizing Game Design Elements into Educational Game Design Fundamentals. In *IntechOpen eBooks*. IntechOpen. https://doi.org/10.5772/intechopen.89971

Ahmad, M., Rahim, L. Ab., & Arshad, N. I. (2015). An analysis of educational games design frameworks from software engineering perspective. *Journal of Information and Communication Technology*, *14*, 123. https://doi.org/10.32890/jict2015.14.8

Akçay, T. (2024). Üst Düzey Düşünme Becerilerinin Okullarda Kullanımına İlişkin Öğretmen Görüşleri. *DergiPark (Istanbul University)*. https://dergipark.org.tr/tr/pub/nefad/issue/89544/1472275

Alawajee, O., & Delafield-Butt, J. (2021). Minecraft in Education Benefits Learning and Social Engagement. *International Journal of Game-Based Learning*, *11*(4), 19. https://doi.org/10.4018/ijgbl.2021100102

Alexiou, A., & Schippers, M. C. (2018). Digital game elements, user experience and learning: A conceptual framework. *Education and Information Technologies*, *23*(6), 2545. https://doi.org/10.1007/s10639-018-9730-6

Al-khresheh, M. H. (2025). The Cognitive and Motivational Benefits of Gamification in English Language Learning: A Systematic Review [Review of *The Cognitive and Motivational Benefits of Gamification in English Language Learning: A Systematic Review*]. *The Open Psychology Journal*, *18*(1). Bentham Science Publishers. https://doi.org/10.2174/0118743501359379250305083002

Anderson, J. R. (2000). *Learning and memory: An integrated approach, 2nd ed.* http://psycnet.apa.org/record/2000-07354-000

Arnab, S., Lim, T., Carvalho, M. B., Bellotti, F., Freitas, S. de, Louchart, S., Suttie, N., Berta, R., & Gloria, A. D. (2014). Mapping learning and game mechanics for serious games analysis. *British Journal of Educational Technology*, *46*(2), 391. https://doi.org/10.1111/bjet.12113

Aydoğan, O., & Karabağ, G. (2020). Eğitsel Bilgisayar Oyunu İle Desteklenmiş Tarih Öğretiminin Öğrencilerin Mekâni Algilama Ve Kronolojik Düşünme Becerilerine Etkisi. *Uluslararası Sosyal Bilgilerde Yeni Yaklaşımlar Dergisi (IJONASS)*. https://doi.org/10.38015/sbyy.734552

Bakhsh, K., Hafeez, M., Shahzad, S., Naureen, B., & Farid, M. F. (2022). Effectiveness of Digital Game Based Learning Strategy in Higher Educational Perspectives. *Journal of Education and E-Learning Research*, *9*(4), 258. https://doi.org/10.20448/jeelr.v9i4.4247

Bellotti, F., Berta, R., Gloria, A. D., Ott, M., Arnab, S., Freitas, S. de, & Kiili, K. (2011). Designing Serious Games for education: from Pedagogical principles to Game Mechanisms. *HAL (Le Centre Pour La Communication Scientifique Directe)*. https://hal.archives-ouvertes.fr/hal-00985800

Bernal, M. E. (2024). Revolutionizing eLearning Assessments: The Role of GPT in Crafting Dynamic Content and Feedback. *Journal of Artificial Intelligence and Technology*. https://doi.org/10.37965/jait.2024.0513

Berta, R., & Moreno-Ger, P. (2018). Introduction: Intelligent Learning Assessment in Serious Games. *International Journal of Serious Games*, *5*(1). https://doi.org/10.17083/ijsg.v5i1.237

Bertram, L. (2020). Digital Learning Games for Mathematics and Computer Science Education: The Need for Preregistered RCTs, Standardized Methodology, and Advanced Technology. *Frontiers in Psychology*, *11*, 2127. https://doi.org/10.3389/fpsyg.2020.02127

Boyle, E., Hainey, T., Connolly, T., Gray, G., Earp, J., Ott, M., Lim, T., Ninaus, M., Ribeiro, C., & Pereira, J. (2015). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. *Computers & Education*, *94*, 178. https://doi.org/10.1016/j.compedu.2015.11.003

Bruun-Pedersen, J. R., & Kofoed, L. B. (2015). How Soft are "Soft Skills" in Engineering Educations? *Research Portal Denmark*, 122. https://local.forskningsportal.dk/local/dki-cgi/ws/cris-link?src=aau&id=aau-20992baf-35fe-4c5a-ad8b-560194dfec05&ti=How%20Soft%20are%20%201CSoft%20Skills%201D%20in%20Engineering%20Educations%3F

Bunt, L., Greeff, J., & Taylor, E. (2024). Enhancing Serious Game Design: Expert-Reviewed, Stakeholder-Centered Framework. *JMIR Serious Games*, *12*. https://doi.org/10.2196/48099

Calderón, A., & Ruiz, M. (2015). A systematic literature review on serious games evaluation: An application to software project management. *Computers & Education*, *87*, 396. https://doi.org/10.1016/j.compedu.2015.07.011

Cano, E. V., Bravo, C. B., Regaña, C. B., & Menéses, E. L. (2024). Exploring the role of interactive games in improving Spanish spelling skills: A Mobile App study. *EDMETIC*, *14*(1), 4. https://doi.org/10.21071/edmetic.v14i1.17374

Cezarotto, M. A., & Chamberlin, B. (2021). Towards accessibility in educational games: a framework for the design team. *InfoDesign - Revista Brasileira de Design Da Informação*, *18*(2). https://doi.org/10.51358/id.v18i2.931

Chartofili, A., & Fokides, E. (2019). Teaching Local History, Culture, Traditions, and Customs Using Digital Games: Preliminary Results from a Case Study in the Island of Nisyros. *Open Journal for Educational Research*, *3*(2), 81. https://doi.org/10.32591/coas.ojer.0302.04081c

Çiftci, K. G., & Yıldız, B. (2024). Impact of Digital Game Design Using Metacognition Strategies on Math Achievement. *DergiPark (Istanbul University)*. https://dergipark.org.tr/tr/pub/ijce/issue/89726/1584113

Clark, D. B., Sengupta, P., Brady, C., Martinez-Garza, M., & Killingsworth, S. S. (2015). Disciplinary integration of digital games for science learning. *International Journal of STEM Education*, *2*(1). https://doi.org/10.1186/s40594-014-0014-4

Clark, D. B., Tanner-Smith, E. E., & Killingsworth, S. S. (2015). Digital Games, Design, and Learning. *Review of Educational Research*, *86*(1), 79. https://doi.org/10.3102/0034654315582065

Çobanoğlu, L., & Çam, E. (2022). Öğretmenlerin Pandemi Sonrası EBA Tutumları ve Kullanım Alışkanlıkları. *Batı Anadolu Eğitim Bilimleri Dergisi*, *13*, 158. https://doi.org/10.51460/baebd.1197252

Coelho, F., Rando, B., Aparício, D., Ribeiro, P. C. P. S. V., Gonçalves, D., & Abreu, A. M. (2025). The impact of educational gamification on cognition, emotions, and motivation: a randomized controlled trial. *Journal of Computers in Education*. https://doi.org/10.1007/s40692-025-00366-x

Coleman, T. E., & Money, A. (2019). Student-centred digital game–based learning: a conceptual framework and survey of the state of the art. *Higher Education*, *79*(3), 415. https://doi.org/10.1007/s10734-019-00417-0

Czauderna, A., & Guardiola, E. (2019). The Gameplay Loop Methodology as a Tool for Educational Game Design. *The Electronic Journal of E-Learning*, *17*(3). https://doi.org/10.34190/jel.17.3.004

Dallaqua, M. F., Nunes, B., & Carvalho, M. M. de. (2023). Serious games research streams for social change: Critical review and framing. *British Journal of Educational Technology*, *55*(2), 460. https://doi.org/10.1111/bjet.13404

Darvishinia, N., & Goodson, T. (2024). Diversity, Representation, and Accessibility Concerns in Game Development. *arXiv (Cornell University)*. https://doi.org/10.48550/arxiv.2407.04892

Daud, S., Yazid, Z. A., Taib, N. M., Othman, M. Z., & Osman, I. (2024). Evaluating the Impact of Usability Components on User Satisfaction in Educational Board Games using the MEEGA+ Framework. *Information Management and Business Review*, *16*, 195. https://doi.org/10.22610/imbr.v16i2(i).3821

Davis, K., Grote, D., Mahmoudi, H., Perry, L., Ghaffarzadegan, N., Grohs, J., Hosseinichimeh, N., Knight, D. B., & Triantis, K. (2023). Comparing Self-Report Assessments and Scenario-Based Assessments of Systems Thinking Competence. *Journal of Science Education and Technology*, *32*(6), 793. https://doi.org/10.1007/s10956-023-10027-2

Deci, E. L., & Ryan, R. M. (2000). The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry*, *11*(4), 227. https://doi.org/10.1207/s15327965pli1104_01

Deliyannis, I., Pace, F. D., Manuri, F., Sanna, A., Lerga, I., Ahmad, M., Václavíková, Z., Kornevs, M., Hauge, J. B., Meijer, S., Smith, K., Shen, Y., Sužnjević, M., Homen, M., Domínguez-Díaz, A., Vallés-Blanco, D., de-Marcos, L., Aguado-Delgado, J., & Caro-Álvaro, S. (2019). Game Design and Intelligent Interaction. In *IntechOpen eBooks*. IntechOpen. https://doi.org/10.5772/intechopen.77403

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. E. (2011). *From game design elements to gamefulness*. 9. https://doi.org/10.1145/2181037.2181040

Dilekçi, A., & Karatay, H. (2023). The effects of the 21st century skills curriculum on the development of students' creative thinking skills. *Thinking Skills and Creativity*, *47*, 101229. https://doi.org/10.1016/j.tsc.2022.101229

Ding, D., Guan, C., & Yu, Y. (2016). Game-Based Learning in Tertiary Education: A New Learning Experience for the Generation Z. *International Journal of Information and Education Technology*, *7*(2), 148. https://doi.org/10.18178/ijiet.2017.7.2.857

Djelil, F., Sanchez, É., Albouy-Kissi, B., Lavest, J., & Albouy-Kissi, A. (2014). Towards a Learning Game Evaluation Methodology in a Training Context: a Literature Review [Review of *Towards a Learning Game Evaluation Methodology in a Training Context: a Literature Review*]. *HAL (Le Centre Pour La Communication Scientifique Directe)*. Centre National de la Recherche Scientifique. https://hal.science/hal-02455128

Dobroskok, I., Rzhevska, N., Айїлдиз, Х., Заімова, Д., & Желязков, Г. (2020). Game Development Software Tools In Higher Educational Institutions: Experience Of Ukraine, Turkey And Bulgaria. *Information Technologies And Learning Tools*, *78*(4), 90. Https://Doi.Org/10.33407/Itlt.V78i4.3370

Eck, R. V. (2008). Building Artificially Intelligent Learning Games. In *Igi Global Ebooks* (P. 793). Igi Global. Https://Doi.Org/10.4018/978-1-59904-941-0.Ch048

Eren, Z. (2019). Investigation of safety and supportive school climate in schools according to various variables. *European Journal of Education Studies*, *5*(11), 56-80. https://zenodo.org/records/2580545

Erümit, S. F., Kalyoncu, F., Kuzu, A., & Karal, H. (2022). Farkli Oyuncu Tiplerine Göre Eğitsel Dijital Oyun Tasarim Süreci. *Dergipark (Istanbul University)*. Https://Dergipark.Org.Tr/Tr/Pub/Kefdergi/Issue/68724/877874

Essafi, M., Belfakir, L., & Moubtassime, M. (2024). Investigating Mobile-Assisted Language Learning Apps: Babbel, Memrise, and Duolingo as a Case Study. *Journal of Curriculum and Teaching*, *13*(2), 197. https://doi.org/10.5430/jct.v13n2p197

Esteban, A. J. (2024). Theories, Principles, and Game Elements that Support Digital Game-Based Language Learning (DGBLL): A Systematic Review [Review of *Theories, Principles, and Game Elements that Support Digital Game-Based Language Learning (DGBLL): A Systematic Review*]. *International Journal of Learning Teaching and Educational Research*, *23*(3), 1. Tresorix Ltd. https://doi.org/10.26803/ijlter.23.3.1

Exter, M. (2018). Developing Multi-Disciplinary Skills through a Course in Educational Software Design. *International Journal of Designs for Learning*, *9*(1), 49. https://doi.org/10.14434/ijdl.v9i1.23413

Faas, T., & Lin, C. (2017). *Self-Directed Learning in Teacher-Lead Minecraft Classrooms*. *19*, 2569. https://doi.org/10.1145/3027063.3053269

Felicia, P. (2009). *Digital games in schools : Handbook for teachers*. https://hal.science/hal-00697599

Finardi, K. R., Leão, R. G., & Amorim, G. B. (2016). Mobile Assisted Language Learning: Affordances and Limitations of Duolingo. *Education and Linguistics Research*, *2*(2), 48. https://doi.org/10.5296/elr.v2i2.9842

Fokides, E., Atsikpasi, P., Kaimara, P., & Deliyannis, I. (2019). Factors Influencing the Subjective Learning Effectiveness of Serious Games. *Journal of Information Technology Education Research*, *18*, 437. https://doi.org/10.28945/4441

Forsström, S., Njå, M., Munthe, E., Álvarez-Galván, J.-L., & Houldsworth, L. (2025). The impact of digital technologies on students' learning. In *OECD education working papers*. https://doi.org/10.1787/9997e7b3-en

Fotouhi-Ghazvini, F., Earnshaw, R., Robison, D., & Excell, P. S. (2009). The MOBO City: A Mobile Game Package for Technical Language Learning. *International Journal of Interactive Mobile Technologies (iJIM)*, *3*(2), 19. https://doi.org/10.3991/ijim.v3i2.757

Freitas, S. de. (2018). Are Games Effective Learning Tools? A Review of Educational Games. *Educational Technology & Society*, *21*(2), 74. http://www.j-ets.net/ETS/journals/21_2/6.pdf

Gaweł, A. (2019). The Influence of Gamification Activities on Learning Outcomes in Higher Education. In *Bogucki Wydawnictwo Naukowe eBooks* (p. 135). Bogucki Wydawnictwo Naukowe. https://doi.org/10.12657/9788379862801-10

Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment*, *1*(1), 20. https://doi.org/10.1145/950566.950595

Govender, T., & Arnedo-Moreno, J. (2021). An Analysis of Game Design Elements Used in Digital Game-Based Language Learning. *Sustainability*, *13*(12), 6679. https://doi.org/10.3390/su13126679

Gui, Y., Cai, Z., Yang, Y., Kong, L., Fan, X., & Tai, R. H. (2023). Effectiveness of digital educational game and game design in STEM learning: a meta-analytic review [Review of *Effectiveness of digital educational game and game design in STEM learning: a meta-analytic review*]. *International Journal of STEM Education*, *10*(1). Springer Science+Business Media. https://doi.org/10.1186/s40594-023-00424-9

Hamari, J., Koivisto, J., & Sarsa, H. (2014). *Does Gamification Work? -- A Literature Review of Empirical Studies on Gamification*. 3025. https://doi.org/10.1109/hicss.2014.377

Hao, T., Winn, J., & Qiang, Q. (2023). Unlocking potential: Systematic review the use of gamification in leadership curriculum. *Education and Information Technologies*, *29*(10), 12305. https://doi.org/10.1007/s10639-023-12332-0

Hare, R., Ferguson, S. L., & Tang, Y. (2024). Enhancing student experience and learning with iterative design in an intelligent educational game. *British Journal of Educational Technology*, *56*(2), 551. https://doi.org/10.1111/bjet.13526

Hauge, J. B., Berta, R., Fiucci, G., Fernández-Manjón, B., Padrón-Nápoles, C. L., Westra, W., & Nadolski, R. (2014). *Implications of Learning Analytics for Serious Game Design*. 230. https://doi.org/10.1109/icalt.2014.73

Hawthorn, S., Jesus, R., & Baptista, M. A. (2021). A review of digital serious games for tsunami risk communication [Review of *A review of digital serious games for tsunami risk communication*]. *International Journal of Serious Games*, *8*(2), 21. Serious Games Society. https://doi.org/10.17083/ijsg.v8i2.411

Holly, M., Habich, L., & Pirker, J. (2024). GameDevDojo -- An Educational Game for Teaching Game Development Concepts. *arXiv (Cornell University)*. https://doi.org/10.48550/arxiv.2407.12050

Huizenga, J. C., Dam, G. T. M. ten, Voogt, J., & Admiraal, W. (2017). Teacher perceptions of the value of game-based learning in secondary education. *Computers & Education*, *110*, 105. https://doi.org/10.1016/j.compedu.2017.03.008

Huo, Y. (2019). A Pedagogy-Based Framework for Optimizing Learning Efficiency across Multiple Disciplines in Educational Games. *International Journal of Information and Education Technology*, *9*(10), 704. https://doi.org/10.18178/ijiet.2019.9.10.1290

Ilić, J., Ivanović, M., & Klašnja-Milićević, A. (2024). Effects Of Digital Game-Based Learning In Stem Education On Students' Motivation: A Systematic Literature Review. *Journal Of Baltic Science Education*, *23*(1), 20. https://doi.org/10.33225/jbse/24.23.20

İlkay, D., & Atİk, A. D. (2024). Fen Bilimleri Dersinde Eğitsel Dijital Oyun Kullanımının 6. Sınıf Öğrencilerinin Motivasyonlarına ve Akademik Başarılarına Etkisi. *Buca Eğitim Fakültesi Dergisi (Online)/Buca Eğitim Fakültesi Dergisi*, *59*, 1. https://doi.org/10.53444/deubefd.1295182

Imran, H. (2019). Evaluation of awarding badges on Student's engagement in Gamified e-learning systems. *Smart Learning Environments*, *6*(1). https://doi.org/10.1186/s40561-019-0093-2

Ishak, S. A., Din, R., & Hasran, U. A. (2021). Beyond Play: Conceptualising the Capability of a Good Digital Game to Stimulate Interest in STEM. *International Journal of Learning Teaching and Educational Research*, *20*(10), 232. https://doi.org/10.26803/ijlter.20.10.13

İskender, H. (2016). Eğitim Bilişim Aği'nda Bulunan 7. Sinif Türkçe Dersi Videolarinin İlköğretim Türkçe Dersi (6, 7, 8. Siniflar) Öğretim Programiyla Uyumu. *DergiPark (Istanbul University)*. https://dergipark.org.tr/tr/pub/adyusbd/issue/37218/429590

Jaccard, D., Suppan, L., Sanchez, É., Huguenin, A., & Laurent, M. (2021). A Generic, Adaptive and Systemic Methodology for the Collaborative Design of Serious Games: Development of the co.LAB Framework (Preprint). *JMIR Serious Games*, *9*(3). https://doi.org/10.2196/28674

Jeanette, E., Ovchinnikova, B., & Nurdiyanto, H. (2022). Student Opinions on the Use of High-Tech Mobile Devices in the Design of Digital Games for Learning. *International Journal of Artificial Intelligence Research*, *6*(2). https://doi.org/10.29099/ijair.v6i2.358

John, D., Hussin, N., Zaini, M. K., Ametefe, D. S., Aliu, A. A., & Caliskan, A. (2023). Gamification Equilibrium: The Fulcrum for Balanced Intrinsic Motivation and Extrinsic Rewards in Learning Systems. *International Journal of Serious Games*, *10*(3), 83. https://doi.org/10.17083/ijsg.v10i3.633

Jonáš, J., & Ogodo, J. (2025). Framework as a Process: A User-Centric Conceptual Framework for Game-Based Learning. *Journal of Research in Science Mathematics and Technology Education*, *8*, 335. https://doi.org/10.31756/jrsmte.4114si

Kaimara, P. (2023). Digital Transformation Stands Alongside Inclusive Education: Lessons Learned from a Project Called "Waking Up in the Morning." *Technology Knowledge and Learning*. https://doi.org/10.1007/s10758-023-09667-5

Kalmpourtzis, G., & Roméro, M. (2020). Constructive alignment of learning mechanics and game mechanics in Serious Game design in Higher Education. *International Journal of Serious Games*, *7*(4), 75. https://doi.org/10.17083/ijsg.v7i4.361

Kapp, K. M. (2012). *The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education*. http://bvbr.bib-bvb.de:8991/F?func=service&doc_library=BVB01&local_base=BVB01&doc_number=024790878&sequence=000001&line_number=0001&func_code=DB_RECORDS&service_type=MEDIA

Kara, M., Cömert, Z., & Samur, Y. (2025). Designing AI-Enhanced Educational Digital Escape Room Games (EDERGs): A Framework for Teacher Implementation. *European Conference on Games Based Learning*, *19*(1), 491. https://doi.org/10.34190/ecgbl.19.1.4154

Kiili, K. (2005). Digital game-based learning: Towards an experiential gaming model. *The Internet and Higher Education*, *8*(1), 13. https://doi.org/10.1016/j.iheduc.2004.12.001

Kiili, K., Lindstedt, A., Koskinen, A., Halme, H., Ninaus, M., & McMullen, J. (2021). Flow Experience and Situational Interest in Game-Based Learning: Cousins or Identical Twins. *International Journal of Serious Games*, *8*(3), 93. https://doi.org/10.17083/ijsg.v8i3.462

Kim, Y. J., & Shute, V. J. (2015). The interplay of game elements with psychometric qualities, learning, and enjoyment in game-based assessment. *Computers & Education*, *87*, 340. https://doi.org/10.1016/j.compedu.2015.07.009

Kocadere, S. A., Özhan, Ş. Ç., Bayrak, F., & Kibar, P. N. (2019). Herkül'ün Hikayesi: Bir Eğitsel Oyun Modeli Önerisi. *Eğitim Teknolojisi Kuram Ve Uygulama*, *9*(1), 230. Https://Doi.Org/10.17943/Etku.451990

Kopniak, N. B. (2018). The Use Of Interactive Multimedia Worksheets At Higher Education Institutions. *Information Technologies and Learning Tools*, *63*(1), 116. https://doi.org/10.33407/itlt.v63i1.1887

Kucher, T. (2021). Principles and Best Practices of Designing Digital Game-Based Learning Environments. *International Journal of Technology in Education and Science*, *5*(2), 213. https://doi.org/10.46328/ijtes.190

Kurt, E., & Dindar, A. Ç. (2024). Thinking Through Play: How Designing Educational Games Enhances Critical Thinking, Motivation and Achievement in Science Classes. *DergiPark (Istanbul University)*. https://doi.org/10.52911/itall.1592036

Laoha, R., Deesongkram, M., & Rudto, N. (2025). Gamification-Based Engineering Design Process Instructional Model to Enhance Digital Innovation Creativity Skills for Upper Secondary School Students. *Journal of Education and Learning*, *15*(1), 319. https://doi.org/10.5539/jel.v15n1p319

Lee, C.-Y., Lee, C., Lai, H.-Y., Chen, P.-J., Chen, M., & Yau, S. (2025). Emerging trends in gamification for clinical reasoning education: a scoping review [Review of *Emerging trends in gamification for clinical reasoning education: a scoping review*]. *BMC Medical Education*, *25*(1). BioMed Central. https://doi.org/10.1186/s12909-025-07044-7

Leuchter, I., & Kurtz, G. (2022). Effects of Instructions, Assistance, Narrative, Competition, Challenge, and Age on Performances in Digital Learning Games. *International Journal of Advanced Corporate Learning (iJAC)*, *15*(2), 16. https://doi.org/10.3991/ijac.v15i2.30867

Li, M., Ma, S., & Shi, Y. (2023). Examining the effectiveness of gamification as a tool promoting teaching and learning in educational settings: a meta-analysis. *Frontiers in Psychology*, *14*, 1253549. https://doi.org/10.3389/fpsyg.2023.1253549

Li, Y., Chen, D., & Deng, X. (2024). The impact of digital educational games on student's motivation for learning: The mediating effect of learning engagement and the moderating effect of the digital environment. *PLoS ONE*, *19*(1). https://doi.org/10.1371/journal.pone.0294350

Liu, Y., Hu, X., Ng, J., Ma, Z., & Lai, X. (2024). Ready or not? Investigating in-service teachers' integration of learning analytics dashboard for assessing students' collaborative problem solving in K–12 classrooms. *Education and Information Technologies*. https://doi.org/10.1007/s10639-024-12842-5

Lobanova, A., Chiknoverova, K., & Tomina, I. (2022). El diseño de los resultados de aprendizaje utilizando las tecnologías de juego: un ejemplo de los elementos y procesos del diseño arqu. *Innovaciencia Facultad de Ciencias Exactas Físicas y Naturales*, *10*(1), 1. https://doi.org/10.15649/2346075x.2959

Maden, S., & Önal, A. (2020). Eğitim Bilişim Aği (Eba) İçerik Modülündeki Türkçe Dersi İle İlgili Dokümanlar. *Eğitim Teknolojisi Kuram ve Uygulama*, *10*(1), 25. https://doi.org/10.17943/etku.553517

Maiorca, C., Roberts, T., Jackson, C., Bush, S. B., Delaney, A., Mohr-Schroeder, M. J., & Soledad, S. Y. (2020). Informal Learning Environments and Impact on Interest in STEM Careers. *International Journal of Science and Mathematics Education*, *19*(1), 45. https://doi.org/10.1007/s10763-019-10038-9

Maltepe, S. (2022). An Investigation of the Quality of Grammar Instruction: Case of Education Informatics Network. *International Journal of Education and Literacy Studies*, *10*(3), 63. https://doi.org/10.7575/aiac.ijels.v.10n.3p.63

Manesis, D. (2020). Digital Games in Primary Education. In *IntechOpen eBooks*. IntechOpen. https://doi.org/10.5772/intechopen.91134

Marone, V. (2016). Playful Constructivism: Making Sense of Digital Games for Learning and Creativity Through Play, Design, and Participation. *Journal of Virtual Worlds Research*, *9*(3). https://doi.org/10.4101/jvwr.v9i3.7244

Martínez, K., Menéndez, I. M., & Bustillo, A. (2022). A New Measure for Serious Games Evaluation: Gaming Educational Balanced (GEB) Model. *Applied Sciences*, *12*(22), 11757. https://doi.org/10.3390/app122211757

Mavromihales, M., Holmes, V., & Răcăşăn, R. (2018). Game-based learning in mechanical engineering education: Case study of games-based learning application in computer aided design assembly. *International Journal of Mechanical Engineering Education*, *47*(2), 156. https://doi.org/10.1177/0306419018762571

Maxim, R. I., & Arnedo-Moreno, J. (2025). EDTF: A User-Centered Approach to Digital Educational Games Design and Development. *Information*, *16*(9), 794. https://doi.org/10.3390/info16090794

Moore, G. T., & Piaget, J. (1971). Science of Education and the Psychology of the Child. *Journal of Architectural Education (1947-1974)*, *25*(4), 113. https://doi.org/10.2307/1423801

Morawski, M., & Wolff-Seidel, S. (2023). Gaming & Geography (Education): Gaming and Geography (Education): A Model of Reflexive Analysis of Space and Action in Video Games. *European Journal of Geography*, *14*(3), 1. https://doi.org/10.48088/ejg.m.mor.14.3.001.019

Muenz, T. S., Schaal, S., Groß, J., & Paul, J. (2023). How a Digital Educational Game can Promote Learning about Sustainability. *Science Education International*, *34*(4), 293. https://doi.org/10.33828/sei.v34.i4.5

Nadolny, L., Valai, A., Cherrez, N. J., Elrick, D., Lovett, A., & Nowatzke, M. (2020). Examining the characteristics of game-based learning: A content analysis and design framework. *Computers & Education*, *156*, 103936. https://doi.org/10.1016/j.compedu.2020.103936

Naidoo, K. N. (2024). A Review of the Effectiveness of Educational Digital Game-Based Learning on Students in Tertiary Institutions. *European Journal of Teaching and Education*, *5*(4), 34. https://doi.org/10.33422/ejte.v5i4.1174

Narayanan, K. S., & Kumaravel, A. (2024). Hybrid Gamification and AI Tutoring Framework using Machine Learning and Adaptive Neuro-Fuzzy Inference System. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, *42*(2), 221. https://doi.org/10.37934/araset.42.2.221233

Norris, C. M., Taylor, T., & Lummis, G. W. (2023). Fostering collaboration and creative thinking through extra-curricular challenges with primary and secondary students. *Thinking Skills and Creativity*, *48*, 101296. https://doi.org/10.1016/j.tsc.2023.101296

Orsoni, M., Dubé, A. K., Prandi, C., Giovagnoli, S., Benassi, M., Mazzoni, E., & Benvenuti, M. (2023). Learning Landscape in Gamification: The Need for a Methodological Protocol in Research Applications. *Perspectives on Psychological Science*, *20*(3), 460. https://doi.org/10.1177/17456916231202489

Pacheco-Velázquez, E., Rodés, V., Rabago-Mayer, L., & Bester, A. (2023). How to Create Serious Games? Proposal for a Participatory Methodology. *International Journal of Serious Games*, *10*(4), 55. https://doi.org/10.17083/ijsg.v10i4.642

Pan, Q. (2019). A Interactive Teaching Mode Based on Educational Games – Case Study of Acupuncture Course. *International Journal of Emerging Technologies in Learning (iJET)*, *14*(17), 167. https://doi.org/10.3991/ijet.v14i17.11205

Panskyi, T., & Rowińska, Z. (2021). A Holistic Digital Game-Based Learning Approach to Out-of-School Primary Programming Education. *Informatics in Education*. https://doi.org/10.15388/infedu.2021.12

Patiño, A., Ramírez-Montoya, M. S., & Buenestado-Fernández, M. (2023). *Active learning and education 4.0 for complex thinking training: analysis of two case studies in open education*.

Petri, G., & Wangenheim, C. G. von. (2016). How to Evaluate Educational Games: a Systematic Literature Review. *JUCS - Journal of Universal Computer Science*, *22*, 992. https://dblp.uni-trier.de/db/journals/jucs/jucs22.html#PetriW16

Petri, G., & Wangenheim, C. G. von. (2017). How games for computing education are evaluated? A systematic literature review. *Computers & Education*, *107*, 68. https://doi.org/10.1016/j.compedu.2017.01.004

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of Game-Based Learning. *Educational Psychologist*, *50*(4), 258. https://doi.org/10.1080/00461520.2015.1122533

Prasetya, F., Fortuna, A., Samala, A. D., Andriani, W., Bagus, M. I., Renaldi, I., Rawas, S., Criollo-C, S., & Ayasrah, F. T. (2025). Gamification in Vocational Education: A Systematic Literature Review of Strategies, Theories, and Impacts. *SN Computer Science*, *6*(8). https://doi.org/10.1007/s42979-025-04488-y

Prensky, M. (2003). Digital game-based learning. *Computers in Entertainment*, *1*(1), 21. https://doi.org/10.1145/950566.950596

Proulx, J.-N., Romero, M., & Arnab, S. (2016). Learning Mechanics and Game Mechanics Under the Perspective of Self-Determination Theory to Foster Motivation in Digital Game Based Learning. *Simulation & Gaming*, *48*(1), 81. https://doi.org/10.1177/1046878116674399

Putri, E. N., Rahmawati, L. E., Sufanti, M., & Mansoor, H. S. (2023). Educational game based on macromedia flash in Indonesian language learning in junior high school. *BAHASTRA*, *43*(2), 234. https://doi.org/10.26555/bs.v43i2.521

Reyerson. (2002). *The Art of the Deal*. https://doi.org/10.1163/9789004475564

Rokhmat, J., Gunawan, G., Sukarso, A., Rahmatiah, R., Mahmudah, H., & Amanah, P. D. (2025). Revealing the Weaknesses of Applying Gamification in Science Learning and Overcoming It: A Systematic Review

[Review of *Revealing the Weaknesses of Applying Gamification in Science Learning and Overcoming It: A Systematic Review*]. *TEM Journal*, 2462. UIKTEN. https://doi.org/10.18421/tem143-50

Santos, W. O. dos. (2018). EGV: A Methodology Proposal to Educational Games Virtualization. *RENOTE*, *16*(1). https://doi.org/10.22456/1679-1916.85875

Savitska, V., Gomotiuk, O., Stefanyshyn, O., Rashid, M. A., Lengyelfalusy, T., & Surin, S. (2025). Educational Possibilities of Gamification in the Formation of Soft & Hard Skills among Students of Socionomic Professions. *Journal of Education Culture and Society*, *16*(2), 819. https://doi.org/10.15503/jecs2025.3.819.839

Sena, Í. S. de, & Stachoň, Z. (2023). Designing Learning Activities in Minecraft for Formal Education in Geography. *International Journal of Emerging Technologies in Learning (iJET)*, *18*(4), 32. https://doi.org/10.3991/ijet.v18i04.36307

Sevindik, T. (2025). OYUNLAŞTIRMA TABANLI YENİ NESİL OKUL TASARIMI: GELENEKSEL EĞİTİM SÜREÇLERİNİ YENİDEN ŞEKİLLENDİRME. *DergiPark (Istanbul University)*. https://dergipark.org.tr/en/pub/ijofe/issue/94101/1668318

Shelton, B. E., & Wiley, D. (2007). *The Design and Use of Simulation Computer Games in Education*. https://doi.org/10.1163/9789087903121

Sobota, B., Pietriková, E., Parapanos, D., Ahmad, M., Wang, H.-M., Tsai, C.-L., & Sun, C. (2023). Computer Science for Game Development and Game Development for Computer Science [Working Title]. In *IntechOpen eBooks*. IntechOpen. https://doi.org/10.5772/intechopen.1000364

Soriano-Sánchez, J. G., López, R. Q., & Rodríguez, D. A. (2026). The Impact of Game-Based Learning on Motivation, Self-Efficacy, and Academic Achievement in the Natural Sciences: A Meta-Analysis. *Education Sciences*, *16*(1), 122. https://doi.org/10.3390/educsci16010122

Stanciu, C. G. I. A., & Stănescu, D. F. (2019). Development of an Integrated Game Based Assessment Approach – The Next Generation of Psychometric Testing. *European Journal of Sustainable Development*, *8*(5), 270. https://doi.org/10.14207/ejsd.2019.v8n5p270

Stănescu, D. F., IONITA, C., & IONITA, A. M. (2020). Game-thinking in Personnel Recruitment and Selection: Advantages and Disadvantages. *Postmodern Openings*, *11*(2), 267. https://doi.org/10.18662/po/11.2/174

Steier, R., & Davidsen, J. (2021). Adapting Interaction Analysis to CSCL: a systematic review [Review of *Adapting Interaction Analysis to CSCL: a systematic review*]. *Research Portal Denmark*, 157. Technical University of Denmark. https://local.forskningsportal.dk/local/dki-cgi/ws/cris-link?src=aau&id=aau-24ff293a-f9b9-4d96-bd8a-aed2cb0114a7&ti=Adapting%20Interaction%20Analysis%20to%20CSCL%3A%20a%20systematic%20review

Steiner, C., Hollins, P., Kluijfhout, E., Dascălu, M., Nussbaumer, A., Albert, D., & Westera, W. (2015). Evaluation of Serious Games: A Holistic Approach. *Open University of the Netherlands Research Portal*, 4334. https://doi.org/10.13140/rg.2.1.3761.8002

Stoddard, J. D. (2015). Toward a game-based pedagogy: Lessons from the field. *Journal of Curriculum and Teaching*, *4*(2), 11. https://doi.org/10.5430/jct.v4n2p11

Tanrıkulu, F. (2017). EBA'nın Türkçe Dersi Öğrenme Alanlarını Karşılama Yeterliliğine Yönelik Öğretmen Görüşleri. *Ana Dili Eğitimi Dergisi*, 395. https://doi.org/10.16916/aded.331244

Tokarieva, A. V., Волкова, Н., Harkusha, I. V., & Soloviev, V. (2019). Educational digital games: models and implementation. *CTE Workshop Proceedings*, *6*, 74. https://doi.org/10.55056/cte.369

Tsekleves, E., Cosmas, J., & Aggoun, A. (2014). Benefits, barriers and guideline recommendations for the implementation of serious games in education for stakeholders and policymakers. *British Journal of Educational Technology*, *47*(1), 164. https://doi.org/10.1111/bjet.12223

Udeozor, C., Abegão, F. R., & Glassey, J. (2023). Measuring learning in digital games: Applying a game-based assessment framework. *British Journal of Educational Technology*, *55*(3), 957. https://doi.org/10.1111/bjet.13407

Valentová, M., & Brečka, P. (2023). Assessment of Digital Games in Technology Education. *International Journal of Engineering Pedagogy (iJEP)*, *13*(2), 36. https://doi.org/10.3991/ijep.v13i2.35971

Vygotsky, L. S. (1978). Mind in Society: The Development of Higher Psychological Processes. In *Medical Entomology and Zoology*. Japan Society of Medical Entomology and Zoology. https://ci.nii.ac.jp/ncid/BA03570814

Wang, L.-H., Chen, B., Hwang, G., Guan, J., & Wang, Y. (2022). Effects of digital game-based STEM education on students' learning achievement: a meta-analysis. *International Journal of STEM Education*, *9*(1). https://doi.org/10.1186/s40594-022-00344-0

Wang, Y., & Deng, P. (2025). Educational Game Design and Evaluation from a Learning Analytics Perspective. In *Advances in Social Science, Education and Humanities Research/Advances in social science, education and humanities research* (p. 217). https://doi.org/10.2991/978-2-38476-440-2_26

Watanapokakul, S. (2018). A Development of a Game-based Supplementary E-learning Program for English for Veterinary Profession I. *Deleted Journal*, *55*(1), 178. https://doi.org/10.58837/chula.pasaa.55.1.8

Webb, M., Fluck, A., Magenheim, J., Malyn-Smith, J., Waters, J., Deschênes, M., & Zagami, J. (2020). Machine learning for human learners: opportunities, issues, tensions and threats. *Educational Technology Research and Development*, *69*(4), 2109. https://doi.org/10.1007/s11423-020-09858-2

Wouters, P., Nimwegen, C. van, Oostendorp, H. van, & Spek, E. D. van der. (2013). A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology*, *105*(2), 249. https://doi.org/10.1037/a0031311

Zhou, G. (2024). Navigating the Future Landscape of Gamified Education. *SHS Web of Conferences*, *187*, 2005. https://doi.org/10.1051/shsconf/202418702005

Zhu, Y., Zhou, R., & Zhang, Y. (2024). Designing preschool children's educational games for enlightenment through decision analysis methods. *Multimedia Tools and Applications*, *83*(32), 78331. https://doi.org/10.1007/s11042-024-19803-7

Zuo, C. (2023). Development of self-critical abilities and values in students using digital games-based learning. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1193