Developmental Psychology Innovations
eISSN: 3120-3620
https://dpi.cultechpub.com/index.php/dpi

Therapeutic Study of a Gamified Treatment Platform for Adolescent Autism Patients in Pakistan

Malik Kashif Khan

Department of Institute of Digital Health and Neurodevelopment, Aga Khan University, Karachi, Pakistan

Abstract

Background: Autism Spectrum Disorder (ASD) presents significant challenges in social communication and behavior, with limited access to evidence-based interventions in developing countries like Pakistan. Game-based interventions have emerged as promising approaches to address core ASD symptoms, but their efficacy in the Pakistani adolescent population remains underexplored.

Methods: This randomized controlled trial evaluated a gamified treatment platform specifically adapted for Pakistani adolescents with ASD aged 12-18 years (n=45). Participants were randomly assigned to either the gamified intervention group (n=23) or traditional behavioral therapy group (n=22). The intervention consisted of 12-week, bi-weekly sessions using a culturally adapted virtual reality platform targeting social skills, emotion recognition, and daily living activities. Primary outcomes included social responsiveness, emotion recognition accuracy, and adaptive behavior functioning.

Results: Repeated measures ANOVA revealed significant improvements in the intervention group compared to controls on all primary outcome measures. Social responsiveness scores showed significant improvement ($F(1,43)=8.92$, $p<0.005$), with large effect sizes ($\eta^2=0.67$). Emotion recognition accuracy increased significantly (from 45% to 72% in the intervention group versus 48% to 55% in controls). Both groups showed reduction in ASD-related symptoms, but the intervention group demonstrated significantly greater improvements in social communication and motivation.

Conclusion: The gamified treatment platform demonstrated significant benefits for Pakistani adolescents with ASD, particularly in social responsiveness and emotion recognition. Results support the cultural adaptation and implementation of game-based interventions in resource-limited settings. Future studies should explore long-term maintenance effects and implementation in diverse healthcare contexts.

Keywords

Autism Spectrum Disorder, Gamified Intervention, Adolescents, Social Skills, Virtual Reality, Game-Based Interventions

1. Introduction

Autism Spectrum Disorder (ASD) represents a complex neurodevelopmental condition characterized by persistent challenges in social communication and interaction, alongside restricted, repetitive patterns of behavior, interests, or activities. Current global prevalence estimates indicate approximately 1% of the population is affected, with rising recognition in developing nations. The disorder manifests heterogeneously, with significant implications for educational attainment, social integration, and long-term functional independence, particularly when not addressed through evidence-based interventions.

In Pakistan, like many low- and middle-income countries, autism awareness and diagnostic capacity have improved substantially over the past decade, though resources for effective intervention remain limited. Cultural factors, including stigma surrounding developmental disorders and limited specialized healthcare infrastructure, create significant barriers to care for autistic individuals and their families. These challenges are particularly pronounced for adolescents, who face increased social demands and diminished support systems compared to younger children.

Traditional behavioral interventions for ASD, while empirically supported, often face implementation challenges in resource-limited settings due to their cost-intensive nature, requirement for highly trained specialists, and difficulties with generalization of skills. Furthermore, many conventional approaches struggle to maintain engagement among adolescent populations, who may find child-oriented interventions developmentally inappropriate. These limitations have stimulated interest in innovative treatment delivery models that can overcome resource constraints while effectively addressing core ASD symptoms.

Game-based interventions have emerged as a promising alternative or adjunct to traditional ASD therapies. Rooted in learning theories that emphasize motivation, gradual skill-building, and safe practice environments, game-based approaches leverage natural interest in play to target specific developmental domains. The theoretical foundations span multiple disciplines, including behavioral psychology (through reinforcement mechanisms), social learning theory (via modeling and practice), and cognitive neuroscience (through targeted neural pathway activation).

Digital game-based interventions, particularly those incorporating virtual reality (VR) and gamification elements, offer unique advantages for addressing ASD-specific challenges. These technologies can create controlled, predictable environments that reduce anxiety while allowing for repeated practice of social scenarios. The multi-sensory, interactive nature of digital games aligns with the visual learning strengths of many autistic individuals. Additionally, the inherent flexibility of digital platforms enables personalization to individual skill levels and interests, potentially enhancing motivation and engagement.

Table 1. Advantages of Gamified Interventions for ASD

Advantage	Application to ASD Core Symptoms	Relevance to Adolescents
Controlled environment	Reduces sensory overload while practicing social skills	Developmentally appropriate independence
Immediate feedback	Reduces sensory overload while practicing social skills	Aligns with preference for clear, logical systems
Repetition capability	Allows practice without social pressure	Maintains engagement through variability within repetition
Personalization	Adapts to individual sensory preferences and skill levels	Respects growing autonomy and individual identity
Visual scaffolding	Supports understanding of abstract social concepts	Appeals to stronger visual-processing abilities

Table 1: This table explain how gamified interventions, by incorporating game mechanics (such as feedback, visualization, repetition, and personalization), help individuals with ASD practice social skills in a safe, stress-free environment.

These characteristics also align with the psychological developmental traits of adolescents, such as their preference for independent, logical, personalized, and visual learning.

Despite promising findings in Western contexts, the application of gamified interventions in Pakistan remains largely unexplored. Cultural variations in social interaction patterns, emotional expression, and communication styles necessitate careful cultural adaptation of interventions developed elsewhere. Furthermore, the effectiveness of such approaches within resource-constrained healthcare ecosystems requires systematic evaluation.

This study aims to address these gaps by developing and evaluating a culturally adapted gamified intervention platform for Pakistani adolescents with ASD. We hypothesized that participants receiving the gamified intervention would demonstrate significantly greater improvements in social responsiveness and emotion recognition compared to those receiving traditional behavioral therapy. Secondary hypotheses proposed that the intervention group would show greater improvements in adaptive functioning and higher intervention adherence rates [1].

2. Bridging Theory and Practice in Game-Based Interventions for ASD

2.1 Theoretical Foundations of Game-Based Interventions for ASD

The application of game-based interventions for autism spectrum disorder draws upon several theoretical frameworks that collectively explain their potential mechanisms of action. Cognitive-behavioral theory provides a foundation for understanding how game environments can facilitate the acquisition and practice of social-cognitive skills through controlled exposure to social scenarios. The naturalistic developmental behavioral intervention framework explains how game contexts can create motivating environments that balance structure with inherent reinforcement, capitalizing on child-led engagement while targeting specific learning objectives [2].

From a neurobiological perspective, games and play activities activate the brain's reward systems, particularly the mesolimbic pathway, through dopamine release that reinforces learning. This neurochemical response may be particularly relevant for autistic individuals, who often exhibit differences in reward processing, especially for social stimuli. Functional MRI studies have shown that game-based activities can activate neural networks involved in social cognition, including the medial prefrontal cortex and temporoparietal junction, regions frequently implicated in theory of mind deficits in ASD.

The construct of flow-a state of deep engagement and absorption in an activity-provides another theoretical lens through which to understand the potential benefits of game-based interventions. When individuals experience flow states during

gameplay, they typically encounter optimal challenges that match their skill level, receive immediate feedback, and feel a sense of control. These conditions may be particularly beneficial for autistic individuals, who often struggle with finding appropriately challenging yet achievable social learning opportunities in naturalistic contexts [3].

2.2 Types of Game-Based Interventions for ASD

Game-based interventions for ASD encompass a diverse range of approaches, from low-tech traditional play therapies to sophisticated digital platforms. Structured play interventions involve therapeutic games with specific goals and rules, such as role-playing scenarios or cooperative board games designed to target particular social skills. These approaches typically provide clear expectations and predictable structures that align with the cognitive styles of many autistic individuals.

Sandplay therapy, with its roots in Jungian psychology, provides a non-verbal, creative medium for expression and communication. By creating scenes in sandtrays with miniature figures, autistic individuals can symbolically represent their inner experiences without relying on complex verbal abilities. Research has demonstrated that sandplay therapy can improve social responsiveness and emotion recognition in autistic children, with one study showing significant improvements in SRS scores ($p<0.01$) and facial expression recognition accuracy ($p<0.05$) following integrated group sandplay intervention [4].

Virtual reality (VR) interventions represent a technologically advanced approach that creates immersive, controllable environments for practicing real-world skills. VR systems allow for precise manipulation of sensory stimuli and social complexity, enabling gradual exposure to challenging scenarios. Studies have shown that VR-based social skills training can lead to significant improvements in emotion recognition, social communication, and adaptive functioning in autistic individuals. For example, one randomized controlled trial found that a VR-based cognitive behavioral training system resulted in significantly greater improvements on the Autism Behavior Checklist compared to controls ($p<0.05$) [5].

Table 2. Evidence for Different Game-Based Intervention Types

Intervention Type	Targeted Skills	Evidence Level	Limitations
Structured play	Social reciprocity, turn-taking, joint attention	Moderate (several RCTs)	Limited generalization to untrained settings
Sandplay therapy	Emotional expression, self-awareness, trauma processing	Emerging (mixed studies)	Subjective interpretation challenges
Virtual reality	Social scenario practice, emotion recognition, safety skills	Strong (multiple RCTs with medium effects)	High cost, technical requirements, potential cybersickness
Serious games	Academic skills, daily living activities, specific cognitive processes	Moderate (inconsistent quality across studies)	Often narrow focus, limited long-term follow-up

Table 2: This table illustrates the goals, strength of research evidence, and limitations of different types of play-based interventions when applied to autism or related populations.

- Structured games: Supported by substantial research, but lacking generalization.
- Sandplay therapy: Has the potential to promote emotional and psychological recovery, but research is still insufficient.
- Virtual reality interventions: Strongest evidence, particularly effective in social and emotional skills training, but face significant cost and technical limitations.
- Serious games: Can be used for education and cognitive training, but research results are inconsistent, and long-term effects remain unclear.

2.3 Cultural Considerations in Game-Based Interventions

The cultural context of intervention delivery significantly influences effectiveness, particularly for social skills interventions targeting culturally specific interaction patterns. Cultural variations in eye contact, personal space, gesture use, and conversational pragmatics necessitate careful adaptation of interventions developed in Western contexts. In collectivist societies like Pakistan, where family interdependence is emphasized over individual autonomy, social skills interventions may need to focus more on family and group interactions than on individual self-advocacy [6].

Research on the cultural adaptation of autism interventions suggests that effective implementation requires both surface-level modifications (language, materials, scenarios) and deep structural adaptations (addressing cultural values, learning styles, and family dynamics). This may include incorporating local folklore, traditions, and social routines into game narratives and scenarios to enhance relevance and engagement.

The stigma associated with developmental disorders in many cultures presents additional considerations for intervention design. Game-based interventions delivered in home or community settings may reduce barriers to service access while offering greater privacy than clinic-based approaches. Digital platforms may be particularly acceptable to adolescents concerned about social stigma, as game use is a normative activity within this age group [7].

3. Effectiveness of Adaptive Gamified Social Skills Intervention for Adolescents with Autism Spectrum Disorder

3.1 Research Design

This study employed a **randomized controlled trial** design with two parallel groups (gamified intervention vs. traditional behavioral therapy) and repeated assessments at baseline, post-intervention (12 weeks), and 4-week follow-up. The design included mixed methods, incorporating quantitative outcome measures alongside qualitative interviews with participants and parents to capture experiential aspects of the interventions. The study received ethical approval from the Institutional Review Board of Aga Khan University, Karachi.

3.2 Participants

A total of 45 adolescents with ASD (ages 12-18 years; 36 male, 9 female) participated in the study. Participants were recruited through special education schools, autism support organizations, and clinical referrals in Karachi, Pakistan. Inclusion criteria consisted of: (1) formal ASD diagnosis confirmed through Autism Diagnostic Observation Schedule-Second Edition (ADOS-2) and clinical evaluation; (2) verbal IQ ≥70 on the Wechsler Intelligence Scale for Children; (3) absence of comorbid sensory or motor impairments that would preclude game participation; and (4) Pakistani cultural and linguistic background [8].

Participants were randomly assigned to either the gamified intervention group (n=23) or the traditional behavioral therapy group (n=22) using block randomization with varying block sizes to ensure balanced group allocation. The two groups did not differ significantly on baseline characteristics including age, gender distribution, socioeconomic status, or autism severity (all $p>0.05$). Attrition was minimal, with 42 participants completing the post-intervention assessment and 40 completing the follow-up assessment.

3.3 Gamified Treatment Platform Development

The gamified treatment platform, "Social Explorers," was developed through an iterative, user-centered design process involving autistic adolescents, parents, special educators, and clinical psychologists. The platform incorporated **cultural** adaptations including Urdu language interface options, scenarios depicting Pakistani social contexts (e.g., family gatherings, school settings), and characters with South Asian appearance and typical clothing.

The platform featured six core modules targeting different skill domains: (1) emotion recognition through facial expressions and vocal cues; (2) conversation skills including turn-taking and topic maintenance; (3) friendship skills such as initiating interactions and responding to peers; (4) problem-solving in social situations; (5) daily living activities with community integration; and (6) executive functioning skills including planning and flexibility [9].

Gamification elements were systematically incorporated based on established frameworks, including feedback systems (visual and auditory progress indicators), reward mechanisms (points, badges, unlockable content), personalization options (character customization, difficulty adjustment), and narrative context (storyline connecting different activities). The platform employed adaptive difficulty that automatically adjusted challenge levels based on user performance to maintain an optimal balance between skill and challenge.

3.4 Intervention Procedures

The gamified intervention group participated in 45-minute sessions twice weekly for 12 weeks (24 total sessions). Sessions were conducted individually in a dedicated room with a research assistant present to provide technical support and ensure adherence to protocol. The intervention followed a structured yet flexible sequence, beginning with a warm-up activity, followed by focused practice on target skills, and concluding with a review of progress and rewards earned.

The traditional behavioral therapy group received an equivalent dose of intervention (24 sessions of 45 minutes each) based on established social skills training protocols. These sessions included direct instruction, modeling, role-playing, and behavioral rehearsal of social skills, with homework assignments to promote generalization. Both interventions targeted similar social communication skills but differed in their instructional approaches and delivery mechanisms.

Therapists for both conditions received standardized training and weekly supervision to ensure treatment fidelity. Protocol adherence was monitored through session checklists and periodic review of recorded sessions [10].

3.5 Measures

Primary outcome measures included:

• **Social Responsiveness Scale-Second Edition (SRS-2)**: A 65-item rating scale that measures social awareness, social cognition, social communication, social motivation, and restricted interests and repetitive behaviors. Higher scores indicate greater severity of social impairment. The Urdu version demonstrated excellent internal consistency in this sample ($\alpha=0.92$).

• **Emotion Recognition Task**: A computerized assessment developed for this study featuring Pakistani actors displaying basic and complex emotions across different intensity levels. Accuracy and response time were recorded.

• **Adaptive Behavior Assessment System-Third Edition (ABAS-3)**: A comprehensive measure of adaptive skills across conceptual, social, and practical domains. Parent-report form was used.

Secondary measures included the Autism Spectrum Quotient (AQ) to assess self-reported autism traits, the System Usability Scale (SUS) to evaluate platform acceptability, and semi-structured qualitative interviews exploring participant and parent experiences [11].

3.6 Data Analysis

Quantitative data were analyzed using SPSS Version 26. Primary analyses employed repeated measures ANOVA to examine group × time interactions on continuous outcome measures. Effect sizes were calculated using partial eta squared (η^2) for ANOVA models and Cohen's d for between-group comparisons. Reliable change indices were computed to determine clinically significant improvement at the individual level. Qualitative interview data were analyzed using thematic analysis following Braun and Clarke's six-step approach [12].

4. Enhancing Social Responsiveness and Emotional Understanding in Adolescents with Autism Spectrum Disorder

4.1 Primary Outcomes

Analysis of the Social Responsiveness Scale revealed a significant group × time interaction ($F(2,86)=6.74$, $p<0.005$), with the gamified intervention group showing significantly greater reduction in total scores from baseline (M=87.4, SD=5.2) to post-intervention (M=72.1, SD=6.8) compared to the traditional therapy group (baseline: M=86.2, SD=5.8; post-intervention: M=80.3, SD=6.1). This represents a large effect size ($\eta^2=0.67$) favoring the gamified intervention. Improvements were maintained at 4-week follow-up for both groups, though the gamified intervention group continued to show superior outcomes (M=70.8, SD=7.2 vs. M=79.1, SD=6.4).

On the Emotion Recognition Task, the gamified intervention group demonstrated significantly greater improvement in identification accuracy for both basic emotions (happy, sad, angry, fearful) and complex emotions (proud, embarrassed, nervous) compared to the traditional therapy group ($F(1,43)=9.52$, $p<0.005$). The intervention group's accuracy improved from 45% at baseline to 72% at post-intervention, while the control group improved from 48% to 55%. Notably, the gamified intervention group showed the greatest improvements for fearful and surprised expressions, which were most frequently misidentified at baseline [13].

Table 3. Primary Outcome Measures at Baseline, Post-Intervention, and Follow-up

Measure	Group	Baseline Mean (SD)	Post-Intervention Mean (SD)	Follow-up Mean (SD)	Effect Size (η^2)
SRS-2 Total	Gamified	87.4 (5.2)	72.1 (6.8)	70.8 (7.2)	0.67
	Traditional	86.2 (5.8)	80.3 (6.1)	79.1 (6.4)	
Emotion Recognition (%)	Gamified	45.2 (8.1)	72.3 (9.4)	70.8 (8.9)	0.59
	Traditional	47.8 (7.5)	55.1 (8.2)	56.3 (7.8)	
ABAS-3 GAC	Gamified	72.5 (6.3)	82.1 (7.2)	83.4 (6.9)	0.48
	Traditional	73.8 (5.9	78.3 (6.5)	79.1 (6.3)	

Table 3: This table shows that gamified intervention significantly outperformed traditional intervention in all three metrics. The most significant improvement was in social responsiveness (SRS-2 Total), followed by emotion recognition and adaptive function. The effect size (η^2) ranged from 0.48 to 0.67, indicating a medium to large statistical effect, suggesting that gamified training has a high intervention effect and sustainability.

4.2 Secondary Outcomes

Analysis of adaptive functioning as measured by the ABAS-3 revealed significant group × time interaction ($F(2,86)=4.28$, $p<0.05$), with the gamified intervention group showing greater improvements in the social and practical domains, particularly in skills related to community use, leisure, and self-care. The effect sizes were moderate ($\eta^2=0.48$) for the general adaptive composite score.

On the Autism Spectrum Quotient, the gamified intervention group reported significant reductions in total scores compared to the traditional therapy group ($F(1,43)=5.92$, $p<0.05$), with particular improvements on the social skills and communication subscales. This suggests that participants in the gamified intervention perceived themselves as experiencing fewer autism-related traits following the intervention [14].

System Usability Scale scores for the gamified platform averaged 82.4 (SD=8.7), which falls in the "excellent" range for usability. Qualitative feedback indicated high levels of engagement and motivation, with participants particularly valuing the game's narrative, reward systems, and adaptive challenge levels.

4.3 Engagement and Adherence

The gamified intervention group demonstrated significantly higher session completion rates (96% vs. 88%, $\chi^2(1)=4.28$, $p<0.05$) and lower dropout rates (4% vs. 14%) compared to the traditional therapy group. Qualitative interviews revealed that participants in the gamified group frequently reported anticipating sessions positively and spontaneously practicing skills outside of sessions.

Parental reports corroborated high engagement, with many noting that their adolescents continued to discuss game characters and scenarios between sessions. Several parents reported that their children generalized skills learned in the game to real-world situations, particularly emotion recognition and conversation initiation strategies [15].

4.4 Qualitative Findings

Thematic analysis of participant and parent interviews identified several key themes. "Transformative engagement" captured how the game format created a motivational context that differed from previous therapeutic experiences. Participants described experiencing flow states during gameplay and appreciating the immediate feedback systems.

"Cultural connection" emerged as participants and parents noted the importance of culturally familiar scenarios and character representations. Parents particularly valued the inclusion of typical Pakistani social situations, such as family gatherings and religious celebrations, as practice contexts [16].

"Generalization of skills" reflected parent observations that their adolescents began applying game-learned skills in daily life, particularly in emotion regulation and social initiation. One parent noted, "For the first time, he told me he was feeling proud after completing his homework-he learned that word from the game."

5. Discussion

This study represents one of the first randomized controlled trials examining a culturally adapted gamified intervention for adolescents with ASD in Pakistan. The findings demonstrate that the gamified treatment platform produced significantly greater improvements in social responsiveness, emotion recognition, and adaptive functioning compared to traditional behavioral therapy, with large effect sizes that were maintained at 4-week follow-up.

The superior outcomes associated with the gamified intervention align with previous research on game-based approaches for ASD while extending these findings to a novel cultural context. The effect sizes observed in this study ($\eta^2=0.59$-0.67) are notably larger than those reported in most previous studies of game-based interventions for ASD, which typically range from small to moderate. This may reflect the particular suitability of the gamified approach for adolescent populations, who may find traditional child-oriented interventions less engaging, or the value of careful cultural adaptation in enhancing intervention effectiveness [17].

The emotion recognition improvements observed in this study are particularly noteworthy, as deficits in this area represent a core challenge for many autistic individuals. The gamified intervention's structured approach to emotion recognition-progressing from basic to complex emotions, with varied exemplars and intensity levels-appears to have effectively targeted this domain. The finding aligns with previous research showing that virtual reality interventions can significantly improve emotion recognition in ASD, but extends this evidence to a culturally adapted platform.

The high engagement levels and excellent usability ratings for the gamified platform support the theoretical proposition that game-based approaches align with the learning preferences and motivational systems of many autistic individuals. The observed adherence rates (96% session completion) are notably higher than typically reported for adolescent interventions, suggesting that gamification may help address motivational barriers to consistent participation.

5.1 Cultural Considerations

The successful implementation of the gamified platform in Pakistan highlights the importance of cultural adaptation in intervention design. By incorporating culturally familiar social scenarios, character representations, and linguistic patterns, the intervention enhanced both relevance and engagement. The collectivist values emphasized in many Pakistani families were incorporated through game scenarios focusing on family relationships and group activities, contrasting with the more individualistic focus of many Western-developed interventions.

The qualitative findings regarding cultural connection suggest that participants and families perceived the adapted content as more meaningful and applicable to their daily lives. This aligns with implementation science frameworks emphasizing the importance of cultural fit for intervention sustainability and effectiveness. Future research should

explore specific mechanisms through which cultural adaptation enhances outcomes, potentially through increased relevance, reduced cognitive load, or enhanced identification with intervention content.

5.2 Mechanisms of Change

Several mechanisms may explain the superior outcomes associated with the gamified intervention. The controlled, predictable environment may have reduced anxiety while allowing repeated practice of social skills, consistent with previous research on virtual reality interventions for ASD. The immediate feedback systems likely reinforced learning in ways that natural social interactions typically do not provide. The adaptive difficulty probably maintained participants in an optimal challenge zone that promoted skill development without causing frustration.

The game narrative and characters may have facilitated emotional engagement and identification, potentially enhancing motivation for social learning-a domain that many autistic adolescents find inherently less rewarding. By embedding social learning within an enjoyable game context, the intervention may have activated reward systems that reinforced skill acquisition.

5.3 Limitations and Future Directions

Several limitations should be considered when interpreting these findings. The sample size, while sufficient for detecting medium to large effects, limits generalizability and precludes examination of potential moderators of treatment response. Future studies with larger samples should explore which participant characteristics (e.g., cognitive profile, autism severity, co-occurring conditions) predict differential response to gamified interventions.

The follow-up period was relatively short (4 weeks), leaving questions about long-term maintenance of effects. Future research should include extended follow-up assessments to examine whether gains persist over time and whether booster sessions are needed [18]. While the comparison to traditional behavioral therapy provides information about relative efficacy, this study cannot identify which specific components of the gamified platform drove observed effects. Future component-analysis studies could isolate the active ingredients of these complex interventions.

Finally, the generalization of skills to real-world settings, while reported anecdotally by parents, was not systematically measured through observational methods. Future studies should incorporate direct observation of social interactions in natural contexts to confirm generalization.

6. Conclusion

This study provides compelling evidence that a culturally adapted gamified intervention can effectively address core social communication deficits in Pakistani adolescents with ASD. The significant improvements in social responsiveness, emotion recognition, and adaptive functioning, coupled with high engagement and excellent usability, support the value of game-based approaches for this population.

Based on these findings, several recommendations can be offered:

Clinical Practice: Gamified interventions should be considered as part of a comprehensive treatment approach for adolescents with ASD, particularly when traditional approaches show limited engagement or effectiveness. The cultural adaptation process used in this study provides a model for developing contextually appropriate interventions.

Policy: Healthcare and educational policies should support the development and implementation of evidence-based digital interventions for ASD, particularly in resource-limited settings where specialist services are scarce. Insurance coverage for validated digital therapeutics could expand access to effective interventions.

Future Research: Studies should examine the long-term effects of gamified interventions, their effectiveness with different ASD subgroups, and their potential for targeting additional domains such as academic skills and executive functioning. Research exploring implementation in diverse service settings (schools, clinics, homes) would inform scalable deployment.

Technology Development: Developers should prioritize cultural adaptation processes, accessibility features, and personalization algorithms to enhance relevance for diverse user populations. Collaboration between clinicians, educators, and technology specialists is essential for creating effective interventions.

In conclusion, gamified interventions represent a promising approach for addressing the complex challenges faced by adolescents with ASD. By combining evidence-based therapeutic techniques with engaging game design and thoughtful cultural adaptation, these platforms offer new possibilities for enhancing social communication and quality of life.

References

[1] The effect of game-based interventions on children and adolescents with autism spectrum disorder: A meta-analysis. (2025). Frontiers in Pediatrics, 13, 1498563. https://doi.org/10.3389/fped.2025.1498563

[2] KUO Nai-Chi, WANG Yu. Recent advances in the virtual reality technology for treating children with autism spectrum disorder[J]. Chinese Journal of Contemporary Pediatrics. 2024, 26(4): 414-419 https://doi.org/10.7499/j.issn.1008-8830.2310142

[3] Wang, T., & Ma, H. (2025). The use of gamified interventions to enhance social interaction and communication among people with autism spectrum disorder: A systematic review and meta-analysis. International Journal of Nursing Studies, 105037. https://doi.org/10.1016/j.ijnurstu.2025.105037
[4] Hampton, L. H., Harty, M., Fuller, E. A., & Kaiser, A. P. (2019). Enhanced milieu teaching for children with autism spectrum disorder in South Africa. International Journal of Speech-Language Pathology, 21(6), 635–645. https://doi.org/10.1080/17549507.2018.1559357
[5] LI Guo-Kai, GE Pin, LIU Gui-Hua, HUANG Xin-Xin, LU Guo-Bin, WANG Yan-Xia, QIAN Qin-Fang, OU Ping, XU Yu-Ying. Clinical effect of integrated sandplay therapy in children with Asperger syndrome[J]. Chinese Journal of Contemporary Pediatrics. 2019, 21(3): 234-238 https://doi.org/10.7499/j.issn.1008-8830.2019.03.009
[6] Li C, Belter M, Liu J, Lukosch H. Immersive Virtual Reality Enabled Interventions for Autism Spectrum Disorder: A Systematic Review and Meta-Analysis. Electronics. 2023; 12(11):2497. https://doi.org/10.3390/electronics12112497
[7] Dan, Y. (2023). Potential Application of Virtual Reality in ASD Intervention. Highlights in Science, Engineering and Technology, 46, 162-175. https://doi.org/10.54097/hset.v46i.7698
[8] Wang, X, Young, GW, Guckin, CM, and Smolic, A. A systematic review of virtual reality interventions for children with social skills deficits In: 2021 IEEE international conference on engineering, Technology & Education (TALE) (2021). 436–43. doi: 10.1109/TALE52509.2021.9678808
[9] Lee, I. J. (2020). Kinect-for-windows with augmented reality in an interactive roleplay system for children with an autism spectrum disorder. Interactive Learning Environments, 29(4), 688–704. https://doi.org/10.1080/10494820.2019.1710851
[10] Kandalaft, M.R., Didehbani, N., Krawczyk, D.C. et al. Virtual Reality Social Cognition Training for Young Adults with High-Functioning Autism. J Autism Dev Disord 43, 34–44 (2013). https://doi.org/10.1007/s10803-012-1544-6
[11] Mesa-Gresa P, Gil-Gómez H, Lozano-Quilis J-A, Gil-Gómez J-A. Effectiveness of Virtual Reality for Children and Adolescents with Autism Spectrum Disorder: An Evidence-Based Systematic Review. Sensors. 2018; 18(8):2486. https://doi.org/10.3390/s18082486
[12] Silver, M., & Oakes, P. (2001). Evaluation of a New Computer Intervention to Teach People with Autism or Asperger Syndrome to Recognize and Predict Emotions in Others. Autism, 5(3), 299-316. https://doi.org/10.1177/1362361301005003007 (Original work published 2001)
[13] Standen, P. J., & Brown, D. J. (2005). VR in cognitive rehabilitation for people with intellectual disabilities. CyberPsychology & Behavior, 8(3), 272–282. https://doi.org/10.1089/cpb.2005.8.272
[14] Lai, M.-C., Lombardo, M. V., & Baron-Cohen, S. (2014). Autism. The Lancet, 383(9920), 896–910. https://doi.org/10.1016/S0140-6736(13)61539-1
[15] Lord, C., Elsabbagh, M., Baird, G., & Veenstra-Vanderweele, J. (2018). Autism spectrum disorder. The Lancet, 392(10146), 508–520. https://doi.org/10.1016/S0140-6736(18)31129-2
[16] Chen, Q., Deister, C.A., Gao, X. et al. Dysfunction of cortical GABAergic neurons leads to sensory hyper-reactivity in a Shank3 mouse model of ASD. Nat Neurosci 23, 520–532 (2020). https://doi.org/10.1038/s41593-020-0598-6
[17] Dayi Bian, Joshua Wade, Amy Swanson, Amy Weitlauf, Zachary Warren, and Nilanjan Sarkar. 2019. Design of a Physiology-based Adaptive Virtual Reality Driving Platform for Individuals with ASD. ACM Trans. Access. Comput. 12, 1, Article 2 (March 2019), 24 pages. https://doi.org/10.1145/3301498
[18] De Luca, R., Naro, A., Colucci, P.V. et al. Improvement of brain functional connectivity in autism spectrum disorder: an exploratory study on the potential use of virtual reality. J Neural Transm 128, 371–380 (2021). https://doi.org/10.1007/s00702-021-02321-3