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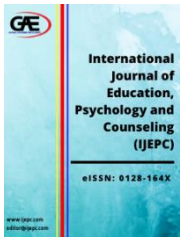

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A REVIEW OF GAMIFICATION FRAMEWORK APPROACH FOR CHILDREN WITH AUTISM SPECTRUM DISORDER (ASD) TO IMPROVE INTERACTION SKILL

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Abstract:

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition marked by deficits in social communication and interaction, impacting an increasing number of children worldwide. Traditional therapies often produce inconsistent results for children with ASD. On the other hand, there is evidence that technology-based interventions, especially those that use gamification, have much potential to help this group improve their social skills. Gamification applies game design elements to increase motivation and engagement. This analysis examines the efficacy of gamification frameworks in enhancing interaction skills among children with ASD. Numerous established gamification frameworks have been utilized throughout diverse applications; nevertheless, these frameworks frequently do not address the distinct requirements of children with ASD. It is essential to acknowledge the particular obstacles encountered by children with ASD in social interactions, including impairments in nonverbal communication, emotional comprehension, and sustaining eye contact. A thorough understanding of these problems is crucial for creating successful and customized gamification frameworks designed to enhance interaction skills in this demographic. This review emphasizes the necessity for more research to develop and assess gamification frameworks tailored to the distinct requirements of children with ASD, to enhance their interaction skills.

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Keywords:

Autism, Behavior, Communication, Development, Engagement.

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition marked by enduring challenges in social communication and interaction, coupled with restrictive and repetitive behaviors (Membrino et al., 2023). Recent data from the Centers for Disease Control and Prevention (CDC, 2024) estimate that ASD affects about 1 in 36 children in the United States, underscoring a rising public health concern (see Table 1). In Malaysia, the prevalence is approximately 1 in 600 children, predominantly males (Alhommos et al., 2022). Psychosocial interventions have demonstrated effectiveness in reducing symptom severity and enhancing the quality of life for individuals with ASD and their caregivers (Membrino et al., 2023).

Gamification, defined as applying game design elements like points, challenges, and feedback to non-game contexts, aims to motivate and engage users (Smith & Abrams, 2019). Frameworks for gamification incorporate specific components and rules to foster enjoyable and effective learning environments tailored to the needs of children with ASD, potentially improving their social interaction abilities.

Table 1: Prevalence of Autism Spectrum Disorder

Year	ASD Prevalence (per 1,000 children)	Source
2024	27.8	CDC (2024)
2021	23.0	CDC (2021)

Source: Data reflects prevalence estimates reported by the Centers for Disease Control and Prevention.

ASD interventions encompass behavioral and communicative strategies, nutritional approaches, pharmacological treatments, and complementary and alternative medicine techniques (Sharfuddeen Zubair et al., 2021). Examples of behavioral and communicative interventions include technology-assisted therapies, floor time, occupational therapy, social skills training, speech therapy, and computer-based methods (Mohmed Atef Azazzy, 2020).

Technological therapies targeting ASD involve serious games, gamification, and e-learning platforms designed to provide educational content and enhance emotional recognition, comprehension, and social skills. Since the 1960s, computer-based therapies have supported individuals with ASD, including using the Logo programming language in the 1980s to improve language proficiency (Sharfuddeen Zubair et al., 2021).

Gamification leverages game design principles in non-game settings to boost engagement and tackle challenges. Since its conceptual emergence in 2003, the field has evolved to elevate the appeal of digital technologies. Although the precise origin of the term "gamification" remains unspecified, it broadly involves incorporating elements such as points, badges, leaderboards, levels, and challenges into non-gaming contexts. Prominent gamification frameworks comprise the 6D Framework (Moreno et al., 2019), GAME Framework (Buckley et al., 2018), MDA Framework (Bucchiarone et al., 2019), Octalysis

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Framework (Chou, 2024), and the Framework for Sustainable Gamification Impact (Chow & Huang, 2017), each providing distinct elements and design guidelines for effective engagement.

Nonetheless, studies warn that inadequate gamification design can lead to reduced user engagement and failure to achieve intended outcomes (Tenório et al., 2020). Consequently, it is vital to integrate expertise from mental health professionals, align designs with children's preferences, and involve experienced gamification developers. Focused primarily on children with disabilities, these efforts emphasize creating accessible and intrinsically motivating experiences tailored to their unique requirements (Shaltout et al., 2021).

Gamification is a powerful approach in education, training, and various non-game domains, yet it requires meticulous design considerations. While it can enhance motivation, engagement, and educational results, poorly crafted gamification may distract users (Callan et al., 2014; Jiang, 2016). Researchers advocate for gamification to promote student participation and learning; however, caution exists that overuse or flawed implementation could shift focus from learning objectives to game mechanics (Mogavi et al., 2022).

Recent research indicates that while gamification can initially enhance intrinsic motivation, its effects on long-term motivation and performance may diminish over time (Lee & Kim, 2021; Martín-Gutiérrez et al., 2023). To mitigate these challenges, scholars recommend embedding gamification thoughtfully and purposefully within curricula rather than treating it as an isolated add-on (Garcia et al., 2022). Effective gamification design should involve multiple stakeholders—including educators, learners, and subject matter experts—to ensure alignment with educational goals and meaningful learner engagement (Chen et al., 2024). However, many existing gamification frameworks do not adequately address the unique needs and challenges experienced by children with Autism Spectrum Disorder (ASD) (Pereira et al., 2023; Nguyen & Tran, 2025).

This gap is particularly critical when targeting social interaction skills in children with ASD, who commonly face difficulties such as nonverbal communication, emotional recognition and expression, maintaining eye contact, interpreting social cues, and adapting to changes in routines (Wang et al., 2021; Rahman & Lee, 2024). Consequently, gamified interventions must be deliberately tailored to these specific challenges to foster social skill development effectively. This necessity underscores the importance of specialized frameworks that cater to the distinctive social interaction difficulties of children with ASD (Azizah et al., 2021; Suarez et al., 2023).

The current analysis examines contemporary gamification frameworks, focusing on those demonstrating comprehensive sensitivity to the obstacles faced by children with ASD. It reviews design principles, game mechanics, and assessment strategies to identify practical approaches and highlight areas requiring further investigation (Wang et al., 2022; Mubin & Poh, 2019). The ultimate goal is to inform the development of customized, evidence-based gamification therapies that support improvements in social interaction and overall quality of life for children with ASD (Pereira et al., 2023; Mubin & Poh, 2019).

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Modern theoretical frameworks have increasingly guided the design of gamification interventions specifically for children with ASD. Self-Determination Theory (Ryan & Deci, 2023) emphasizes nurturing intrinsic motivation by supporting autonomy, competence, and relatedness, aligning with gamification elements such as badges and constructive feedback that promote engagement while reducing anxiety. Social Cognitive Theory (Bandura, 2022) supports using observational learning within gamified contexts to enhance social interaction skills. Theory of Mind (Peterson & Wellman, 2024) highlights the importance of fostering emotional understanding and perspective-taking. Cognitive Load Theory (Sweller & Chandler, 2021) warns against overloading cognitive resources through overly complex or competitive tasks, advocating for adaptive challenges tailored to the cognitive profiles of children with ASD. Emerging frameworks integrating eye-tracking technology (Azizah et al., 2023) showcase the potential of personalized, real-time adjustments to address social deficits precisely. Additionally, taxonomy-based classifications of gamification components (Toda et al., 2021) provide systematic guidance for selecting game mechanics that effectively target interaction skills. These theoretical insights underpin this review's synthesis and critical evaluation, highlighting the vital role of tailored, collaboratively developed gamification frameworks in enhancing social outcomes for children with ASD.

Materials and Methods

This review complied with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) recommendations (Page et al., 2021).

Search Strategy

This review complied with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Ratinho & Martins, 2023). A thorough search was performed across three databases: IEEE Xplore, Scopus, and ACM Digital Library, concentrating on literature from the last decade, specifically from 2014 to 2024. The search aimed to identify pertinent studies on gamification frameworks, autism spectrum disorder, learning disabilities, and improving interaction skills. The search employed the following keywords: ("gamification" OR "framework" OR "Autism Spectrum Disorder" OR "ASD" OR "autism" OR "autistic" OR "gamified" OR "game element*" OR "game design") AND ("learning disability" OR "interaction skills"). The search returned a total of 1,154 articles.

Inclusion And Exclusion Criteria

The literature study focused on articles addressing the creation and development of gamification frameworks to enhance interactions for students with ASD. The collected publications predominantly centered on developing gamification frameworks that include appropriate gamification aspects to improve interactions with others for students with ASD, engaging them as either users or participants. Following an exhaustive examination of the designated databases, only 19 articles fulfilled the eligibility requirements according to the predetermined inclusion and exclusion criteria. The inclusion criteria were: (a) existence of a gamification framework; (b) a gamification framework specifically designed for students with ASD; (c) targeting children as end users or participants; (d) accessibility of the complete text; and (e) publications published in English. The exclusion criteria comprised: (a) gamification methods integrated within a system or application; (b) game interventions that constituted only a small element of a broader intervention; (c) workshop papers or brief papers; and (d) preliminary papers.

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Study Selection

The study's selection process was conducted in three steps. Initially, duplicates were eliminated from the articles obtained from the databases. Subsequently, the titles and abstracts were evaluated based on the inclusion and exclusion criteria, eliminating irrelevant articles. The subsequent phase entailed assessing the full-text publications to verify their conformity with the review criteria. This procedure was executed twice for each phase to eradicate duplicates and extraneous documents further. Authors were solicited to furnish complete texts of papers inaccessible during the preliminary search. Ultimately, from the 1,154 articles initially obtained, only 19 were chosen during the screening process. Figure 1 depicts the flowchart outlining the study selection and identification procedure.

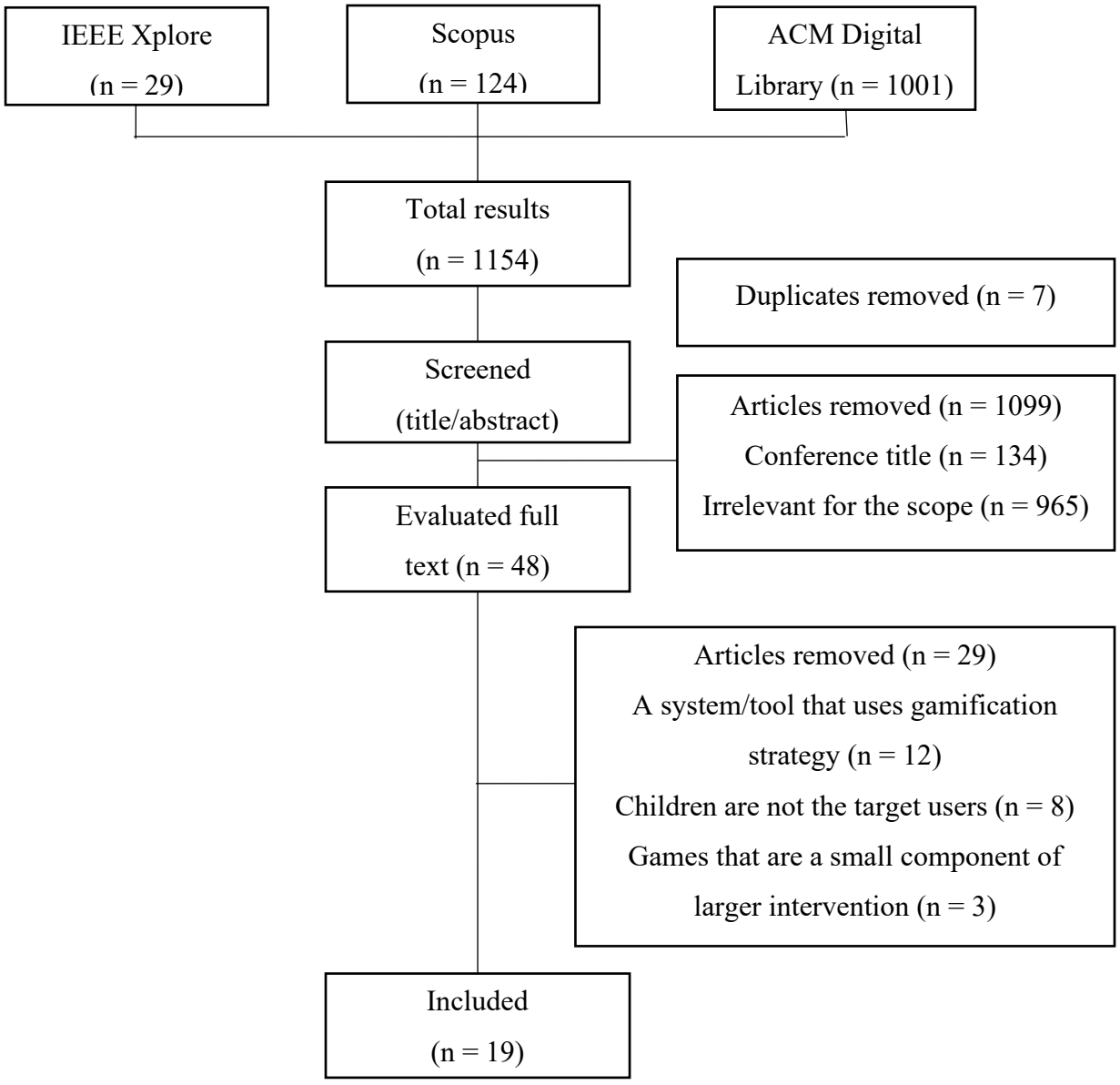

Figure 1: Study Selection And Identification Flowchart

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Data Extraction And Synthesis

Nineteen articles satisfied our inclusion criteria. The publications were examined to identify the predominant gamification aspects in gamification framework treatments, specifically aimed at enhancing interaction skills. Limited research has investigated the taxonomy and classification of gamification aspects, including a study by Toda et al. (2019), which assessed these features in educational contexts utilizing an established gamification taxonomy. This research may guide the creation of interventions for individuals with ASD. Azizah et al. (2021) introduced a framework combining gamification with eye-tracking technologies to improve children's interpersonal skills with Autism Spectrum Disorder (ASD).

Table 2: The List Of Selected Studies

Author Name(s)	Gamification Framework	Focus of Research
Mukh, Y. A. et. al. (2023)	Gamified Learning	Motivation and Learning
Cordioli, M. et. al. (2024)	Gamified Framework	Therapy
Wang, C. et. al. (2022)	Gamified Intervention	Emotional Understanding
Azizah, A. F. et. al.(2021)	Gamified Framework	Eye Tracking and Interaction
Dharmarathne, R. S. C. K. et. al. (2022)	Gamification System	Psychological Maturity and Interaction
Grund, J. et. al. (2020)	Gamified Framework	Work Skills
Silva Mota, J. et. al. (2020)	Gamified Process	Association of Images and Words
Toda, A. M. et. al. (2019)	Gamification Taxonomy	Educational settings
Shaban, A., & Pearson, E. (2019)	Design Guidelines	Learning
TWMIPS, B., et. al. (2024)	Gamified Application	Communication, Numeracy, Emotional Understanding
Cruz, C. S. D. et. al. (2019)	Gamified Application	Learning
Pereira, L. M. et. al. (2023)	Gamified Intervention	Geometric Thinking
Castillo, T. A. et. al. (2016)	Web-Based Tool	To understand and interpret facial expressions associated with an emotion
Smith, K. et. al. (2018)	Gamified Framework	Intersection of gamification and accessibility
Pinedo Rivera, D. I. et. al. (2018)	Gamification Review	Support the development of literacy skills
Johnson, R. W. et. al. (2022)	Gamified App	Therapy Adherence
Carreno-Leon, M. A. et. al. (2021)	Tangible Interface	Emotional Regulation
Paolillo, D. et. al. (2024)	Serious Game	Level Generation in Serious Games
Kim, B. (2022)	Gamified Simulation	Social Skills

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Table 3: Gamification Element in Gamification Framework

Author Name(s)	Gamification Element											Total
	Points	Levels	Badges	Leaderboards	Challenges	Avatars	Three-Dimensional Environments	Feedback	Competition	Collaboration	Time Pressure	
Mukh, Y. A. et. al. (2023)			✓	✓				✓				3
Cordioli, M. et. al. (2024)		✓						✓				2
Wang, C. et. al. (2022)								✓		✓		2
Azizah, A. F. et. al.(2021)		✓										1
Dharmarathne, R. S. C. K. et. al. (2022)	✓	✓	✓	✓	✓		✓	✓	✓	✓		9
Grund, J. et. al. (2020)	✓	✓					✓	✓				4
Silva Mota, J. et. al. (2020)							✓	✓				2
Toda, A. M. et. al. (2019)	✓	✓	✓	✓	✓			✓	✓	✓	✓	9
Shaban, A., & Pearson, E. (2019)	✓	✓						✓				3
TWMIPS, B., et. al. (2024)	✓		✓	✓				✓	✓			5
Cruz, C. S. D. et. al. (2019)	✓		✓	✓								3
Pereira, L. M. et. al. (2023)	✓	✓	✓				✓	✓				5
Castillo, T. A. et. al. (2016)						✓						1
Smith, K. et. al. (2018)			✓	✓				✓	✓	✓		5
Pinedo Rivera, D. I. et. al. (2018)	✓			✓				✓	✓			4
Johnson, R. W. et. al. (2022)	✓	✓	✓		✓			✓				5
Carreno-Leon, M. A. et. al. (2021)								✓				1
Paolillo, D. et. al. (2024)		✓										1
Kim, B. (2022)	✓	✓	✓					✓	✓	✓		6
Total per gamification element	10	10	9	7	3	1	4	15	6	5	1	

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Result

This review adhered to the PRISMA principles, as depicted in the flow diagram (Figure 1). The search process entailed retrieving 1,154 publications concerning gamification framework interventions to enhance interaction skills in individuals with Autism Spectrum Disorder (ASD). Nineteen research studies (see Table 2) were deemed appropriate for inclusion in identifying the predominant gamification aspects within frameworks that enhance interaction skills in individuals with ASD.

Study Inclusion

Figure 1 of the PRISMA flow diagram indicates that the databases produced 1,154 results. Seven duplicates were eliminated in the initial phase, followed by the subsequent phase. Articles were evaluated based on their titles and abstracts at this stage. During this screening, we removed 1,147 articles, mainly due to their irrelevance to the scope and lack of consideration of gamification aspects about interaction skills or ASD. The reviews were omitted during this period. Subsequently, we assessed the complete texts of the remaining publications. Subsequently, 48 articles have been removed, mainly because the research was determined to concentrate on a system, program, or tool that employs serious gaming intervention rather than a gamification framework when reviewing the complete text. Furthermore, additional factors encompass the absence of children as target users, the minor role of games within a broader intervention, the absence of complete text, the nature of the content as a workshop or brief article, and its classification as a preliminary study. Ultimately, two manual searches were conducted, leading to the inclusion of 19 studies.

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Intervention characteristics

Table 2 enumerates the chosen studies, whereas Table 3 classifies the gamification aspects according to the selected studies. All investigations were performed in English and published between 2014 and 2024. All 19 studies concentrated on fundamental gamification aspects for ASD therapies that enhance interaction skills. The research on gamification elements in interventions for individuals with ASD predominantly emphasizes fundamental components, despite numerous other gamification features.

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As the literature outlines, the fundamental components encompass points, levels, badges, leaderboards, and feedback (Pereira et al., 2023). Although rivalry, collaboration, and time pressure are present, research does not frequently utilize them. The emphasis on fundamental gamification components is likely related to enhancing interpersonal skills (Mota et al., 2020; Ifigenia et al., 2018). Fundamental gamification components are remarkably efficient in enhancing engagement and motivation, essential for cultivating interaction skills in adults with ASD (Pereira et al., 2023; Mubin & Poh, 2019; Azizah et al., 2021; Wang et al., 2021; Smith & Abrams, 2019; Carreño-León et al., 2021). They offer explicit objectives and a sense of achievement, which can motivate individuals with ASD who may excel in structured educational settings. Moreover, these aspects provide avenues for feedback and reinforcement, hence enhancing the learning process and promoting positive behaviors (Grund et al., 2020).

The research on gamification for individuals with ASD significantly focuses on enhancing learning and educational results (Figure 2). 29% of the research focuses on learning and education, examining how gamified treatments might improve learning experiences, engagement, and skill development in communication, numeracy, and emotional comprehension domains. Therapy and intervention constitute another significant emphasis, accounting for 21% of the study. This research seeks to develop and assess gamified frameworks that assist therapists in administering successful therapies such as ABA, enhancing therapy adherence, and employing serious games for emotional regulation and comprehension. Targeted skill development constitutes a notable domain, with 21% of the study concentrating on cultivating abilities such as geometric reasoning, literacy, psychological maturity, and social interaction via gamified interventions. Research on comprehensive gamification frameworks and concepts constitutes a mere 14% of the studies, indicating that, although there is an awareness of these principles, the focus of the research predominantly lies on practical applications and skill enhancement. Social skills, interaction, emotional understanding, and regulation are each examined in 7% of the studies, indicating an increasing interest in employing gamification to enhance these essential domains for those with ASD.

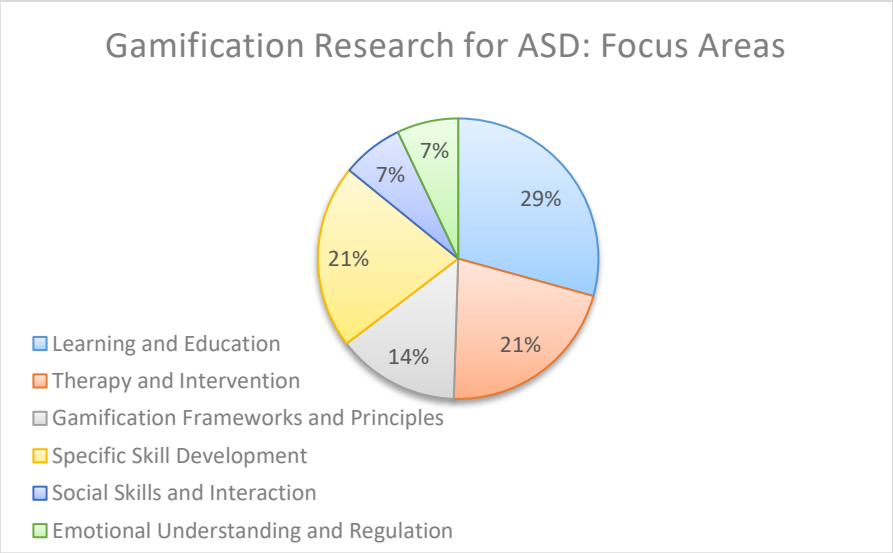

Figure 2: Gamification Research for ASD: Focus Areas

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Gamification Element

This review identified 11 gamification elements among the 19 evaluated trials. The gamification features are categorized based on their existence or absence in the treatments outlined in each source. Table 2 displays the frequency of gamification elements from each selected study, detailing the total number of gamification elements per study and the aggregate count for each gamification element included in this review. The most commonly incorporated gamification components were points (n=10), feedback (n=15), levels (n=10), badges (n=9), and leaderboards (n=7). The infrequent gamification components in this category include challenges (n=3), avatars (n=1), three-dimensional settings (n=4), competition (n=6), cooperation (n=5), and time pressure (n=1) (Figure 3).

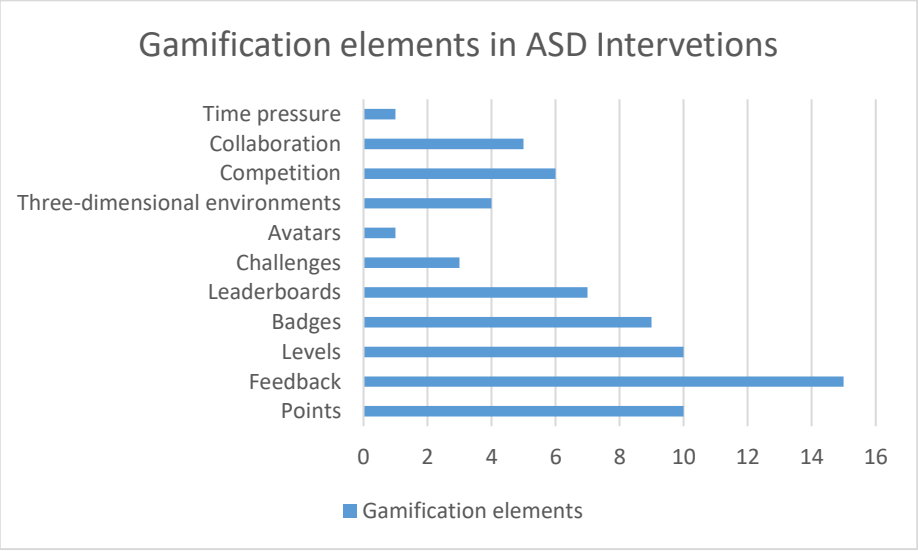

Figure 3: Gamification Elements in ASD Interventions

Discussion

Different types of research have employed gamification frameworks for Autism Spectrum Disorder (ASD). This study concentrated on identifying pertinent research that sought to enhance interaction skills. This review sought to elucidate the predominant gamification aspects employed in gamification frameworks to enhance interaction skills.

Gamification Frameworks and ASD

The research emphasizes the growing interest in utilizing gamification frameworks to develop interventions for children with ASD, specifically to improve their interpersonal skills. The sources highlight the necessity for specialized frameworks designed to meet the distinct demands and challenges of children with ASD, instead of depending on generic gamification frameworks aimed at broader audiences. According to the 19 selected research studies, the predominant gamification aspects comprise:

Points, Badges, and Leaderboards: These components are frequently utilized in gamified educational programs for outstanding learners, fostering rivalry and a sense of accomplishment. The Puzzle Walk app integrates visual rewards and performance feedback to encourage persons with ASD to enhance their physical activity levels. Nonetheless, it is crucial to acknowledge

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that rivalry may elicit anxiety and cognitive burden in specific individuals (Lee et al., 2018; Johnson et al., 2022; Pereira et al., 2023).

Levels serve to monitor growth and present escalating obstacles as the youngster progresses. Numerous gamified applications for children with ASD utilize levels to monitor development and offer a sense of achievement. The TFA games employ five testing levels within each category to assess a child's readiness to go to the subsequent level (Azizah et al., 2021; Pereira et al., 2023; Ifigenia et al., 2018; Johnson et al., 2022).

Challenges and Quests: Challenges can be vital in inspiring youngsters and shaping their behavior. In the context of ASD, establishing attainable challenges can foster participation and enhance a sense of achievement. The Aliza smart mirror, for instance, provides interactive games to enhance motivation for learning (Najeeb et al., 2020; Pereira et al., 2023; Smith & Abrams, 2019; Mubin & Poh, 2019; Carreño-León et al., 2021; Azizah et al., 2021; Shaban & Pearson, 2019).

Feedback is crucial in gamified therapy for children with ASD, as it aids in comprehending their development and sustaining attention. Feedback may be conveyed through diverse modalities, such as visual signals, auditory stimuli, and verbal reinforcement (Pereira et al., 2023; Smith & Abrams, 2019; Mubin & Poh, 2019; Johnson et al., 2022; Shaban & Pearson, 2019; Wang et al., 2021; Grund et al., 2020).

Customization: The prior study underscores the significance of adapting therapies to the distinct needs and preferences of children with ASD. This personalization guarantees the games are captivating and pertinent to the child's interests. Examples encompass utilizing visuals in inquiries to enhance comprehension and integrating aspects from the child's everyday experiences to promote engagement (Azizah et al., 2021; Pereira et al., 2023; Wang et al., 2021).

Elements of Social engagement: While specific gamified programs emphasize individual talents, others integrate components to promote social engagement. Some games, for example, foster teamwork and collaboration, whereas others employ virtual characters to instruct on emotion recognition and social skills (Smith & Abrams, 2019; Toda et al., 2019; Mubin & Poh, 2019).

Designing for Interaction Enhancement

Numerous instances illustrate the practical application of gamification to improve the social interaction abilities of children with ASD. One method is to establish a secure and organized setting for the practice of these abilities. Gamified therapies offer a more structured and manageable environment compared to real-world social contexts, which may be daunting for many children with ASD (Wang et al., 2021). For instance, the application of computer games employing virtual individuals to instruct youngsters with ASD in emotion identification and programming principles. These activities provide a secure environment for practicing identifying and responding to emotions, an essential component of social interaction (Azizah et al., 2021).

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Gamification may enhance social engagement by strategically employing game components such as points, feedback, levels, badges, and leaderboards. These factors can incentivize youngsters to participate in the intervention and enhance the enjoyment of the learning experience (Pereira et al., 2023; Cruz & Palaoag, 2019). The sources emphasize the efficacy of visual incentives and performance feedback in encouraging adults with ASD to engage in physical activity, as demonstrated by the Puzzle Walk app (Lee et al., 2018). Likewise, the TFA games utilize levels and an interest detection methodology to improve engagement in children with ASD (Azizah et al., 2021). By adjusting the difficulty level to align with the child's capabilities and integrating their interests, gamified treatments can offer a more customized and captivating learning experience. The sources emphasize the necessity of include researchers, educators, therapists, parents, and children with ASD in the design process to develop interventions that are pertinent, engaging, and efficacious (Mubin & Poh, 2019; Wang et al., 2021).

Incorporating User-Centered Design

Highlight the essential importance of user-centered design in creating effective gamified interventions for children with Autism Spectrum Disorder (ASD). This approach acknowledges that children with ASD constitute a heterogeneous group with a broad spectrum of abilities, challenges, and preferences. Designers must consider each child's distinct needs, interests, and cognitive profiles to develop genuinely engaging, motivating, and effective interventions. This approach requires abandoning generic, uniform methods in favor of personalization and customization (Johnson et al., 2022).

Promote the active participation of parents, educators, therapists, and children during the design process (Carreño-León et al., 2021). Engaging with these stakeholders yields essential information about the child's distinct requirements and preferences, guaranteeing that the intervention is pertinent, captivating, and customized to their learning style. The text illustrates how talks with parents, educators, and therapists contributed to the Zingo app's development, resulting in the integration of features like an in-app timer and the option for children to choose digital pets as avatars aligned with their interests (Johnson et al., 2022). It underscores the necessity of tailoring textual descriptions and sensory components in a gamified learning framework for neurodivergent employees, considering their unique sensitivities and preferences (Johnson et al., 2022). These instances illustrate how user-centered design might yield more effective and pleasurable interventions for children with ASD (Shaban & Pearson, 2019).

Focus on Emotional Understanding and Social Cognition

Enhancing interpersonal skills is a vital goal; nonetheless, it is essential to address emotional understanding and social cognition in therapies for children with ASD (Pereira et al., 2023). These characteristics are essential for effective social interactions, as they allow individuals to understand and react suitably to social signs, emotions, and viewpoints. The sources indicate that children with ASD frequently have challenges in these domains, affecting their capacity to establish meaningful relationships and adeptly navigate social situations.

It examines the utilization of computer games with emotionally intense scenarios to assist children with ASD in improving their emotional comprehension. The authors assert that games can elicit and record emotional responses proficiently, providing a significant medium for honing this ability. Presents "Aliza," an intelligent mirror to enhance diverse skills in

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youngsters with Autism Spectrum Disorder (Najeeb et al., 2020). One of its features is emotion tracking, enabling the mirror to respond to the child's feelings throughout activities. This immediate feedback can assist children in identifying and managing their emotions, an essential component of social-emotional development (Pereira et al., 2023). presents a prototype that emulates a primary school's social milieu to instruct social skills, specifically emphasizing dialogue and emotional expression. The game seeks to assist children with High-Functioning Autism Spectrum Disorder (HFASD) in cultivating empathy and Theory of Mind by associating characters' emotions and circumstances. The game's narrative design presents players with diverse social circumstances, encouraging them to contemplate multiple perspectives and emotional reactions (Wang et al., 2022; Carreño-León et al., 2021).

Multimodal Approaches and Tangible Interfaces

The potential of integrating multimodal feedback and tactile interfaces into gamified therapy for children with ASD to enhance learning experiences (Pereira et al., 2023). Incorporating visual, aural, and tactile elements accommodates the sensory processing preferences and learning styles frequently observed in children with ASD. It examines an enhanced interaction environment for neurodivergent employees engaged in electronic assembly jobs, incorporating physical and digital components to facilitate the user's workflow (Grund et al., 2020). This system integrates flexible, multimodal input via text, static and dynamic graphics, audio, and visual projections to address the unique requirements of each user. The intensity of sensory input can be modified to suit users with heightened sensitivity, and textual descriptions can be tailored to align with the user's linguistic and social capabilities (Johnson et al., 2022).

Tangible user interfaces (TUIs) offer advantages in therapies for children with ASD, highlighting that TUIs can bridge technology and the child by including familiar physical objects that house technology capable of producing digital representations (Carreño-León et al., 2021). This method can be especially advantageous for children who struggle to connect meanings with graphic representations or recognize real-world things in photographs. Presents a serious game that combines tangible user interfaces with an RFID communication board to assist children with Autism Spectrum Disorder regulate their emotions. The game employs physical objects children can handle, eliciting auditory feedback and visual reactions within the program. This multimodal strategy integrates physical engagement with digital components, fostering a more engaging and accessible educational experience for the youngster. It similarly depicts "Aliza," an intelligent mirror intended to improve diverse abilities in children with Autism Spectrum Disorder (ASD). The source does not specify the technology employed; nonetheless, the description of the mirror's responsiveness to the child's emotions implies the possibility of integrating sensors and multimodal feedback systems (Najeeb et al., 2020).

Limitations

Developing gamified therapies for children with Autism Spectrum Disorder (ASD) faces challenges, primarily due to the lack of complete gamification frameworks targeting interpersonal skills (Mubin & Poh, 2019; Azizah et al., 2021). The diverse abilities and needs within the ASD spectrum hinder universal solutions (Johnson et al., 2022; Mota et al., 2020; TWMIPS et al., 2024), requiring therapies to be tailored and adaptable to cognitive and sensory differences (Ghafghazi et al., 2021; Muminova, 2019). Traditional game elements like collaboration or competition can be challenging for children with social communication difficulties (Gonçalves et al., 2020), and maintaining motivation remains complex (Martin et

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al., 2022). Transferring skills from virtual to real-world settings and ethical concerns such as safety and stigma are essential considerations (Richards, 2023; Wang et al., 2021; Carreño-León et al., 2021; Pereira et al., 2023). Gamified interventions should complement existing therapies and involve therapists and educators (Reis et al., 2021), with longitudinal studies needed to assess long-term effects.

Innovations like Virtual Reality and Augmented Reality offer immersive, personalized experiences (Cheng & Ebrahimi, 2023), integrating therapeutic features to promote lasting behavioral change (Haber et al., 2020). Involving individuals with ASD in design enhances relevance and inclusion (Egan et al., 2023; Cox et al., 2020; Altenmüller-Lewis, 2017). Collaborative games that use clear visual cues and varied communication modes strengthen social skills (Wasserman et al., 2019; Moreno et al., 2019). Examples of gamified systems include "Chain of Words" for progress tracking (Cheng & Ebrahimi, 2023), EmoEden for emotional learning (Thampy et al., 2023; Susanto et al., 2022), and RoutineAid for self-efficacy (Ghafghazi et al., 2021). Additional research covers robotic-assisted language learning and sensory-supportive environments (Amato et al., 2021; Augello et al., 2020; Shou et al., 2023; Ali et al., 2021).

Gamification has strong potential for supporting children with ASD, but success depends on tailored, inclusive, and ethical approaches involving stakeholders throughout design and implementation (Reis et al., 2021; Ghafghazi et al., 2021).

Conclusions

This study explored the potential of gamification frameworks to enhance the social interaction skills of children with Autism Spectrum Disorder (ASD). The key objectives were to identify predominant gamification elements utilized in current interventions, evaluate their effectiveness, and emphasize the critical need for customized gamified interventions tailored to the distinctive strengths, challenges, and preferences of children with ASD (Azizah et al., 2021; Pereira et al., 2023; Chen et al., 2024; Zhao et al., 2025).

The comprehensive review confirms that gamification frameworks present significant promise as engaging and practical tools to address social communication difficulties encountered by children with ASD. Common game design elements—such as points, badges, levels, feedback, and leaderboards—are frequently leveraged to incentivize participation and enhance motivation (Pereira et al., 2023; Wang et al., 2021; Lin & Tsai, 2022; Martinez et al., 2023). However, many existing frameworks still fall short of sufficiently adapting these elements to accommodate the wide heterogeneity within the ASD population, limiting their efficacy for some individuals (Johnson et al., 2022; Lee et al., 2018; Kumar et al., 2024). Thus, while this study largely succeeded in identifying and assessing core gamification components, the development of fully optimized, ASD-specific gamification frameworks remains an essential objective for future research (Carreño-León et al., 2021; Mota et al., 2020; Nguyen & Brown, 2023).

Significantly, this study advances theory and practice by underscoring the value of a collaborative and multidisciplinary design process involving researchers, educators, therapists, parents, and children. Such an inclusive approach ensures gamified interventions are contextually relevant, engaging, and practical for real-world deployment (Smith & Abrams, 2019; Wang et al., 2022; Daniels et al., 2024). The findings reinforce that future frameworks

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must thoughtfully address the complex social interaction challenges faced by children with ASD, including impairments in nonverbal communication, difficulties in emotion recognition, sustaining eye contact, interpreting social cues, and coping with changes in routine (Azizah et al., 2021; Pereira et al., 2023; Zhao et al., 2025).

Despite these promising findings, several challenges were identified. These include the scarcity of rigorous long-term studies necessary to confirm sustained benefits and generalizability, and reports that competitive gamification components, such as leaderboards, may induce anxiety or cognitive overload for confident children, reducing effectiveness (Lee et al., 2018; Johnson et al., 2022; Lin & Tsai, 2022; Kumar et al., 2024). Additionally, translating theoretical gamification constructs into practical, scalable interventions continues to be complex. To address these challenges, the study advocates for expanded longitudinal research, refinement of game mechanics to balance motivation gains and cognitive demands, and the establishment of standardized assessment tools focused on ASD-specific outcomes (Mubin & Poh, 2019; Pereira et al., 2023; Wang et al., 2022; Chen et al., 2024).

In conclusion, this review enhances the understanding of gamification's role in ASD intervention development and highlights clear avenues for future research and practice. The advancement and widespread adoption of tailored gamification frameworks have a strong potential to improve social interaction skills significantly and, consequently, the overall well-being of children with ASD.

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