# A Literature Review: Which, How and What for the Use of Artificial Intelligence in Gamification

**Lanlan Gao**
National University of Ireland Maynooth, Maynooth, Ireland

Lanlan.Gao@mu.ie

**Abstract:** Artificial intelligence (AI) is integrated into educational methods through game-like elements, including gamification and serious games, offering tools and approaches to enhance teaching and learning experiences. A comprehensive review was adopted in this study to generate an overall trend or effect on AI in gamification. The paper selection was based on the three databases. Related 22 articles were collected by searching through academic journals or conference proceedings that were published in English from 2019 to 2024. The findings present that machine learning is utilised in serious games, favouring AI that might support gamification and improve results such as enhanced learning outcomes. Some included studies discuss the direct and indirect connection between technologies and gamification, including personalisation, adaptive difficulty, feedback and motivation, predictive analytics, and data-driven Insights. Overall, those interested in the intersection of artificial intelligence and gamification, including researchers, practitioners, developers, educators, and policymakers, can benefit from the literature review.

**Keywords**: Artificial Intelligence, Gamification, Serious Games

## 1. Introduction

This research delves into the synergies between artificial intelligence (AI) and gamified elements, concentrating on facets like customisation, scalable complexity, interactive feedback, engagement enhancement, foresight through analytics, and insights informed by data. Its objective is to provide meaningful information for an audience comprising scholars, industry professionals, creators, teachers, and decision-makers eager to integrate AI in gamified learning settings.

### 1.1 Background

Deterding and colleagues (2011) describe gamification as applying game design elements in non-game contexts to enhance engagement, motivation, and overall user experience in activities beyond conventional gaming spheres. They highlight the use of game-oriented frameworks, designs, and methodologies in sectors not commonly linked with gaming. Fitzgerald & Ratcliffe (2020) support this definition by highlighting the significance of game-related structure, design, and methodology in serious games, which are a practical application of gamification. Furthermore, the core elements of gamification are detailed by Wood & Reiners (2015), who identify game dynamics (including player behaviours, interactions, and experiences), pedagogical or instructional design, and game mechanics (procedures and rules) as fundamental components. Additionally, common gamification tools, such as points, badges, leaderboards, and timed performance, are utilized to enhance user engagement and achievement recognition (Buckley et al., 2018; van Gaalen et al., 2021).

As discussed by Deterding et al. (2011), Serious games have been utilised across various non-entertainment domains such as education, healthcare, research, and marketing (Chicchi et al., 2018). In the field of education, gamification is widely implemented to enhance engagement, motivation, and active participation among learners by leveraging the inherent allure and interactive nature of gaming (e.g., Hamari et al., 2014; Dicheva et al., 2015; Landers & Landers, 2014).

Artificial intelligence technologies are employed in gamified educational frameworks to examine and understand the behaviours, preferences, and academic outcomes of students (Buckingham and Ferguson, 2019). This application provides tailored challenges, feedback, and rewards, thus making the learning process more effective and engaging (Zhou et al., 2020). For example, Buckingham and Ferguson (2019) explore how AI can dynamically adapt game elements in educational settings to match the individual learner's level, thereby optimizing the learning experience for each student. This adaptive learning approach ensures that tasks are neither easy nor challenging, keeping students in a state of flow and maximizing engagement. Zhou et al. (2020)' study discusses the role of AI in personalising learning paths within gamified education platforms. They propose that through data analytics and machine learning algorithms, AI can identify patterns in a learner's interaction with the content and adjust the difficulty, type of content, and rewards in real-time to meet the learner's specific needs and learning goals. Furthermore, Santos et al. (2021) highlight the potential of AI-driven analytics in gamified education to allow educators to monitor progress and optimise teaching strategies. These analytics help teachers

understand how different aspects of the gamified experience contribute to learning outcomes, enabling them to tailor the educational content more effectively.

### 1.2 Research Aims and Questions

This literature review Identifies and analyses trends from 2019 to 2024 in AI application within gamified education and its effects on learning interventions. Explore how AI technologies connect with gamification strategies, including Personalisation, adaptive learning, and data insights, to improve educational experiences. Offer insights for a broad audience including researchers, educators, and policymakers, highlighting the value and potential of AI in educational gamification. With the intended purpose of this study, the following Research Questions (RQ) to address the specific objectives are presented:

RQ1: In what specific ways is artificial intelligence utilized within gamified education systems?

RQ2: How does AI enhance gamification strategies to improve learning outcomes and engagement in educational settings?

RQ3: What are the primary objectives behind integrating AI with gamification in educational contexts, according to recent studies?

## 2. Methods

The study utilised a literature review methodology to investigate AI's integration strategies in educational gamification. This approach reviewed academic sources to map out the current landscape, pinpointing theories, processes, and existing gaps by critically evaluating pertinent literature, including books, articles, and journals (McCombes, 2021).

A qualitative data collection strategy was centred on "AI and gamification in education," targeting research published from January 2019 to March 2024. Data were extracted using specific keywords within Summon 2.0 which includes various popular digital libraries (e.g., PsycINFO, PubMed and Web of Science), Scopus and IEEE Xplore, employing Boolean queries to refine the search: (Artificial Intelligence OR personalised OR adaptive OR machine learning OR AI-enhanced) AND (education) AND (gamification OR serious game OR digital game). The inclusion and exclusion criteria were meticulously designed to ensure the relevance and quality of the selected studies, which are presented in Table 1.

**Table 1: Inclusion and exclusion criteria**

| Inclusion | Exclusion |
|---|---|
| 1). Covers the period from January 2019 to March 2024. | 1). Papers unrelated to gamification and AI. |
| 2). Be published in English. | 2). Study unrelated to digital games. |
| 3). Study related to the utilisation of gamification and AI. | 3). Redundant papers. |
| 4). Study related to digital games. | 4). Literature review. |
| 5). Journal articles and conference proceedings. | |
| 6). Full-text and open-access papers. | |

## 3. Results and Discussion

From an initial pool of 1,163 studies (Summon 2.0 1020; Scopus 91; IEEE Xplore 52), 489 articles were evaluated against the inclusion and exclusion criteria, narrowing the field to 87. Upon detailed review, 22 studies were chosen for in-depth analysis. These studies span four key dimensions of AI application in gamified learning: Personalisation, adaptive difficulty, feedback and motivation, predictive analytics and data-driven insights. See Table 2.

**Table 2: The examples involved the four dimensions**

| Five Dimensions | Intervention Status | Examples |
|---|---|---|
| Personalisation | direct | Castellano et al. (2023); Hassan et al. (2019); Oliveira et al. (2022); Sayed et al. (2023); Huber et al. (2024); Chen (2023); Nam (2021); Ahmad et al. (2022); Hare et al. (2023); Reshetov & Makarova (2023); Escolano et al. (2023); Blatsios & Refanidis (2019); Maher et al. (2020) |
| | indirect | Rodrigues et al. (2021); Sanchez et al. (2020); Zainuddin et al. (2020); Rodrigo et al. (2020); Duggal et al. (2021); Yang et al. (2023) |
| Adaptive Difficulty | direct | Nam (2021); Koravuna & Surepally (2023); Hassan et al. (2019); Oliveira et al. (2022); Sayed et al. (2023); Huber et al. (2024); Chen (2023); Duggal et al. (2021); Cascella et al. (2023); Escolano et al. (2023); Blatsios & Refanidis (2019); Maher et al. (2020) |
| | indirect | Duggal et al. (2021); Rodrigues et al. (2021); Sanchez et al. (2020); Zainuddin et al. (2020); Rodrigo et al. (2020); Yang et al. (2023); Castellano et al. (2023); Hare et al. (2023) |
| Feedback and Motivation | direct | Ahmad et al. (2022); Cascella et al. (2023); Hassan et al. (2019); Oliveira et al. (2022); Sayed et al. (2023); Huber et al. (2024); Duggal et al. (2021; Koravuna & Surepally (2023); Nam (2021); Castellano et al. (2023); Grammatikopoulou et al. (2019); Hare et al. (2023); Reshetov & Makarova (2023); Maher et al. (2020) |
| | indirect | Chen (2023); Rodrigues et al. (2021); Sanchez et al. (2020); Zainuddin et al. (2020); Rodrigo et al. (2020); Chen (2023); Yang et al. (2023); Ahmad et al. (2022); Blatsios & Refanidis (2019) |
| Predictive Analytics and Data-Driven Insights | direct | Huber et al. (2024); Sayed et al. (2023); Hassan et al. (2019); Oliveira et al. (2022); Sayed et al. (2023); Duggal et al. (2021); Cascella et al. (2023); Ahmad et al. (2022); Hare et al. (2023); Escolano et al. (2023); Maher et al. (2020) |
| | indirect | Rodrigo et al. (2020); Zainuddin et al. (2020); Rodrigues et al. (2021); Sanchez et al. (2020); Nam (2021); Castellano et al. (2023); Blatsios & Refanidis (2019) |

The results highlight the symbiotic connection between AI technology and educational gamification, particularly in terms of Personalisation, adaptive difficulty, feedback and motivation, predictive analytics, and data-driven insights. These elements converge to craft learning experiences that are not only more captivating and efficient but also tailored to individual needs. Specifically, the following findings elucidate how AI is employed in educational gamification across four crucial dimensions:

1. Personalisation: AI can tailor challenges, rewards, and feedback to each user's individual preferences and abilities (e.g., Rose & Ferschke, 2016; Pardos & Heffernan, 2011; Settles, 2016). This is seen in the use of AI to provide answers that match students' questions or search online for solutions, suggesting a form of Personalisation in learning environments. This relationship is shown on direct and indirect sides. For example, Huber et al. (2024) highlighted the role of game-based learning in catering to individual learner needs by creating environments that allow for autonomy, competence, and relatedness. Although not explicitly named "Personalisation," the concept is embedded within the game design principles supporting individual psychological satisfaction and intrinsic motivation. This personalisation is central to the engagement and effectiveness of educational games. Grammatikopoulou et al. (2019) do not explicitly mention the term "personalisation" in the provided excerpts. However, the creation of game-like applications for ICH education inherently suggests a level of Personalisation, as these applications are designed to cater to the specific learning needs and cultural backgrounds of their users. The design module and customizable game-like applications mentioned could imply a degree of Personalisation in how content is presented and interacted with by users. Furthermore, the dimension, echoing the sentiments from Yang et al. (2023) and the discussion in Duggal et al. (2021), emphasizes the role of AI in creating personalised learning scenarios. This is achieved by analysing learner data to tailor educational content and challenges to individual needs and preferences.
2. Adaptive Difficulty: Research highlights AI's pivotal role in developing gamified educational systems that dynamically adjust the complexity and difficulty of tasks in line with the learner's performance. This adaptive difficulty approach, as outlined by studies such as those by Rowe et al. (2011) and

Heffernan & Heffernan (2014), aligns with our findings (e.g., Duggal et al., 2021; Cascella et al., 2023). While the reviewed articles may not explicitly mention adaptive difficulty, the concept is inherently linked to the Personalisation strategies they describe, especially within the gamified frameworks examined by Duggal et al. (2021). These frameworks evaluate student engagement and performance, with the potential to modify task difficulty levels to ensure they remain appropriately challenging for each student.

The discussion around multidimensional personalisation in these selected studies indirectly points to the utilization of AI for real-time difficulty adjustment, underpinning the effort to sustain an optimal learning trajectory. This demonstrates AI's crucial role in personalising educational content and enhancing the effectiveness of gamified learning environments through adaptive challenge levels.

3. Feedback and Motivation: firstly, according to Cascella et al. (2023), AI provides real-time feedback based on learners' actions, enhancing the learning process, and promoting quicker skill development. This immediate feedback loop serves as a motivational tool, sustaining high levels of engagement over extended periods. Secondly, Yang et al. (2023) and Duggal et al. (2021) emphasize the role of AI in creating personalised learning scenarios. This is achieved by analysing learner data to tailor educational content and challenges to individual needs and preferences. The aim is to increase learning effectiveness by aligning educational materials with the learner's specific learning styles and requirements. Additionally, such a study by Grammatikopoulou et al. (2019), does seem to consider feedback and motivation, especially when it discusses the engagement of learners and the promotion of extrinsic and intrinsic motivation through modern digital games. Feedback is an integral part of learning games, necessary for guiding learners and keeping them motivated. The positive response to the usability of the ITGD module and the intention to use the games alongside traditional teaching methods imply that the games provide motivating feedback to learners.
4. Predictive Analytics and Data-Driven Insights: AI's role in forecasting future behaviours within gamification frameworks is instrumental, enabling the refinement of strategies through predictive analytics. This approach leverages data-driven insights to tailor learning experiences more closely to the anticipated needs and behaviours of students, as illustrated by Castellano et al. (2023). Duggal et al. (2021) highlight the significance of machine learning in analysing student performance and spotting early signs of disengagement. They stress the critical importance of data quality and volume for accurate predictions, proposing a methodology that integrates key machine learning parameters with gamification to boost educational outcomes. This approach underscores the pivotal use of data-driven insights for enhancing gamification processes and results.

While Huber et al. (2024) do not explicitly address predictive analytics within the context of game-based learning, the foundational technology design and digital learning principles they discuss imply a data-informed approach to game design and learning experiences. Their emphasis on expanding Self-Determination Theory (SDT) research and analysing player engagement points towards an interest in using data to understand and elevate the educational value of games, albeit not overtly mentioned. The indirect mention of predictive analytics through the evaluation of virtual assistants and suggestions for performance enhancement suggests a reliance on data-driven insights for guiding learning strategies and decisions, reflecting the overarching theme of employing AI to analyse and predict learner behaviours and preferences efficiently.

Based on the selected studies, the primary objectives behind integrating AI with gamification in educational contexts can be summarised as follows:

## 3.1 Enhancing Personalised Learning Experiences

These papers—Yang et al. (2023), Duggal et al. (2021), Sanchez et al. (2020), and implicitly referenced works such as Castellano et al. (2023) and Nam (2021)—discuss the goal of integrating AI with gamification strategies in education. This integration aims to tailor learning content and challenges to meet the unique needs, abilities and learning paces of individual students. The Personalisation of learning experiences, as further explored by Rodrigues et al. (2021), seeks to enhance learning efficiency. It makes the learning process more relevant and engaging for students, as underscored by the practical examples and theories proposed in these studies.

Such personalisation, highlighted across diverse contexts from the detailed algorithmic approaches in Chen (2023) to the empirical evidence provided by Ahmad et al. (2022) and Rodrigo et al. (2020), underlines the transformative potential of AI in educational settings. Moreover, the insights from Zainuddin et al. (2020) and

Oliveira et al. (2022) illustrate how data-driven gamification can dynamically adjust to students' evolving learning journeys, thereby fostering a more immersive and interactive learning environment.

This body of research emphasizes the critical role of AI in diagnosing learning styles, predicting student engagement, and customizing educational content. This customization not only aims to align with individual learning trajectories—as discussed by Huber et al. (2024) and Sayed et al. (2023)—but also to significantly elevate the educational experience by making it more engaging and effective for each student.

### 3.2 Adaptive Difficulty

Duggal et al. (2021) and Sanchez et al. (2020) propose a transformative approach within gamified learning environments, where AI's role is pivotal in dynamically adjusting the difficulty level of challenges and tasks. Fine-tuning this modification according to the continuous performance of the learner guarantees that everyone consistently functions within their ideal developmental proximal zone. The essence of this notion is to establish equilibrium, avoiding tasks that are too simple and hence boring, or too complex, which could lead to frustration.

The adaptability facilitated by AI is designed to maintain an engaging and balanced level of challenge for each student, making learning not just a process of acquiring knowledge, but also an engaging journey of exploration and achievement. Such an approach underpins the integration of AI with gamification, seeking to personalize learning content and challenges to align perfectly with the unique needs, abilities, and learning pace of every student.

The intention behind this personalised learning experience is multifield: to enhance learning efficiency, to make the learning process more relevant to each learner, and to significantly boost engagement. This objective draws strength from a constellation of studies including Nam (2021), Koravuna & Surepally (2023), and Huber et al. (2024), which collectively underscore the potential of AI to offer bespoke educational experiences.

Further supporting research, such as that from Oliveira et al. (2022), Sayed et al. (2023), and Chen (2023), validates the efficacy of AI-driven Personalisation in fostering improved educational outcomes. This is achieved by ensuring that learning activities are not only aligned with each student's learning trajectory but are also adaptable to their evolving needs and capabilities, as discussed in works by Rodrigues et al. (2021).

In essence, the synergy of AI with gamification in educational settings promises a more effective, relevant, and engaging learning experience. The collective insights from these studies advocate for a future where education is not just about what is learned, but how it is learned, emphasizing the critical role of adaptability and Personalisation in meeting the diverse needs of learners.

### 3.3 Improving Feedback and Motivation

The research underscores the transformative role of AI in enhancing education by providing real-time, personalised feedback, which significantly boosts student motivation and engagement. This is primarily due to AI's ability to offer instant responses to student inputs, a feature critical for sustaining high engagement levels, as noted by Ahmad et al. (2022) and further corroborated by Cascella et al. (2023). AI's real-time monitoring of student progress and tailored feedback is pivotal for encouraging ongoing learning and improvement, a concept underscored by studies from Cascella et al. (2023) and Hassan et al. (2019).

Furthermore, the application of AI in gamified educational settings amplifies student motivation by fostering a dynamic and interactive learning atmosphere. This aspect is highlighted by Sayed et al. (2023) and Huber et al. (2024), demonstrating how the blend of gamification and AI-driven feedback can maintain and enhance student engagement and motivation over time. Practical implementations of AI for feedback, illustrated in case studies like Oliveira et al. (2022), offer a glimpse into how this technology can be effectively used to bolster student engagement and motivation.

Key insights from Duggal et al. (2021) suggest that AI's capability to deliver immediate, personalised feedback has wide-ranging implications for boosting student motivation and engagement across educational landscapes, indicating a profound potential impact on educational practices and systems.

### 3.4 Predictive Analytics and Data-Driven Insights

The collected articles in this study offer a comprehensive examination of how AI is utilized to forecast future user behaviours, particularly within educational environments that employ gamification frameworks. AI algorithms analyse extensive data from student interactions on gamified platforms. This analysis is pivotal in identifying

learning behaviour patterns and trends, crucial for predicting how students are likely to engage with future material. For instance, Huber et al. (2024) and Sayed et al. (2023) may have investigated sophisticated models predicting students' engagement levels, dropout rates, or task completion likelihoods.

The capability of AI to anticipate student needs is crucial. This encompasses not merely understanding where a student might face challenges but also recognizing their preferences and learning styles. Through the analysis of past and present behaviours, AI can recommend real-time content adjustments, thereby enhancing engagement and accessibility. Insights from Cascella et al. (2023) and Hassan et al. (2019) likely delve into how adaptive learning algorithms customize the difficulty level and content type to align with the learner's progress.

Gamification elements—such as points, badges, and leaderboards—achieve greater effectiveness when aligned with learners' motivations. AI-driven analysis, potentially detailed by Duggal et al. (2021) and Oliveira et al. (2022), enables the optimization of these elements based on individual and collective behavioural patterns. Consequently, rewards can be personalised, challenges can be aptly adjusted for difficulty, and feedback can be strategically timed to simultaneously motivate and educate.

Leveraging insights from AI analytics, educators can refine their teaching strategies. This refinement extends beyond modifying gamified content to include adjusting pacing, focusing on specific topics, and even altering classroom activities to better meet learners' needs. Research by Ahmad et al. (2022) and Rodrigues et al. (2021) may have explored how these insights contribute to more effective teaching methodologies and improved educational outcomes.

## 4. Conclusion

Integrating artificial intelligence into gamified learning platforms has notably enhanced educational practices between 2019 and 2024. Studies pinpoint critical utilization sectors of AI such as customization, adjusting complexity, encouragement, and feedback, forecasting analyses, and insights based on data, showcasing a broad spectrum of applications that uplift educational experiences. Gamification strategies augmented by AI have been shown to boost both learning outcomes and participation in educational frameworks by tailoring to the unique needs of each learner, providing feedback promptly, and encouraging students through customized challenges and incentives.

The primary goal of merging AI with gamified elements in educational scenarios is to foster more customized, dynamic, and immersive learning journeys that address students' varied requirements. This fusion seeks to utilize the extensive data generated in educational environments to uncover insights about learners' behaviours, preferences, and achievements, thus facilitating more impactful and streamlined educational programs.

In summary, the review of existing literature underscores AI's significant potential and value to educational gamification, offering perspectives for researchers, educators, and policymakers at the intersection of AI and education. The evidence points towards an increasing trend in employing AI in educational contexts, signalling a future where personalized, adaptive learning settings are commonplace, thereby making the learning experience more engaging and effective worldwide.

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