AI AND GAMIFICATION FOR INCLUSIVE AND ENGAGING LEARNING: A PRELIMINARY SCOPING REVIEW

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ABSTRACT
This preliminary scoping review explores the intersection between Artificial Intelligence and gamification in education, aiming to map emerging evidence, implementation models, and good practices for teaching and learning. It examines how AI-based systems, adaptive feedback, learning analytics, and gameful design can support engagement, personalization, inclusion, and students' active participation. Following a non-exhaustive review design, the contribution identifies recurrent application areas, pedagogical opportunities, and critical issues, and the risk of reducing motivation to automated rewards. The review argues for moving beyond a merely technical view of innovation, framing AI and gamification as educational mediators that require intentional design, methodological coherence, and attention to relational and affective dimensions. The outcome is a first conceptual map to inform future empirical research and teacher education.

KEYWORDS
Artificial intelligence; gamification; education.

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[1] Paragraphs 1, and 5.
[2] Paragraphs 3, and 4.
[3] Paragraph 2.

1. Introduction

In recent years, artificial intelligence has taken on an increasingly significant role in pedagogical and educational debate, progressively redefining the ways in which learning environments are designed, organized, and evaluated. The spread of adaptive systems, learning analytics, educational chatbots, intelligent tutoring systems, and generative models has enabled increasing personalization of educational pathways, opening new perspectives for student support, instructional design, and teacher education. The usability of AI devices and platforms has expanded considerably, permeating multiple aspects of everyday life, also thanks to their intrinsic features of accessibility and intuitiveness.

At the same time, gamification has become established as an approach capable of addressing the motivational, participatory, and experiential dimensions of learning through the integration of game-based elements into non-game contexts. In educational and instructional settings, gamification represents a particularly fruitful area of application, as it can make teaching materials and content, assessment and evaluation tools, and, more broadly, learning experiences more dynamic and engaging.

Interest in the integration of artificial intelligence and gamification arises from the possibility of moving beyond a merely instrumental conception of educational technology. When considered separately, AI and gamification offer significant potential: the former makes it possible to analyze data, adapt content, provide personalized feedback, and support decision-making processes; the latter can foster engagement, persistence, a sense of progression, and active participation. However, it is in their intentional integration that a particularly promising pedagogical perspective emerges. Artificial intelligence can make gamified elements dynamic and adaptive, while

gamification can make AI-enhanced environments more accessible, motivating, and meaningful. This may have effective implications both for teachers' work, by supporting them in the design of adaptive and personalized learning environments, and for students' learning experiences, by motivating them through gamification elements and activities designed according to their needs.

This reflection is particularly relevant in contemporary school contexts, which are increasingly complex and heterogeneous, and in which the personalization of content and processes is becoming a necessity. From this perspective, designing learning environments based on AI and gamification means questioning how these technologies can respond to learner variability, support the participation of each student, reduce barriers to learning, and promote forms of cognitive, emotional, and social engagement. The inclusive dimension therefore represents a fundamental criterion for assessing the educational value of technological innovation.

The topic is also particularly timely in light of the rapid spread of generative artificial intelligence systems since 2023, which has accelerated scientific production and international debate on the educational implications of AI. In this scenario, schools are called upon to introduce new tools while, at the same time, developing pedagogical models capable of guiding their use in critical, informed, and responsible ways. Technological innovation, in fact, does not automatically generate educational innovation: it requires intentional design, professional competencies, ethical awareness, and the ability to translate the possibilities offered by tools into meaningful educational experiences.

From this perspective, the role of teachers becomes central. The integration of AI and gamification does not concern only the availability of digital platforms or applications but also entails reflection on the competencies needed to design accessible, motivating, and personalized learning environments. Initial

and in-service teacher education therefore represents a strategic area, as it enables the development of pedagogical awareness, design competencies, and critical capacities regarding the use of emerging technologies. Teachers are called upon to interpret data, select tools consistent with educational objectives, monitor their effects on students, and ensure that the solutions adopted do not amplify inequalities or forms of exclusion.

In light of these premises, this contribution proposes a preliminary scoping review aimed at mapping recent literature on the integration of artificial intelligence and gamification in education. The objective is not to evaluate the effectiveness of a specific type of intervention, but rather to explore the field of research by identifying emerging trends, prevailing thematic areas, modes of integration between AI and gamification, and possible implications for inclusion, personalization, engagement, and teacher education. The choice of a scoping review responds to the broad and multidimensional nature of the topic, which is still undergoing theoretical and methodological consolidation.

Specifically, the article aims to answer the following research question: what emerging evidence exists on the integration of artificial intelligence and gamification in education with respect to engagement, personalization, and inclusion? This question makes it possible to analyze the joint presence of AI and gamification in educational contexts and, at the same time, the quality of their design relationship. Indeed, the mere coexistence of intelligent tools and gamified elements does not necessarily guarantee a genuine pedagogical synergy. It is therefore necessary to distinguish between approaches in which AI and gamification are effectively integrated and approaches in which they are merely placed side by side.

The contribution is thus positioned at the intersection of special education and educational technologies, adopting inclusion as a central interpretative lens for analyzing the relationship between innovation and the quality of educational processes. The perspective adopted considers AI and gamification not as neutral or universally valid solutions, but as pedagogical devices whose effectiveness depends on intentional design. It is therefore necessary to reflect on how to design, mediate, and evaluate them in light of students' needs, educational aims, and the concrete conditions of school contexts. In this sense, the review aims to offer a preliminary mapping that may be useful for guiding future empirical research, supporting instructional design, and contributing to the debate on teacher education in the age of artificial intelligence.

2. AI and Gamification in Education: Personalization, Engagement, and Inclusion

This contribution is structured around three closely interconnected conceptual cores: artificial intelligence in education, gamification as a motivational and design-oriented approach, and the inclusive personalization of learning. Alongside these, the role of teacher education is addressed as a cross-cutting and necessary condition for guiding the use of emerging technologies within a conscious and pedagogically grounded design framework. These conceptual nodes make it possible to understand the integration of AI and gamification as a complex pedagogical configuration in which technologies, motivational processes, instructional design, and inclusive approaches mutually influence one another.

Artificial intelligence in education can be defined as the set of systems, models, and applications capable of supporting teaching and learning processes through data processing, content adaptation, feedback generation, the

automation of certain functions, and the personalization of educational experiences. In school contexts, AI takes shape through a variety of tools: intelligent tutoring systems, adaptive platforms, conversational chatbots, learning analytics-based environments, recommendation systems, applications for language support, generative tools, and digital environments capable of monitoring students' progress. It should be emphasized, however, that the pedagogical relevance of AI lies in its potential to support learning processes that are more flexible, responsive, and attentive to student diversity.

From an educational perspective, AI introduces a significant transformation in the relationship between data, design, and instructional intervention. Intelligent systems can collect information on performance, response times, recurring errors, levels of participation, and learning trajectories, providing useful indications for adapting activities and feedback (Amatori et al., 2024; De Mutiis et al., 2025). However, this potential must be interpreted critically. The risk is that personalization may be reduced to an automated process of technical adaptation, neglecting the relational, cultural, emotional, and contextual dimensions of learning. For this reason, AI in education always requires pedagogical and professional mediation, in which the teacher maintains a central role of interpretation, guidance, and responsibility.

The second essential theoretical reference is gamification, understood from the perspective presented by Deterding et al. (2011), namely the use of game elements, dynamics, and mechanics in non-game contexts. Landers (2014) was among the first authors to highlight the educational and pedagogical effectiveness of this approach, especially with regard to typical game elements that can directly influence learning, such as challenge, progression, and self-efficacy. In education, gamification is used to support motivation, promote participation, make progress visible, foster engagement, and increase students'

persistence when facing complex tasks (Anderle et al., 2022; Koivisto & Hamari, 2019). Elements such as points, badges, levels, challenges, missions, immediate feedback, leaderboards, narratives, and progressive goals can contribute to transforming the learning experience, provided that they are coherently integrated with instructional objectives and not reduced to mere external incentives (Bruni, 2015; Sardo, 2023).

The literature on gamification highlights a crucial distinction between superficial design, mainly centered on rewards and competition, and deeper design, oriented toward supporting autonomy, competence, relatedness, meaning, and participation (Cavus et al., 2023; Pelizzari, 2025). From this perspective, the educational value of gamification does not depend on the presence of isolated game elements, but on their capacity to construct a motivating, accessible, and meaningful educational experience. Gamification can support student engagement when it enables learners to perceive clear goals, receive timely feedback, experience progress, take on an active role, and live learning as an exploratory pathway.

The integration of AI and gamification opens up interesting perspectives in education. More specifically, artificial intelligence may represent a particularly effective tool for designing gamified learning activities, as well as for supporting teachers in personalizing such activities, thus enabling adaptive, personalized, and learner-sensitive approaches. For example, an intelligent system can modulate the difficulty level of challenges, personalize feedback, propose differentiated missions, adapt content and pathways, recognize patterns of disengagement or frustration, and suggest targeted interventions. In this way, teachers may have greater opportunities to devote attention to observing and monitoring activities and, consequently, to developing more precise reflections on learning processes, which are essential for returning to instructional design

from a recursive perspective. Gamification thus becomes part of a dynamic environment capable of responding in real time to students' characteristics, progress, and difficulties (Gaggioli, 2022; Palma & De Mutiis, 2025).

This possibility is particularly relevant from the perspective of inclusive education. Inclusion, by its very nature, implies the design of environments capable of recognizing learner variability (Giaconi et al., 2024). On the basis of such design, inclusive teaching aims to offer, within the Universal Design for Learning framework outlined by CAST (2024), multiple means of engagement, representation, action, and expression. In this framework, AI and gamification can contribute to reducing barriers to learning, provided that they are guided by inclusive pedagogical principles. Indeed, it is crucial that personalization supports participation within the learning community to which the student belongs.

The reference to inclusion therefore makes it possible to distinguish between adaptive personalization and inclusive personalization. The former tends to regulate content, timing, and difficulty according to individual performance; the latter also takes into account the context, relationships, opportunities for participation, and each student's right to be involved in common yet flexible experiences. From this perspective, AI and gamification can offer important opportunities for students with special educational needs, executive function difficulties, learning disorders, neurodivergences, or conditions of disadvantage, but only if they are designed to expand opportunities for access, choice, expression, and self-regulation.

A further theoretical element concerns the concept of engagement, which cannot be reduced solely to motivation or to the frequency of use of a platform. Educational engagement includes behavioral, cognitive, emotional, and social dimensions. Gamification can support visible participation and persistence in

tasks; AI can help monitor and adapt the experience; and inclusive design can ensure that engagement is not limited to students who are already motivated or technologically competent. The integration of these dimensions makes it possible to interpret engagement as meaningful participation, namely as the opportunity for students to feel like active participants in the learning process.

In this scenario, the teacher assumes a decisive function. The presence of intelligent systems and gamified environments does not replace pedagogical competence; rather, it makes it even more necessary. Teachers must be able to evaluate the appropriateness of tools, design activities consistent with educational objectives, interpret data produced by platforms, monitor motivational dynamics, prevent forms of exclusion, and ensure the ethical and responsible use of technologies. Teacher education therefore becomes a cross-cutting and fundamental axis for the effective integration of AI and gamification in school contexts.

Initial and in-service teacher education should promote not only technical skills, but also critical, design-oriented, and inclusive capacities. Teachers must be able to understand the operating logic of tools, their limitations, possible biases, implications related to privacy and data protection, and the pedagogical consequences of design choices. In particular, it is necessary to avoid perceiving AI as an automatic solution to learning problems or reducing gamification to an entertainment strategy. Both require educational intentionality, methodological reflection, and attention to students' real needs.

The theoretical framework outlined so far therefore makes it possible to interpret the integration of AI and gamification as an emerging and promising field, yet one still marked by ambiguities. On the one hand, the convergence between intelligent systems and gamified strategies may foster more personalized, motivating, and inclusive environments; on the other hand, the

mere co-presence of technologies does not guarantee pedagogical innovation. It is necessary to understand when AI and gamification are effectively integrated within a coherent educational design and when, instead, they are merely juxtaposed. This distinction represents one of the central interpretative nodes of the present scoping review.

In light of these considerations, the present study adopts an exploratory and critical perspective. It is exploratory because it aims to map a recent and rapidly evolving field of research; it is critical because it seeks to question the pedagogical quality of the integration between AI and gamification, with particular attention to its implications for inclusion, personalization, engagement, and teacher education. The proposed theoretical framework thus provides the conceptual basis for interpreting the results of the review and for identifying future directions for research and instructional design.

3. Methodology

This study is designed as a scoping review, aimed at conducting an exploratory investigation into the integration of Artificial Intelligence and gamification in educational settings, with particular attention to the dimensions of engagement, personalization, and inclusion, as well as the implications for teacher education. The scoping review, unlike systematic reviews, does not seek to synthesize evidence of effectiveness for a single intervention; rather, it maps the existing literature on a broad topic, identifying key concepts, types of evidence, and knowledge gaps (Munn *et al.*, 2018).

The analysis seeks to address the following research question:

"What emerging evidence exists on the integration of Artificial Intelligence and gamification in education in terms of engagement, personalization, and inclusion?"

To structure the research question and guide the selection of contributions, the PCC framework (Population, Concept, Context) was adopted, given its flexibility with plural and multidimensional objects of study.



Figure 1 – PCC framework (Population, Concept, Context)

The first item - Population - includes primary and secondary school students, pre-service and in-service teachers, as well as instructional designers working in formal educational contexts. The second item - Concept - concerns the integration of Artificial Intelligence systems with gamification elements, aimed at promoting engagement, personalization, and inclusion. The third item - Context - includes teacher education programs as an institutional domain with direct implications for school practices. The aim is to provide a comprehensive mapping of the topic and open a space for reflection on rethinking learning pathways and instructional design in the era of artificial intelligence. Scopus was used as the primary database for data collection, selected for its wide coverage of indexed publications in the educational and technological fields. Linguistic restrictions to English-language publications

were applied to the inclusion criteria in order to ensure uniformity and comparability of the selected contributions. Bibliographic management was entrusted to Zotero software, to optimize the storage, organization, annotation, and sharing of references and research data.

While inclusion criteria were defined at a preliminary stage, exclusion criteria were specified during the eligibility phase, in line with the logic of scoping reviews. Inclusion and exclusion criteria were summarized in tabular form to facilitate immediate consultation and ensure methodological transparency.

Table 1 — Inclusion and exclusion criteria

Criterion	Inclusion	Exclusion
Language	English	Other languages
Study type	Primary studies, secondary studies (reviews, meta-analyses), theoretical studies and conceptual frameworks	Editorials, letters, commentaries without analysis
Publication date	2023–2026	Publications prior to 2023
Topic	Integration of AI and gamification in formal educational settings	Studies without explicit reference to AI and/or gamification; non-educational contexts
Context	Primary school, secondary school, teacher education	Higher education (except teacher education), health care, corporate, or non-school contexts

In a subsequent phase, the most relevant key terms in relation to the research question were identified and combined through Boolean operators to construct the search string, respecting the syntactic specifications of the Scopus database. The string used is as follows:

TITLE-ABS-KEY (("artificial intelligence" OR "AI" OR "machine learning" OR "adaptive learning" OR "learning analytics" OR "intelligent tutoring" OR "generative AI" OR "chatbot" OR "LLM") AND ("gamification" OR "gameful design" OR "game-based learning" OR "serious games" OR "game

elements") AND ("education" OR "learning" OR "teaching" OR "school" OR "teacher education" OR "teacher training" OR "inclusive education" OR "student engagement" OR "personalization" OR "personalized learning"))

The selection of contributions was supported by consultation of the PRISMA-ScR guidelines (Tricco et al., 2018), to ensure transparency and reproducibility of the research process. The identification, screening, eligibility, and inclusion phases were conducted systematically, with double verification at critical selection stages.

4. Results

The search conducted on Scopus was concluded on May 11, 2026 and returned an initial corpus of 259 contributions. Selection was carried out through a double-blind screening process, in which two reviewers operated independently across the entire dataset. The first reviewer included 30 articles, excluded 194, and flagged 35 contributions as uncertain. The second reviewer included 55 articles, excluded 152, and flagged 52 contributions as uncertain. Discordant cases were subsequently reconsidered collegially through a reconciliation phase. Following this process, the final corpus includes 45 contributions, while 214 articles were excluded for non-conformity with the defined criteria.

To ensure full transparency in the selection process, the reasons for exclusion were documented for all 259 records identified through database searching. Although the PRISMA-ScR flow diagram reports the exclusions occurring at each formal stage of the screening process, a comprehensive account of all exclusionary decisions is provided below, including those applied during title and abstract screening. This approach was adopted in order to offer a complete

and traceable record of the selection criteria as applied throughout the review, in accordance with the principles of methodological rigor and reproducibility that characterize the scoping review methodology.

The reasons for exclusion, applied throughout the entire selection process - from title and abstract screening to full-text analysis - were as follows:

- **Non-conformity with the research question (72 articles)**, contributions did not address the integration of AI and gamification in an educational perspective in a relevant manner, proving thematically extraneous to the objectives of the review.
- **Non-school or non-formal context (51 articles)**, studies conducted in healthcare, corporate, military, tourism, or other contexts without formal educational purposes.
- **Higher education context (33 articles)**, studies referring exclusively to adult university students, not falling within the scope defined by the PCC framework.
- **Game-Based Learning instead of gamification (29 articles)**, contributions adopted game-based learning approaches without drawing on gamification mechanics properly understood.
- **Absence or marginality of gamification (25 articles)**, contributions dealt exclusively with artificial intelligence without any effective integration of gamification elements.
- **Absence or marginality of AI (5 articles)**, contributions dealt with gamification without any effective integration of artificial intelligence systems.

The research process unfolded as illustrated in the diagram:

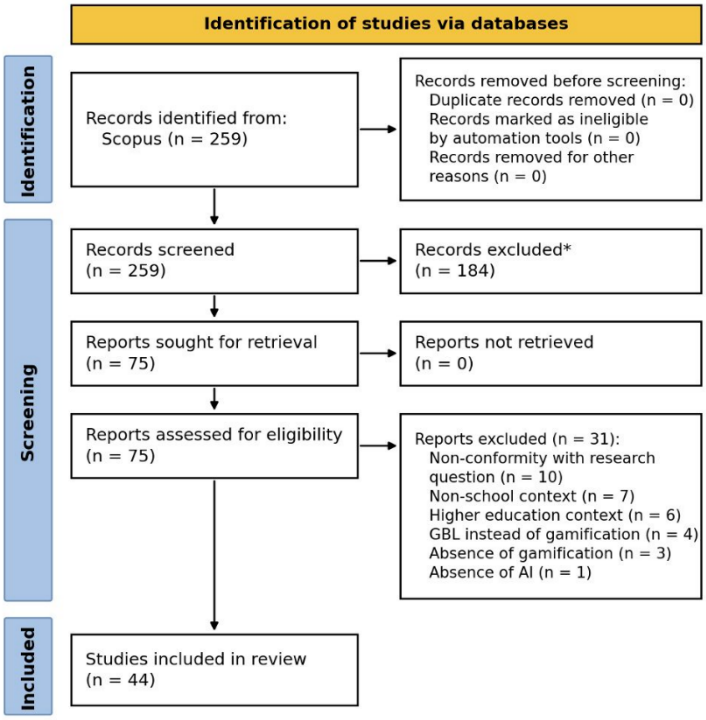


Figure 2 – PRISMA-ScR flow diagram

The 44 included contributions were published between 2023 and 2026, with a marked concentration in 2025 (n=28; 64%), followed by 2026 (n=8; 18%), 2023 (n=4; 9%), and 2024 (n=4; 9%). This temporal distribution highlights exponential growth in scientific interest in the integration of AI and gamification in education, consistent with the rapid diffusion of large language models from 2023 onwards.

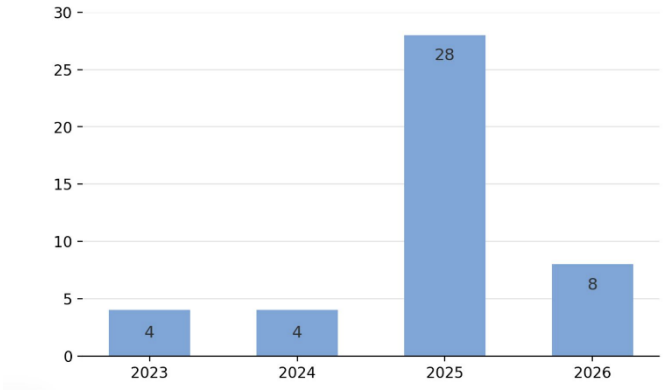


Figure 3 – Temporal distribution of included studies (2023–2026)

In terms of methodological typology, the research corpus is dominated by empirical studies (n=32; 73%), confirming the centrality of experimental and quasi-experimental approaches in the field. These are followed by review studies - including systematic reviews, one integrative review, one meta-analysis, and one bibliometric analysis - (n=8; 18%), and to a lesser extent theoretical and conceptual contributions (n=4; 9%). The decision to include both empirical studies and theoretical contributions reflects the preliminary nature of this scoping review, which aimed to map the field on a broad scale.

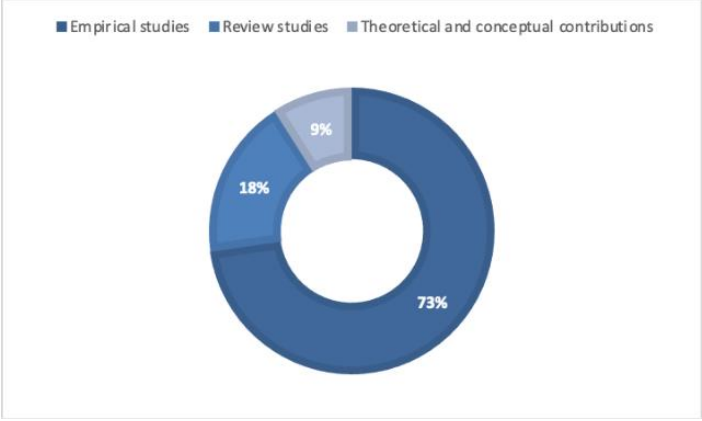


Figure 4 – Methodological typology of included studies

With regard to the school level, secondary school is the most represented context (n=16; 36,4%), followed by primary school (n=5; 11,4%) and early childhood education (n=2; 4.5%). A substantial group of studies involves multiple school levels simultaneously or is not anchored to a specific context, including mixed and theoretical contributions (n=13; 29.5%), alongside studies explicitly covering both primary and secondary levels (n=4; 9.1%). Within this framework, contributions are specifically dedicated to teacher education (n=4; 9.1%).

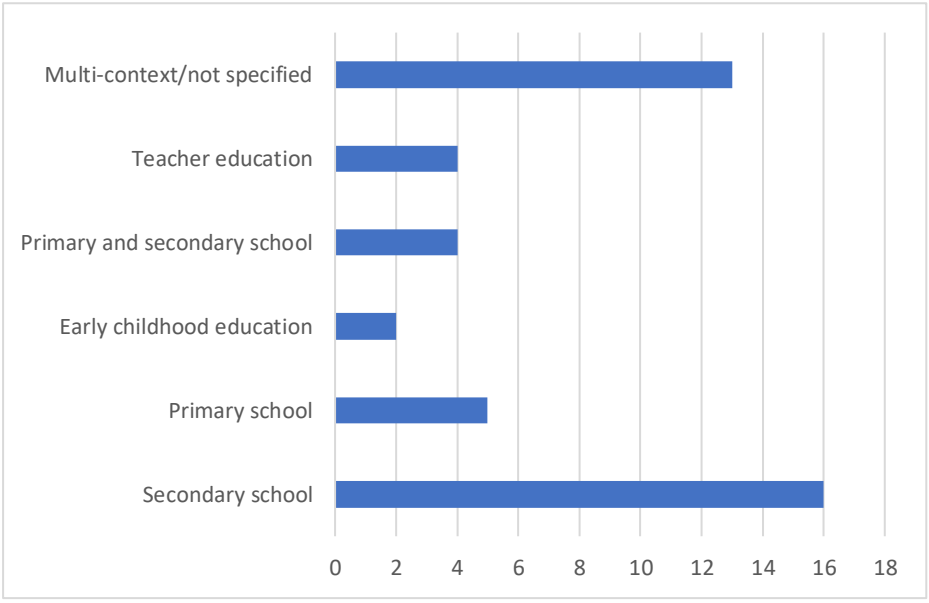


Figure 5 – Distribution of included studies by school level

With regard to the mode of integration between AI and gamification, the most significant finding concerns studies in which the two elements are genuinely integrated (n=18; 40.9%), where AI dynamically enhances or adapts game elements. In 11 studies (25%), AI and gamification are instead used in parallel, without an intentional integration by design. A substantial group of contributions (n=12; 27.3%) consists of reviews, frameworks, and theoretical

studies that address both elements without specifying the nature of their relationship. Finally, in 3 studies (6.8%), gamification is used as a tool to teach AI to students, representing a peculiar use in which AI becomes an object of learning rather than a pedagogical tool. The analysis thus reveals a critical element: in the 11 studies just mentioned, the two elements are simply placed alongside each other without intentional integration by design, and the mere co-presence of tools does not equate to pedagogical synergy. When AI and gamification operate in parallel without interaction, the approach risks losing its transformative potential, being reduced to an overlap of technologies rather than a genuine pedagogical innovation.

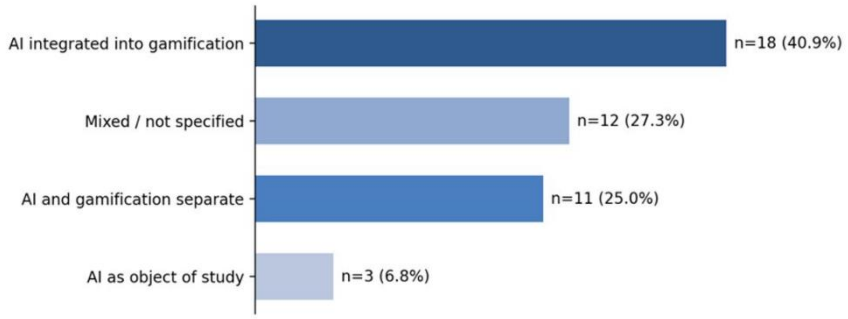


Figure 6 – Mode of integration between AI and gamification

5. Discussion and Conclusion

The results of this initial literature review allow some relevant considerations to be outlined regarding the integration of artificial intelligence and gamification in educational contexts. The first element that emerges concerns the rapid growth of scientific interest in this field, which has become particularly evident since 2025. This increase confirms how the introduction of generative and adaptive AI systems has accelerated reflection on the possibility of rethinking learning environments from a more personalized, interactive

perspective oriented toward student engagement. However, the growing number of contributions does not yet correspond to the full maturity of the field, which still appears to be in a phase of theoretical, methodological, and design-related definition.

A particularly significant finding concerns the way in which AI and gamification are brought into relation with one another. Only some of the included studies show a genuine integration of the two elements, in which artificial intelligence contributes to dynamically adapting content, feedback, levels of difficulty, learning pathways, and gamified mechanics. In these cases, gamification becomes part of a responsive learning environment capable of supporting participation and accompanying learning processes in a more flexible way. Conversely, in other contributions, AI and gamification are simply placed side by side, without an intentional design of their interaction. This aspect represents a critical issue: the co-presence of innovative technologies does not automatically produce pedagogical innovation unless it is supported by a coherent instructional design and a clear educational intentionality.

In relation to the research question, the evidence collected suggests that the integration of AI and gamification may contribute positively to engagement, personalization, and inclusion, although with some caveats. In terms of engagement, gamified elements appear to foster motivation, persistence, and participation, especially when associated with immediate feedback, visible progression, and clear objectives. In terms of personalization, AI can make learning pathways more adaptive by modulating activities and resources according to students' needs, performance, and learning pace.

From this perspective, inclusion represents the decisive pedagogical criterion for assessing the value of the integration between AI and gamification. Educational technologies can reduce certain barriers to learning, but they can

also generate new ones, especially when they do not take into account learner variability, accessibility conditions, special educational needs, and linguistic, cognitive, emotional, and sociocultural differences. For this reason, the design of learning environments based on AI and gamification should be guided by the principles of Universal Design for Learning, providing multiple forms of engagement, representation, action, and expression. The objective should not be merely to make learning more effective or more motivating, but to build genuinely participatory experiences in which each student can find favorable conditions for learning, contributing, and feeling recognized.

This review presents some limitations that should be carefully considered. First, the search was conducted using a single database, Scopus, and included only English-language contributions published between 2023 and 2026. Furthermore, the preliminary nature of the scoping review does not allow definitive conclusions to be drawn regarding the effectiveness of the interventions analyzed; rather, it makes it possible to map trends, emerging categories, and areas that remain underexplored. Further research should broaden the databases considered, include studies in other languages, examine the methodological quality of the interventions in greater depth, and develop empirical investigations in school contexts, with particular attention to students with special educational needs and to inclusive design processes.

In conclusion, the integration of artificial intelligence and gamification represents a promising field for the renewal of teaching and learning, but its educational value depends on the quality of pedagogical design. AI can make learning environments more adaptive and personalized; gamification can support motivation, participation, and a sense of progression; and inclusion can guide both toward the construction of accessible, meaningful, and participatory experiences. The future challenge, therefore, does not

consist simply in introducing new technologies into schools, but in designing learning environments in which innovation, equity, and educational intentionality are closely connected.

Included articles

Table 2 - Included articles

N	Authors	Title	Year
1	Stalmach A. et al.	A conceptual impact model of digital support for student self-regulation and emotion regulation grounded in self-determination theory	2025
2	Shilaskar S. et al.	A gamified online learning environment with comprehensive assessments and software integration	2025
3	Kassenkhan A.	A KNN-Based Bilingual Book Recommendation System with Gamification and Learning Analytics	2026
4	Aravind A. et al.	Adaptive AI-Based Personalized Learning for Accelerated Vocabulary and Syntax Mastery in Young English Learners	2025
5	Bazargani J.S. et al.	Adaptive Spelling in Immersive Reality: The Impact of Gamified VR and LLMs on Young Learners' English Color Word Acquisition	2025
6	Sethi S.S.; Jain K.	AI technologies for social emotional learning: recent research and future directions	2024
7	Sayed W.S. et al.	AI-based adaptive personalized content presentation and exercises navigation for an effective and engaging E-learning platform	2023
8	Sun X. et al.	AI-driven gamified speech training for primary students: framework and evaluation	2025
9	Chavez O.J.; Palaoag T.	AI-driven mobile application: unraveling students' motivational feature preferences for reading comprehension	2024

10	Li P. et al.	AI-Enhanced E-Learning for Intellectual Property Education: Cultiv ating International Talents Through Accessible and Personali sed Digital Training	2026
11	Adi P.N. et al.	AI-enhanced gamification in education: an integrative review of trends, impacts, and corrective role potential	2026
12	Bachiri Y.-A. et al.	Artificial Intelligence Empowers Gamifica tion: Optimizing Student Engagement and Learning Outcomes in E-learning and MOOCs	2023
13	Sheejamol P.T. et al.	Beyond the One-Size-Fits-All: A Systematic Review of Personalized and Gamified e-Learning for Neurodivergent Learners	2025
14	Ursachi T.-M.; Dascalu M.-I.	Curriculum to Immersion: A Conceptual Framework of AI-Assisted Scenario Generation in Extended Reality for Primary and Secondary Education	2025
15	Getman Y. et al.	Developing an AI-Assisted Low-Resource Spoken Language Learning App for Children	2023
16	Khaoula A. et al.	EduXgame: Gamified learning for secondary education	2025
17	Bayaga A.	Enhancing mathematics problem-solving skills in AI-driven environment: Integrated SEM-neural network approach	2024
18	Ku N.	Exploring elementary pre-service teachers' instrumental genesis in designing AI chatbots	2026
19	Aswini M.G. et al.	Exploring the Impact of Gamified Artificial Intelligence-Driven English Vocabulary Learning Systems on Learner Retention and Motivation	2026
20	Ng D.T.K. et al.	Fostering students' AI literacy development through educati onal games: AI knowledge, affective and cognitive engagement	2024
21	Costescu C. et al.	Functionality, safety and usability of a digital platform supporting executive func	2025

		tions in children with specific educational support needs	
22	Khosrawi-Rad B. et al.	Game-inspired Pedagogical Conversational Agents: A Systematic Literature Review	2023
23	Kassenkhan A.M. et al.	Gamification and Artificial Intelligence in Education: A Review of Innovative Approaches to Fostering Critical Thinking	2025
24	Alanzi A.A.; Taloba A.I.	Gamification and Deep Learning-Driven Transformer Feedback Mechanism for Adaptive Language Learning Assessment	2025
25	Pawnsawan P.	Gamified Flipped Design Innovation Classroom with AI Chatbot to Promote Soft Skills for Student Innovators	2025
26	Gomez Nino J.R. et al.	Gamifying Learning with AI: A Pathway to 21st-Century Skills	2025
27	Setiawan R. et al.	Harnessing AI-based learning media in education: A meta-analysis of its effects on student achievement	2025
28	Susilawati W. et al.	Integrating realistic mathematics education, AI, and gamification to enhance students' learning motivation and problem-solving skills	2025
29	Panjaburee P. et al.	Modeling the sustainability perspectives on personalized digital games for digital citizenship education: A PLS-SEM approach	2025
30	Jimenez-Valverde G. et al.	Narrative-Driven Digital Gamification for Motivation and Presence: Preservice Teachers' Experiences in a Science Education Course	2025
31	Ristianto S. D. et al.	Personalized Gamification a Technological Approach for Student Education: A Systematic Literature Review	2025
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References

Achour, K., Lachgar, M., Elloubab, A., Ait Ouahda, Y., Laanaoui, M. D., & Ourahay, M. (2025). EduXgame: Gamified learning for secondary education. Software Impacts, 24, 100761. https://doi.org/10.1016/j.simpa.2025.100761

Adi, P. N., Köhler, T., Triyono, M. B., Priyanto, Handayani, S. A., & Maruanaya, R. F. (2026). AI-enhanced gamification in education: An integrative review of trends, impacts, and corrective role potential. Journal of Computers in Education, 13, 1183–1212. https://doi.org/10.1007/s40692-026-00387-0

Alammary, A. (2025). VClass Engager: A generative AI-based system for enhancing student engagement in synchronous online classes. Electronics, 14(21), 4154. https://doi.org/10.3390/electronics14214154

Alanzi, A. A., & Taloba, A. I. (2025). Gamification and deep learning-driven transformer feedback mechanism for adaptive language learning assessment. Journal of Machine and Computing, vol.5, no.2, pp. 789-803, April 2025, DOI: 10.53759/7669/jmc202505062.

Amatori, G., De Mutiis, E., & Pavone Salafia, P. (2024). Perspectives on personalization for inclusion: prompt engineering and ICF in the case of Asklea Chatbot. *Italian Journal of Health Education, Sport and Inclusive Didactics.* 8(2), 1-12. https://doi.org/10.32043/gsd.v8i2.1139

Anderle, F., Cattoni, A., Venuti, P., & Pasqualotto, A. (2022). The use of gamification to improve reading and writing abilities in primary schools. *Form@re – Open Journal per la Formazione in Rete.* 22(3), 30-49. https://doi.org/10.36253/form-13524

Aravind, A., Durairaj, M., Chitkara, P., El-Ebiary, Y. A. B., Muniyandy, E., Ushasree, L., & Ben Ammar, M. (2025). Adaptive AI-based personalized learning for accelerated vocabulary and syntax mastery in young English learners. International Journal of Advanced Computer Science and Applications, 16(4), 678–687. https://doi.org/10.14569/IJACSA.2025.0160467

Aswini, G., Munagala, M., Saranya, V., R, K., Smerat, A., Sumra, V., & Taloba, A. I. (2026). Exploring the impact of gamified artificial intelligence–driven English vocabulary learning systems on learner retention and motivation. International Journal of Advanced Computer Science and Applications, 17(1), pp. 692 – 704. https://doi.org/10.14569/IJACSA.2026.0170168

Bachiri, Y.-A., Mouncif, H., & Bouikhalene, B. (2023). Artificial intelligence empowers gamification: Optimizing student engagement and learning outcomes in e-learning and MOOCs. International Journal of Engineering Pedagogy, 13(8), 4–19. https://doi.org/10.3991/ijep.v13i8.35565

Bataineh, R. F., Obeiah, S. F., & Bataineh, R. F. (2026). Tuning in with technology: AI-enhanced listening instruction in the Jordanian EFL classroom. Journal of Information Technology Education: Innovations in Practice, 25, Article 7. https://doi.org/10.28945/5699

Bayaga, A. (2024). Enhancing mathematics problem-solving skills in AI-driven environment: Integrated SEM-neural network approach. Computers in Human Behavior Reports, 16, 100491. https://doi.org/10.1016/j.chbr.2024.100491

Bazargani, J. S., Sadeghi-Niaraki, A., Shi, X., & Choi, S.-M. (2025). Adaptive spelling in immersive reality: The impact of gamified VR and LLMs on young learners' English color word acquisition. IEEE Access, 13, 131789-131802. https://doi.org/10.1109/ACCESS.2025.3591114

Bruni, F. (2015). Observations on the perspectives and limits of the evidence-based approach in the evaluation of gamification processes, *REM – Research on Education and Media,* 7(2). https://doi.org/10.1515/rem-2015-0015

CAST (2024). *Universal Design for Learning Guidelines version 3.0.* Lynnfield, MA: Author. https://udlguidelines.cast.org/

Cavus, N., Ibrahim, I., Ogbonna Okonkwo, M. O., & Bode Ayansina, N. B., & Modupeola, T. (2023). The Effects of Gamification in Education: A Systematic Literature Review. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 14(2), 211-241. https://doi.org/10.18662/brain/14.2/452

Chavez, O. J., & Palaoag, T. D. (2024). AI-driven mobile application: Unraveling students' motivational feature preferences for reading comprehension. Journal of Research in Innovative Teaching & Learning, 17(2), 226–242. https://doi.org/10.1108/JRIT-02-2024-0045

Cimino, S., Maremmani, A. G. I., & Cerniglia, L. (2025). The use of artificial intelligence (AI) in early childhood education. Societies, 15(12), 341. https://doi.org/10.3390/soc15120341

Costescu, C., Ferreira, P., Ferreira, A., David, C., Herrera, G., Heldal, I., Dæhlen, A., Kovari, A., Brito, J., Campos, J., Vera, L., Stilwell, D., Lopes, S., Stefanut, T. T., Thill, S., Bueno, M. L. P., Haselager, P., Coggins, T., Fernández, M., & Rosan, A. (2026). Functionality, safety and usability of a digital platform supporting executive functions in children with specific educational support needs. Journal of Enabling Technologies, 20(1), 34–55. https://doi.org/10.1108/JET-01-2025-0003

Dahri, N. A., Rahman, M. M., Sarker, M. F. H., Sarker, S. K., Nihar, M. A., & Rahman, M. S. (2025). The effect of AI gamification on students' engagement and academic achievement in Malaysia: SEM analysis perspectives. IEEE Access, 13, 70791–70810. https://doi.org/10.1109/ACCESS.2025.3560567

De Mutiis, E., Cesaretti, L., Palma, F., Pavone Salafia, P., & Amatori, G. (2025). Artificial intelligence and inclusive dynamics: An adaptive educational ecosystem for personalized learning. *Italian Journal of Special Education for Inclusion*, 13(1), 69-81.

De Mutiis, E., Pavone Salafia, P., Palma, F., & Amatori, G. (2025). Artificial intelligence and inclusive teaching: reflections from the use of a chatbot to support instructional design and teacher professionalism. *Journal of Inclusive Methodology and Technology in Learning and Teaching*, 5(3), 1-10.

Desai, R., et al. (2026). Tech-based motivational design. Journal of Engineering Education Transformations, Volume 39, January 2026, Special Issue 2, eISSN 2394-1707.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L.E. (2011). From game design elements to gamefulness: defining "gamification", *Proceeding of the 15th international academic MindTrek conference: Envisioning future media environments,* 9-15. ACM. https://doi.org/10.1145/2181037.2181040

Fibriasari, H., Waluyo, B. D., Putri, T. T. A., Soraya, T. R., & Harianja, N. (2025). Revolutionizing language learning: The power of AI-driven chatbots in enhancing engagement and proficiency. International Journal of Information and Education Technology, 15(10), 2058–2071. https://doi.org/10.18178/ijiet.2025.15.10.2405

Gaggioli, C. (2022). La classe oltre le mura. Gamificare per includere. Milano: FrancoAngeli.

Getman, Y., Phan, N., Al-Ghezi, R., Voskoboinik, E., Singh, M., Grósz, T., Kurimo, M., Salvi, G., Svendsen, T., Strömbergsson, S., Smolander, A., & Ylinen, S. (2023). Developing an AI-assisted low-resource spoken language learning app for children. IEEE Access, 11, 86025–86037. https://doi.org/10.1109/ACCESS.2023.3304274

Giaconi, C., Del Bianco, N., & D'Angelo, I. (2024). La progettazione come dispositivo inclusivo. In P. Aiello & C. Giaconi (a cura di), *L'agire inclusivo. Interfacce pedagogiche e didattiche. Manuale per l'insegnante.* 75-98, Scholé.

Gómez Niño, J. R., Árias Delgado, L. P., Chiappe, A., & Ortega González, E. (2025). Gamifying learning with AI: A pathway to 21st-century skills. Journal of Research in Childhood Education, 39(4), 735–750. https://doi.org/10.1080/02568543.2024.2421974

Jiménez-Valverde, G., Fabre-Mitjans, N., & Guimerà-Ballesta, G. (2025). Narrative-driven digital gamification for motivation and presence: Preservice teachers' experiences in a science education course. Computers, 14(9), 384. https://doi.org/10.3390/computers14090384

Junruang, C., & Kanjug, I. (2025). The relationship between computational and creative thinking in preschool children: An application through gamification and artificial intelligence-supported constructivist personalized learning environment. Educational Process: International Journal, 17, e2025337. https://doi.org/10.22521/edupij.2025.17.337

Kassenkhan, A. (2026). A KNN-based bilingual book recommendation system with gamification and learning analytics. Information, 17(2), 120. https://doi.org/10.3390/info17020120

Kassenkhan, A. M., Moldagulova, A. N., & Serbin, V. V. (2025). Gamification and artificial intelligence in education: A review of innovative approaches to fostering critical thinking. IEEE Access, 13, 98699–98728. https://doi.org/10.1109/ACCESS.2025.3576147

Khosrawi-Rad, B., Grogorick, L., & Robra-Bissantz, S. (2023). Game-inspired pedagogical conversational agents: A systematic literature review. AIS Transactions on Human-Computer Interaction, 15(2), 146–192. https://doi.org/10.17705/1thci.00187

Khosrawi-Rad, B., Keller, P. F., Benner, D., Grogorick, L., Borchers, A., Janson, A., Leimeister, J. M., & Robra-Bissantz, S. (2025). Promoting students' motivation in language education with gamified pedagogical conversational agents. Computers & Education, 238, 105374. https://doi.org/10.1016/j.compedu.2025.105374

Koivisto, J., & Hamari, J. (2019). The rise of motivational information systems: a review of gamification research, *International Journal of Information Management,* 45, 191-210. https://doi.org/10.1016/j.ijinfomgt.2018.10.013

Koskinen, A., Aikoma, T., Lindstedt, A., & Kiili, K. (2025). Pre-training AI fundamentals enhance game-based AI ethics learning: A quasi-experimental study. International Journal of Game-Based Learning (IJGBL), 15(1), 1-22. https://doi.org/10.4018/IJGBL.397672

Ku, N. (2026). Exploring elementary pre-service teachers' instrumental genesis in designing AI chatbots. Eurasia Journal of Mathematics, Science and Technology Education, 22(3), em2792. https://doi.org/10.29333/ejmste/18067

Landers, R.N. (2014). Developing a theory of gamified learning: Linking serious games and gamification of learning, *Simulation & Gaming,* 45(6), 752-768. https://doi.org/10.1177/1046878114563660

Li, P., Liu, J., Yao, J., & Luo, L. (2026). AI-enhanced e-learning for intellectual property education: Cultivating international talents through accessible and personalised digital training. European Journal of Education, 61(1), e70480. https://doi.org/10.1111/ejed.70480

López-Galisteo, A. J., & Borrás-Gené, O. (2025). The creation and evaluation of an AI assistant (GPT) for educational experience design. Information, 16(2), 117. https://doi.org/10.3390/info16020117

Machado, A., Tenório, K., Santos, M. M., Peixoto Barros, A., Rodrigues, L., Ferreira Mello, R., Paiva, R. & Dermeval, D. (2025). Workload perception in educational resource recommendation supported by artificial intelligence: A controlled experiment with teachers. Smart Learning Environments, 12, 20. https://doi.org/10.1186/s40561-025-00373-6

Munn, Z., Peters, M. D., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC medical research methodology*, *18*(1), 143. https://doi.org/10.1186/s12874-018-0611-x

Ng, D. T. K., Xinyu, C., Leung, J. K. L., & Chu, S. K. W. (2024). Fostering students' AI literacy development through educational games: AI knowledge, affective and cognitive engagement. Journal of Computer Assisted Learning, 40(5), 2049–2064. https://doi.org/10.1111/jcal.13009

Palma, F., & De Mutiis E. (2025). Playing for Inclusion: evaluating Board Games as a Tool for Enhancing Executive Functions*, QTimes. Journal of Education Technology and Social Studies*, 17(4), 433-446.

Panjaburee, P., Hwang, G.-J., Intarakamhang, U., & Srisawasdi, N. (2025). Modeling the sustainability perspectives on personalized digital games for digital citizenship education: A PLS-SEM approach. Computers and Education: Artificial Intelligence, vol. 4, 2025, 100498. https://doi.org/10.1016/j.caeai.2025.100498

Pawnsawan, P. (2025). Gamified flipped design innovation classroom with AI chatbot to promote soft skills for student innovators. International Journal of Information and Education Technology, 15(7) 1436-1448. https://doi.org/10.18178/ijiet.2025.15.7.2345

Pelizzari, F. (2025). Strategie ludiche per l'apprendimento. Gioco, Videogioco e Gamification in contesti educativi e didattici. Lecce: PensaMultimedia.

Pušić, L., Jagušt, T., Horvat, M., & Boras, B. (2026). The impact of a hidden AI-based chatbot on the quality of collaborative problem solving in a school context. Electronics, 15(5), 956. https://doi.org/10.3390/electronics15050956

Ristianto, S. D., Putri, A., & Rosmansyah, Y. (2025). Personalized gamification a technological approach for student education: A systematic literature review. IEEE Access, 13, 55712–55726. https://doi.org/10.1109/ACCESS.2025.3552826

Sardo, M. (2023). Gamification: modelli di progettazione, risultati accademici e valore pedagogico. Analisi di secondo ordine di evidenze. Form@re – Open Journal per la Formazione in Rete, 23(1), 176-188. https://doi.org/10.36253/form-14518

Sayed, W. S., Noeman, A. M., Abdellatif, A., Abdelrazek, M., Badawy, M. G., Hamed, A., & El-Tantawy, S. (2023). AI-based adaptive personalized content presentation and exercises navigation for an effective and engaging e-learning platform. Multimedia Tools and Applications, 82(3), 3303–3333. https://doi.org/10.1007/s11042-022-13076-8

Sethi, S. S., & Jain, K. (2024). AI technologies for social emotional learning: Recent research and future directions. Journal of Research in Innovative Teaching & Learning, 17(2), 213–225. https://doi.org/10.1108/JRIT-03-2024-0073

Setiawan, R., Farisiyah, U., Abidin, M. Z., & Widiawanti, W. (2025). Harnessing AI-based learning media in education: A meta-analysis of its effects on student achievement. Participatory Educational Research, 12(1), 222–242. https://doi.org/10.17275/per.25.12.12.1

Sheejamol, P. T., Chacko, A. M., & Madhu Kumar, S. D. (2025). Beyond the one-size-fits-all: A systematic review of personalized and gamified e-learning for neurodivergent learners. Electronic Journal of e-Learning, 23(3), 101–119. DOI: 10.34190/ejel.23.3.4051

Shilaskar, S., Bhatlawande, S., Deshpande, R., Shinde, S., Madake, J., & Solanke, A. (2025). A gamified online learning environment with comprehensive assessments and software integration. International Journal of Advances in Applied Sciences, 14(2), 416–429. https://doi.org/10.11591/ijaas.v14.i2.pp416-429

Stalmach, A., Reinck, C., D'Elia, P., Di Sano, S., & Casale, G. (2025). A conceptual impact model of digital support for student self-regulation and emotion regulation grounded in self-determination theory. Discover Education, 4(1), 383. https://doi.org/10.1007/s44217-025-00825-8

Sun, X., Xu, Z.-X., Meng, L.-C., & Shi, D.-N. (2025). AI-driven gamified speech training for primary students: Framework and evaluation. Computers and Education Open, 9, 100312. https://doi.org/10.1016/j.caeo.2025.100312

Susilawati, W., Sharov, S., Pasqa, M., & Malik, H. (2025). Integrating realistic mathematics education, AI, and gamification to enhance students' learning motivation and problem-solving skills. Journal on Mathematics Education, 16(4), 1257–1282. https://doi.org/10.22342/jme.v16i4.pp1257-1282

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., ... & Straus, S. E. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Annals of internal medicine, 169(7), 467-473. https://doi.org/10.7326/M18-0850

Ursachi, T.-M., & Dascalu, M.-I. (2025). Curriculum to immersion: A conceptual framework of artificial intelligence-assisted scenario generation in extended reality for primary and secondary education. Electronics, 14(24), 4955. https://doi.org/10.3390/electronics14244955

Wongla, A., Chatwattana, P., & Piriyasurawong, P. (2025). Study of perspectives towards the development of the gamified computational thinking platform with AI prompt engineering. TEM Journal, 14(4), 3206 – 3216. https://doi.org/10.18421/TEM144-29