

Chapter 9

Empowering Learners with Autism Spectrum Disorder (ASD) Through Gamification



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Abstract This chapter examines the potential of gamification to promote the skills development of learners with disabilities. Using a desk review approach, this chapter has collected gamification practices that have supported the development of different skills in people with ASD and explored some barriers to effective use in different settings. It also provides some concrete, actionable strategies for educators and administrators to use gamification effectively for inclusion. By providing personalized learning experiences, gamification improves the motivation and social-communicative, motor, and cognitive skills of autistic learners. It also improves academic skills such as vocabulary, pronunciation, and math skills. Challenges such as accessibility of game design, sensory sensitivity, information overload, limited availability of contextualized games, and lack of collaboration to understand the complexity of conditions, learner interests, and game design need to be addressed.

Introduction

Gamification is an integrative technique for improving the quality of the learning process. It is used in various disciplines and in different environments, such as healthcare, psychology, human resources, wellness, environmental sustainability, and marketing. In education, it has been used primarily to increase learner motivation and academic achievement (Linehan et al., 2011; Smiderle et al., 2020). Nevertheless, it has not attracted much attention to support learners with disabilities as they are underrepresented in the development of gamified solutions.

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The foundation of gamification in education is rich and varied and spans several decades. The Sumerian Game, developed by Mabel Addis, a school teacher, in 1964, is the earliest available example of digital gamification in education. This text-based educational game focused on teaching concepts of Sumerian culture, economics, and governance (The New York Times, 2024). After that, LOGO - a programming language was used to teach math and the first computer programs. In the 1970s, various educational games were invented, such as Oregon Trail, which is used to teach history. In the 1980s, at the height of the video game industry, Tom Malone from MIT developed the first video game that showed that children can learn well through games (Khaitova, 2021). With the invention of IBM DOS, hundreds more educational games were introduced. In the 2000s, educators began to incorporate points, badges, and leaderboards into educational games to increase learner motivation and engagement. The term “gamification” was coined in 2002. Over time, the concept of artificial intelligence was integrated into gamification and brought innovative solutions to the field.

Gamification has been used in academia in various ways to improve scientific knowledge (Kalogiannakis et al., 2021); to improve problem solving in mathematics (Smith, 2018); to improve critical thinking in programming education (Zhan et al., 2022); to improve English language (Zhang & Hasim, 2023); in statistics education (Legaki et al., 2020), to enrich vocabulary (Chowdhury et al., 2024), to improve teacher training (Liu et al., 2023; Yildiz et al., 2021) and to improve the learning performance of students at universities (Aguiar-Castillo et al., 2020, 2021; Sánchez-Martín et al., 2017; Zhang et al., 2024). Nevertheless, many disciplines have not yet adapted gamification for learning purposes, especially in underdeveloped countries.

Gamification increases motivation (Mohammed et al., 2024); improves student engagement (Bai et al., 2020; Chen & Liang, 2022; Núñez-Naranjo et al., 2024; Putz et al., 2020; Zeng et al., 2024), promotes social connectedness (Ratinho & Martins, 2023; Rodriguez-Calzada et al., 2024; Zainuddin et al., 2020); and improves critical thinking skills (Angelelli et al., 2023; Oliveira et al., 2022; Metwally et al., 2020). Some studies point to negative effects. For example, it increases frustration (Dichev & Dicheva, 2017; Toda et al., 2018) and worsens academic performance (Almeida et al., 2021). Game design elements can worsen performance and raise ethical issues, such as cheating (Almeida et al., 2023), problems with cognitive manipulation (Klock et al., 2023), and exploitation of learners (Thorpe & Roper, 2019). In addition, the gamification industry raises ethical issues such as the violation of privacy (Kröger et al., 2023; Trang & Weiger, 2021).

An experimental study investigated how gamification motivates and satisfies the psychological needs of learners. This showed that gamification alone may not be sufficient; rather, it is specific design elements that trigger the desired results (Sailer et al., 2017). Certain game elements can even hinder the satisfaction of psychological needs (Van Roy & Zaman, 2019). This raises the question of whether the elements used in educational games really motivate learners. Does gamification improve educational outcomes? Does it support the different needs of learners? While this concept continues to gain traction in the academic environment, its

integration into educational systems at different levels, in different disciplines and in different countries remains inconsistent due to cultural differences in teaching, different educational priorities and different levels of technological infrastructure.

The gamification market in education is a billion-dollar industry that is growing with time. It is crucial to understand whether it supports learners' social and educational needs or aims to generate profit and increase revenue.

Gamification and Disability

Around 1.3 billion people worldwide live with disabilities, including over 650 million in Asia and the Pacific (UNFPA, 2022). Despite policy progress, people with disabilities still face barriers to education. Especially in low-income countries, access to education remains a major challenge for learners with disabilities (UNICEF, 2022). Even where education is accessible, there are still challenges in providing quality, inclusive education (Hayes & Bulat, 2017). Disability-inclusive education practices are minimal. Where support is available, learners often lack help as teachers are not adequately equipped to address diverse learning needs. One of the reports states "As it stands, the world will not achieve the SDGs by, for and with persons with disabilities by 2030. Accelerations are needed to make physical and virtual environments accessible to persons with disabilities, adopt anti-discrimination laws, expand social protection and implement measures to ensure the safety and protection of all persons with disabilities in disasters and emergencies" (United Nations, 2024).

Technology provides a gateway to educational accessibility for many learners with disabilities. The use of assistive technology is increasing, but it is unclear how learners with disabilities are using it for educational purposes. One of the reports states "Technologies developed for other purposes cannot necessarily be expected to be suitable for all learners in all educational settings. When considering the adoption of digital technologies, education systems should always ensure that the interests of learners are placed at the center of a rights-based framework. The focus should be on learning outcomes and not on digital input" (UNESCO, 2024).

Learners with disabilities have unique learning styles. Their emotions, motivation, information intake and engagement are different from those of other learners. They require individualized learning experiences and additional academic support. This brings gamification to the fore as a potential tool for inclusion. This learning approach has been used for the development of various skills, such as analytical thinking, problem-solving skills, cooperative learning skills, motivation, and collaboration in learners with different types of disabilities (Alkhalwaldeh & Khasawneh, 2024; Dziorny, 2007; Ghasemi et al., 2021; Jadán-Guerrero et al., 2023; Khaleghi et al., 2022; Martín-Gutiérrez et al., 2022; Stančin et al., 2020; Tlili et al., 2022; Zlotnik et al., 2024). It is important to emphasize that not all games are suitable for all learners with disabilities, as they have different learning styles. The effectiveness of the game in developing skills for a wider group of people with

disabilities depends on the learning design framework, the strategies and game elements used and, most importantly, the interest of those involved.

Gamification, Skills Development, and Autism Spectrum Disorder (ASD)

ASD “is a neurodevelopmental disorder characterized by deficits in social communication and the presence of restricted interests and repetitive behaviors” (American Psychiatric Association, 2013). One in 100 children has ASD (World Health Organization, 2023). Learners with ASD lack social interaction. However, they have unique perspectives and exceptional memory. Some children with autism are extremely good at reading and math compared to their peers. They perceive visual information better than other children (Cañete et al., 2023; Chung & Son, 2020; Zhou et al., 2023). However, learners with ASD face challenges in learning. They have special learning needs and require an individualized learning environment. Their limited social skills sometimes hinder their academic performance. They may be able to participate in mainstream classes, but social stigma and prejudice often prevent parents from sending them to school. These learners are less expressive and need time to adapt to new environments. They may also face health problems that affect their learning in various ways.

Gamification is a tool for inclusion. It provides learners with ASD with immersive learning experiences, supports their social, emotional and cognitive development and improves their academic performance in different settings, such as rehabilitation and work. However, their performance and interest in gamification varies. For example, even learners who are categorized as easy will not achieve at the same pace due to their unique learning characteristics.

Learners with ASD can learn a variety of academic skills through gamification. For example, El Shemy et al. (2025) developed two augmented reality games for vocabulary learning for autistic learners and their parents. The games supported the learning of new vocabulary about brushing teeth and hygiene practices. Teaching strategies such as repetition, personal experience, and classification were successful. In addition, collaboration with parents was beneficial in developing educational interventions. Another game-based intervention was developed and used with children with autism and dyscalculia to learn math. The games motivated the participants and gave them confidence in learning math (Pradiante, 2022). Similarly, gamification has been used to help learners acquire English vocabulary. In one study, an enhanced app was developed and tested with six mildly autistic learners. The games helped them to expand their vocabulary, pronunciation skills, and language articulation. It also encouraged their interest in the language learning process (Hashim et al., 2022). These studies emphasize the role of games in skill development. However, in the current contexts, it cannot be readily determined whether the

use of gamification is effective for teaching in different subjects and at different levels. Further studies are needed to confirm these claims.

Learners with ASD lack social interaction and cooperation. They have limited interests and limited skills, especially social skills. Gamification offers opportunities to teach them social skills through positive reinforcement in different environments (Azadboni et al., 2024; Tezcan & Sadık, 2018; Walsh et al., 2024). For example, a game was developed and tested to teach self-care and personal hygiene skills to learners with autism in Brazilian public schools. The game helps to recognize pictures and improve vocabulary and reading skills (Gobbo et al., 2021). Lopez-Bouzas et al (2024) experimented with extended games with ASD learners that improved their socioemotional skills. Wang and Xing (2021) found that 3D games improved social skills and social interaction behavior in adolescents with autism. Wainer et al. (2014) also developed a social robot (KASPAR) and evaluated it with autistic learners aged 8–9 years. It helped them to improve their social behavior and cooperation skills. These studies show that gamification can promote the social skills of learners with autism. However, many other skills, such as initiating friendships, engaging in conversations, collaborating and expressing emotions, have not yet been extensively studied to determine whether gamification can help with these skills.

There is a growing trend towards the use of cell phones and tablets by autistic learners. Many mobile apps offer real-time learning experiences, but not all gamification apps are designed for educational purposes. Thirty-two gamified mobile apps demonstrating communication and self-management skills were identified in a scoping review (Mahmoudi et al., 2024). Boyd et al. (2014) experimented with the iPad game “Zody” and found that learners with ASD improved their collaboration and communication skills through gamification. Similarly, Penev et al. (2021) developed a mobile application for children with autism aged 3–12 years that showed a significant improvement in their socialization. These results confirm the development of skills, especially social skills, in learners with ASD. However, it is important to investigate the patterns of technology use in autistic learners as this area is not well documented. In addition, learners with autism often require the support of others, so assuming that gamification alone can lead to improvements without external support would be a misconception.

The trend of using serious games with learners with ASD for academic and therapeutic purposes is increasing (Azadboni et al., 2024; Barajas et al., 2017; Carneiro et al., 2024; Hassan et al., 2021; Kousar et al., 2019; Khabbaz et al., 2023; López-Bouzas et al., 2024; Zakari et al., 2014). For example, Elshahawy et al. (2022) prepared serious games and block-based programming platforms that improved the problem-solving skills of learners with autism. Similarly, a systematic review showed that cognitive computer games improved social cognition and emotional understanding in autistic learners (Rezayi et al., 2023). While limited studies confirm the effective use of serious games and cognitive games, their impact can vary significantly depending on age, specific learning goals and learning style, which calls for more nuanced research on adapting games to maximize their engagement and learning outcomes.

Learners with autism need motivation and support that gamification can bridge. Che Ku Mohd et al. (2019) developed and tested a game application with autistic students, teachers, and parents. It improved their grades and increased their motivation. Similarly, Silva-Calpa et al. (2018) developed a collaborative game “CoASD” and experimented with seven children with autism aged 5–14 years. The game improved motivation and encouraged them to engage in collaborative tasks. It is important to emphasize that motivating learners with ASD does not come from gamification alone; it also requires patience and a support system. Furthermore, these learners often lack intrinsic motivation, making it difficult to use gamification effectively. Further studies are needed to understand how gamification can help improve their intrinsic motivation.

Learners with ASD generally have a shorter attention span than other children. Gamification has the potential to increase their attention span. Mercado et al. (2019) developed a neurofeedback brain training game and experimented with sixty autistic children aged 4–11 years. The game improved attention span. Similarly, Cruz et al. (2011) experimented with games with ten autistic children aged 5–10 years. The results suggest that video games have a positive effect on attention span compared to traditional toy games. In another study, Wagle et al. (2021) designed and tested smartphone-based games and showed a strong correlation between game performance and improvement in working memory. The use of games enables the development of attention skills, but with limitations. Previous studies do not indicate whether attention span was considered as a critical factor in game design when developing games for learners with autism. It is also unclear what features have been successfully used in previous games to improve attention span.

There is limited participation of learners with autism in physical activities. Gamified mobile technology is a promising way to develop their motor skills (Lee & Gutierrez, 2023). Hassani et al. (2020) experimented with exercise programs using gamified technologies that reduced unwanted behaviors, supported positive interactions, and improved motor skills. Similarly, Kim et al. (2020) experimented with a mobile game that increased physical activity in 229 autistic adults aged 18 to 55 years and motivated them to continue participating in activities through the leaderboard. While gamified approaches may improve some aspects of physical activity, they may unintentionally limit opportunities for socialization and collaboration with peers. There is insufficient empirical evidence that gamification consistently leads to meaningful improvements in motor skills for different groups of learners with autism. Increasing physical activity through gamification also does not take into account the sustainability of such engagement.

Challenging behavior and emotional distress are often associated with learners with ASD (Boonen et al., 2014; Hastings et al., 2021). Gamification can improve behavioral skills (Mota et al., 2020) and increase emotional understanding skills (Wang et al., 2023). Navan and Khaleghi (2020) developed an intervention game and tested it on children with autism. Although the study did not reduce behavioral problems, it helped them learn about facial expressions. In contrast, Wan and Li (2023) studied the effects of interactive games and behavioral skills on eight children with autism in a special kindergarten. They promoted their physical and mental

health to a greater extent, highlighting that gamification could potentially support learners' well-being, albeit not for behavioral or emotional challenges. There are few studies demonstrating whether gamification supports behavioral and emotional challenges in learners with ASD.

With technological advances, virtual reality and artificial intelligence in gamification have opened up promising avenues for promoting various skills such as communication (Suparjoh et al., 2020; Valencia et al., 2019). Soltiyeva et al. (2023) proposed a virtual reality training system and conducted initial observations that improved communication and social interaction among learners with ASD in Kazakhstan. Although the study cannot be generalized and was not used in an educational setting, it provides a perspective on technological advancement for skill development.

Potential Barriers

Gamification has some potential barriers that could hinder its effective use in developing skills in learners with ASD. Accessibility of game design remains a challenge in gamification due to the lack of research and development focused on developing customized games for learners with autism. Accessibility here refers to user interface design, sensory adaptation, social interaction, and visual and auditory accessibility.

Gamifications are not primarily designed to take into account the sensory limitations of learners with ASD. It is also difficult for them to understand complex information. The available games are usually filled with overloaded information, which can lead to stressful situations (Elcik, 2021). Costello and Donovan (2019) developed a prototype video game, investigated its accessibility features and found that it is difficult for autistic users to read or understand non-verbal cues. They also struggle with sensory problems when playing the game. Furthermore, their ability to absorb information is limited (Marco et al., 2011).

Not all children with autism respond positively to gamification, as individual preferences and sensitivities significantly affect their engagement. Although the color combination and visual appearance of the game appeals to learners with ASD, they are overwhelmed by the gamified environments available, which often include bright colors and loud sounds.

Many gamified activities have complex or multi-step instructions that are difficult for learners with ASD to follow. In addition, some learners may find the competitive aspects of gamification applications overwhelming or stressful, potentially leading to increased anxiety rather than motivating them to participate in physical activities.

Learners with ASD may exhibit restricted behaviors or become overly dependent on gamification. Excessive game use can lead to aggression and have a negative impact on academic performance (Kuo et al., 2024; Murray et al., 2022; Paulus et al., 2020). Certain game designs, even those not specifically tailored to

educational contexts, can exacerbate problem behaviors in learners with ASD. Research shows that attention, social dynamics, access to games, and time spent predict problematic video game use (Craig et al., 2021). Games to address behavioral challenges in learners with ASD are still lacking.

The design of games, particularly the lack of customization, is a gap in providing unique learning experiences for all learners with ASD (Smith & Abrams, 2019). There is a lack of awareness among game designers about ASD, its complexity and the needs and interests of learners. Parents, teachers, and health professionals are not involved in game development (Camargo et al., 2019; Malinverni et al., 2017). Ribeiro Silva et al. (2024), in collaboration with autism experts, developed a gamified prototype that reduced unwanted behaviors in learners with ASD. This example lays the foundation for the importance of involving a wide range of stakeholders in the development of games for learning purposes. However, there is a significant research gap in the gamification industry to provide meaningful gamification experiences for all learners with ASD.

Conclusions and Recommendations

Gamification holds great promise for supporting the social, emotional, cognitive, and academic development of learners with ASD. Its engaging, customizable, and interactive features allow learning pathways to be tailored to individual learner needs. With advances in technology, gamification design is expected to improve and accelerate the quality of the learning experience with potential opportunities for collaboration.

The available studies do not explicitly target gamification for learners with ASD. However, they offer a promising perspective on how gamification can support skill development. Educating learners with ASD poses significant challenges for the gaming industry, which emphasizes the need to understand different approaches to gamification in education.

Below are some actionable strategies for educators and administrators to effectively implement gamification for inclusion.

For Educational Policymakers

An inclusive gamification policy should be introduced that supports research and evidence-based sustainable gamification initiatives for learners with ASD. The policy should encourage collaboration between educational institutions, game designers, and industry to develop innovative gamified learning solutions that meet the diverse learning needs of learners with ASD.

For Curricula Developers

Understanding the characteristics of learners with ASD is important in order to understand their strengths, preferences, and sensitivities. In this context, curricula for both ASD and gamification should be introduced, especially for learners interested in pursuing higher education in the fields of technology, game design or AI.

For School Management and Administrators

The availability of various educational games to support the social, communicative, and behavioral learning of learners with ASD is limited due to a lack of awareness and understanding of their educational needs. Free online training, workshops, and curriculum integration across disciplines on ASD would help game designers and the research community to understand the educational needs of learners and ultimately facilitate their learning experience in a gamification environment. In addition, this will also help to review existing educational games and modify them according to learners' needs.

Evidence-based studies on how gamification supports the learning of students with ASD are not available. Gamification in the disability sector should be encouraged to develop contextualized gamification tailored to the specific needs of learners with ASD to promote their engagement and academic success. To this end, university students and entrepreneurs who develop games for learners with ASD should receive micro-grants.

Set up a gamification lab for teachers and learners to brainstorm and try out a variety of game designs and provide sustainable solutions.

For Teachers and Parents

There is a lack of integration of courses on gamification into teacher and parent education programs. A specialization course on gamification for ASD should be introduced to enable educators to propose, design, and develop engaging and contextualized educational games for learners with ASD.

For Game Designers

The involvement of teachers, health professionals, and parents in the gamification process is crucial for the conceptualization and validation of game designs. They can form a collaborative team with the game designers and keep a reflective digital

diary to add the social and educational challenges faced by ASD learners. These can be used to design role-play games with simple tasks such as brushing teeth and sticking buttons. A musical reward is provided to stimulate them when they give the correct answer.

Learners with ASD need to strengthen their vocational skills, for which scenario-based games on real work situations should be developed. Gamification experts should work with technology companies and vocational education and training institutes (VET) to understand what future employability skills are needed for learners with ASD.

Open-source games are a cost-effective option for gamification. This will help developers to improve existing games based on learners' needs and feedback. It will also speed up collaboration in adapting existing games for ASD learners and reduce time and costs.

A collaborative simulated game should be developed in which parents or teachers and learners with ASD can participate together. A customized AI-based real-time and offline game should be developed to track learners' progress in real time. These games would be useful for areas without internet access.

The design of the game should be simple, without sensory or cognitive overload. There must be the possibility to take a break when needed. It must include narrative elements and visual cues. The concept of failure should be eliminated. Games should offer unlimited attempts and rewards for each attempt.

Overall, the gamification industry offers great potential for the development of accessible, contextualized, innovative, and inclusive educational games for learners with ASD. By understanding individual needs, developers can design more effective and accessible games. However, further research is needed to refine these approaches and accelerate progress in gamified learning.

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