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Enhancement of Teachers Knowledge in Gamification for Improving Reading Skills in Students with Autism Spectrum Disorder

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Abstract: Autism Spectrum Disorder (ASD) is a developmental disorder characterized by challenges with social interaction, communication, and repetitive behaviors. Students with ASD often struggle with reading skills due to deficits in language comprehension, attention, and social communication. Gamification, applying game-design elements in non-game contexts, has emerged as a promising approach to enhance learning for these students. This study aimed to develop and implement a gamification-based learning application to improve the reading skills of students with ASD in special schools. The initiative sought to empower teachers through comprehensive training and support, enabling them to effectively use gamified educational tools. The method followed the ADDIE model: Analysis involved a needs assessment; Design included creating a training program and evaluation instruments; Development involved creating training materials and preparing for pilot testing; Implementation included conducting the training for teacher and administering pre-tests and post-tests; Evaluation consisted of analyzing test data and feedback. The training session was conducted on July 17, 2024, at SLB Autis Lab UM. Paired t-test results showed a significant increase in mean scores from pre-test (78.67±11.87) to post-test (88.00±10.14), with a P-value of 0.014, indicating effective training. Participant feedback highlighted the gamification application's appealing interface, ease of use, and positive impact on student motivation, participation, and reading skills. The gamification-based learning application effectively improves reading skills in students with ASD and enhances teachers' knowledge and skills in using such tools. Ongoing support and professional development for educators are crucial for integrating innovative tools into teaching practices, fostering academic success and overall development for students with ASD.
Keywords: Autism Spectrum Disorder, Gamification, Reading Skills, Teacher Training, Special Education

INTRODUCTION

Autism Spectrum Disorder (ASD) is a developmental disorder characterized by challenges with social interaction, communication, and repetitive behaviours (Hodges, Fealko, & Soares, 2020). The prevalence of people with ASD in Indonesia is estimated to increase by 500 people annually (Astuti, With Autism, & Suminar, 2022). Despite growing awareness, there remains a significant need for effective educational interventions to support these students (Odom et al., 2021). Students with ASD often face significant challenges in developing reading skills (Vale, Fernandes, & Cardoso, 2022)there is mixed evidence on their weaknesses in different reading components, and little is known about how reading skills characterize in ASD. Thereby, the current study aimed to systematically review the research investigating this function in children with ASD. To this purpose, we reviewed 24 studies that compared (1. These difficulties can stem from various factors, including deficits in language comprehension, attention, and social communication (Schaeffer et al., 2023)a consequence of autism itself (no comorbidity. Data indicates that a substantial percentage of children with ASD struggle with reading, estimates from recent studies range from 38–73%, and traditional teaching methods are often insufficient (Davidson, Kaushanskaya, & Ellis Weismer, 2018). This highlights the need for specialized approaches tailored to their unique learning needs.

Gamification, the application of game-design elements in non-game contexts, has emerged as a promising approach to enhance learning, particularly for students with ASD (Honorato et al., 2024). Mobile gamification applications for reading have been developed to make learning more engaging and interactive. These applications use features such as rewards, progress tracking, and interactive content to motivate students and improve their reading skills (Safatian, 2023). Studies have shown that gamification can significantly enhance motivation and learning outcomes in students with ASD (Tuna, 2023). Teachers play a crucial role in the successful implementation

of gamified learning. For gamification to be effective, teachers must be adequately trained and supported (Martí-Parreño, Seguí-Mas, & Seguí-Mas, 2016). Therefore, researchers are focusing on providing training and resources to educators as the primary step in integrating gamification into reading instruction for students with ASD. This includes workshops, professional development sessions, and ongoing support to ensure that teachers can effectively use gamification tools to enhance their students' learning experiences. The aim is to implement a gamification-based learning application to improve the reading skills of students with ASD) in special schools. This initiative seeks to empower teachers through comprehensive training and support, enabling them to effectively utilize gamified educational tools. By enhancing the capability of educators and providing engaging learning resources, the project aims to significantly improve the reading outcomes for students with ASD, fostering a more inclusive and supportive educational environment.

METHODS

The method used in this service activity follows the ADDIE model, which ensures a systematic and structured approach to developing and implementing the project.

1. Analysis

In the analysis phase, we will conduct a thorough needs assessment by identifying the specific challenges and requirements for teaching reading to students with ASD. We also identified and selected suitable gamified reading applications available on the Play Store and App Store that can effectively address the learning needs of students with ASD. We used the Marbel: Lancar Membaca v3.1.0 application developed by PT Educa Sisfomedia Indonesia. This application is designed to enhance learning through interactive and engaging content, incorporating various game-design elements to make the educational experience more enjoyable for students with ASD.

2. Design

Based on the findings from the analysis phase, we will design a comprehensive training program for Special School (SLB) teachers. The program will include theoretical knowledge about ASD, the principles of gamification, and practical guidance on using selected gamified reading applications. Additionally, we will design pretest and posttest instruments to evaluate the teachers' knowledge before and after the training.

3. Development

In the development phase, we will create the training materials, including presentations, instructional videos, user manuals, and interactive activities.

4. Implementation

During the implementation phase, we will conduct the training program for SLB teachers. The program started with a pretest to assess the teachers' initial knowledge and perceptions regarding ASD and gamified learning. After the pretest, the outreach program provided comprehensive training sessions, including practical demonstrations and interactive discussions on using the selected gamified applications to enhance reading instruction for students with ASD.

5. Evaluation

In the evaluation phase, we will analyze the data collected from the pretests and posttests using paired t-test by SPSS to assess the effectiveness of the training program and identify areas for further improvement. This statistical analysis will help determine if there is a significant difference in teachers' knowledge about gamification before and after the training, with a significance level set at $p<0.05$. Additionally, feedback from teachers regarding the usability and impact of the gamified reading applications will be gathered to ensure that the tools are both effective and user-friendly. This comprehensive approach will guide necessary adjustments and enhancements to both the training program and the application usage, ensuring that the gamified applications are thoroughly tested and that teachers are well-prepared to support the reading development of students with ASD.

By following the ADDIE model, we ensure a comprehensive and systematic approach to improving teachers' knowledge and skills in using gamification as a learning medium for reading instruction for students with ASD.

RESULTS AND DISCUSSION

Results

The training session was successfully conducted on July 17th, 2024, at SLB Autis Lab UM. It was attended by total 15 teachers. The effectiveness of the training program was evaluated through pre-tests and post-tests, and a questionnaire was administered to assess participants' perceptions of the gamification application. The majority of the respondents were female (73.3%), while males constituted 26.7% of the participants as seen in Table 1. All participants held a bachelor's degree as their highest level of education (100%). The average length of teaching experience among the respondents was 9.4 years, with a standard deviation of 8.62 years, indicating a diverse range of teaching tenures among the participants.

Table 2 presents the paired t-test results of pre-test and post-test scores, showing a significant improvement in teachers' knowledge about gamification for students with Autism Spectrum Disorder (ASD). The results indicate a statistically significant increase in the mean

score from pre-test to post-test, with a P-value of 0.014. This suggests that the training effectively improved the teachers' knowledge of gamification in reading instruction for students with ASD.

Figure 1. App interface and the training session

Table 1. Respondent characteristics

Characteristics	N (%)	Mean±SD
Gender		
Male	4 (26.7)	
Female	11 (73.3)	
Highest level of education		
Bachelor	15 (100)	
Length of teaching (years)		9.4 ± 8.62

Table 2. Table of Paired T-Test Results

	N	Mean ± SD	P-value
Pre-Test	15	78.67±11.87	0,014*
Post-Test	15	88.00±10.14	

The feedback from 15 participants was gathered through a detailed questionnaire to evaluate the games. The questionnaire was divided into three main topics: 1) evaluation of game display, 2) evaluation of ease of use, and 3) evaluation of game function and its impact on learning.

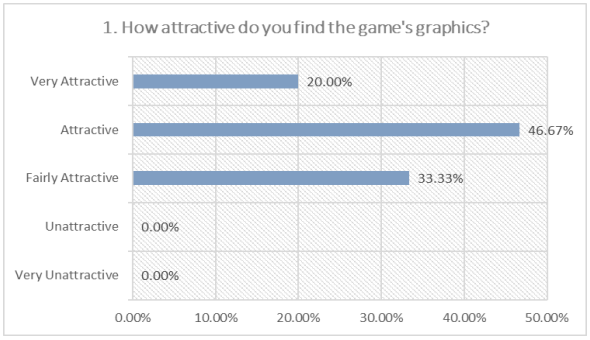

Figure 2. Evaluation of the attractiveness of game graphics

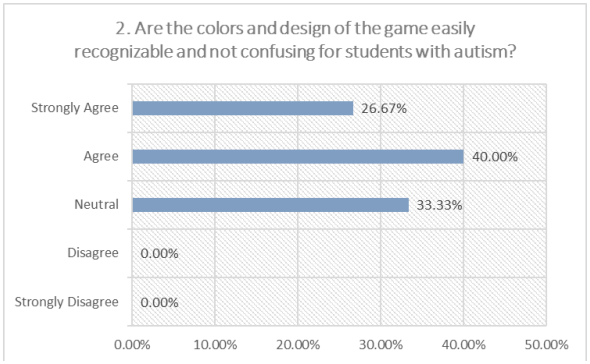

Figure 3. Evaluation of game colors and design for students with autism

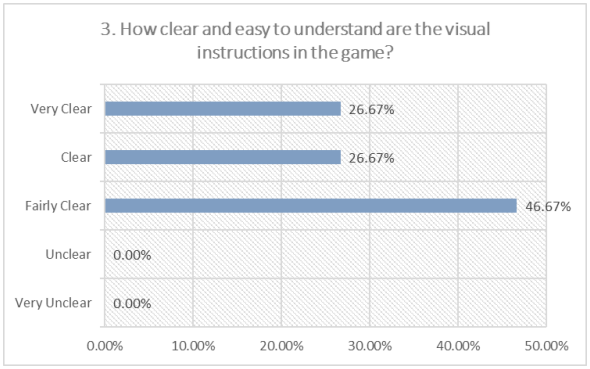

Figure 4. Evaluation understandability of visual instructions in the game

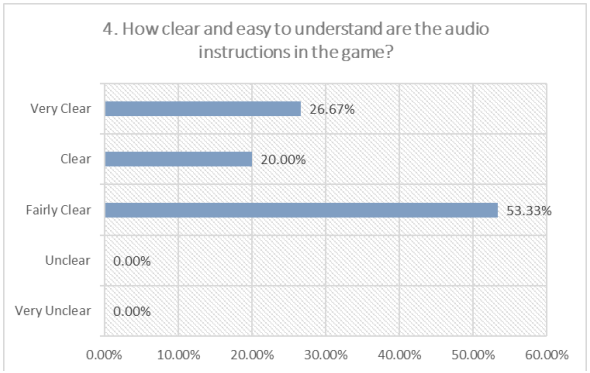

Figure 5. Evaluation understandability of audio instructions in the game

There are four question for evaluating the game display. First, the majority of participants found the

game's graphics to be appealing as seen in Figure 2, with 46.67% rating them as "Attractive" and 20% as "Very Attractive." Most participants felt the colors and design were suitable for students with autism, with 40% agreeing and 26.67% strongly agreeing as seen in Figure 3. Visual instructions were generally clear, with 53.4% rating them as "Clear" or "Very Clear" as seen in Figure 4. Audio instructions were also clear, with 46.67% rating them as "Clear" or "Very Clear" as seen in Figure 5. There are four question for evaluating the easiness of use. First, the game was easy to start, with 66.7% finding it "Easy" or "Very Easy" as seen in Figure 6.

The game was relatively easy for students to understand, with 66.6% finding it "Fairly Easy" or easier as seen in Figure 7. Most participants found the game's features to function well, with 60% agreeing or strongly agreeing as seen in Figure 8. Instructions were clear and helpful, with 66.7% agreeing or strongly agreeing as seen in Figure 8. There are four question for evaluating the game function and its impact on learning. First, the game positively influenced students' learning motivation, with 100% finding it at least "Fairly Influential" as seen in Figure 10. There was a notable increase in student participation, with 80% indicating "Often" or "Very Often" as seen in Figure 11. The game was effective in improving reading skills, with 73.34% agreeing or strongly agreeing as seen in Figure 12.

All participants found the application suitable for autistic children, with 100% indicating "Suitable" or "Very Suitable" as seen in Figure 13. Overall, the feedback indicates that the gamification application was well-received by the participants. The graphics, design, and instructions were generally found to be clear and engaging. The ease of use was highly rated, and the game was perceived to positively impact students' motivation, participation, and reading skills. The application was deemed suitable for use in educational settings for children with Autism Spectrum Disorder.

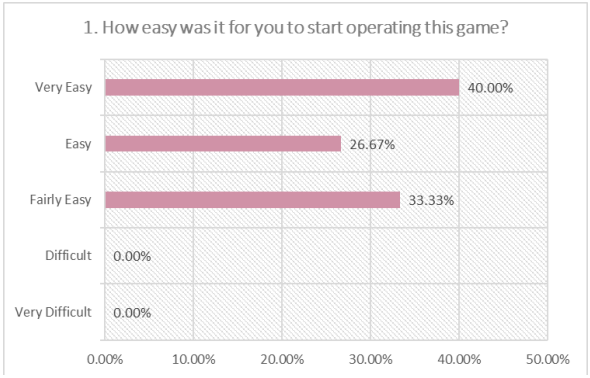

Figure 6. Ease of starting game operation

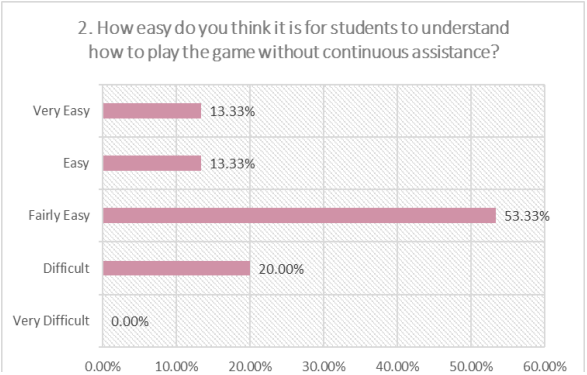

Figure 7. Perceived ease of understanding game mechanics without continuous assistance

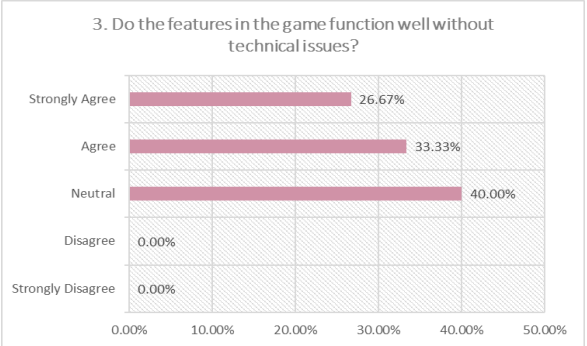

Figure 8. Functioning and technical issues

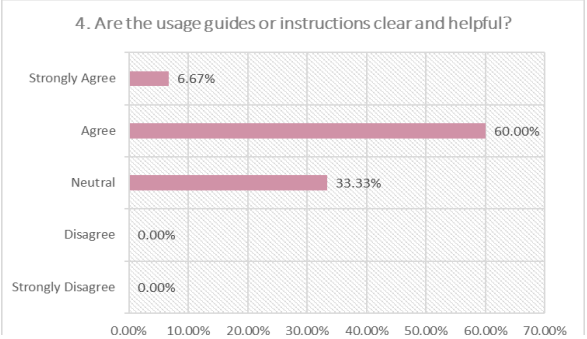

Figure 9. Clarity and helpfulness of usage guides or instructions

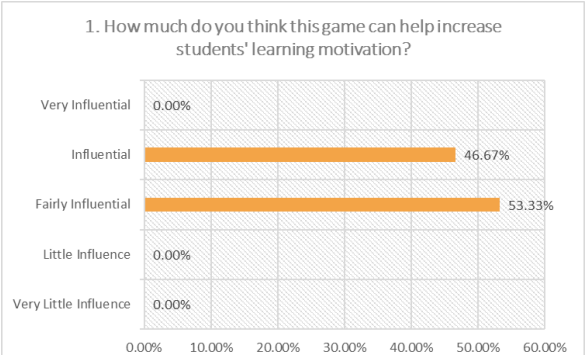

Figure 10. Perceived effectiveness of the game in enhancing students' learning motivation

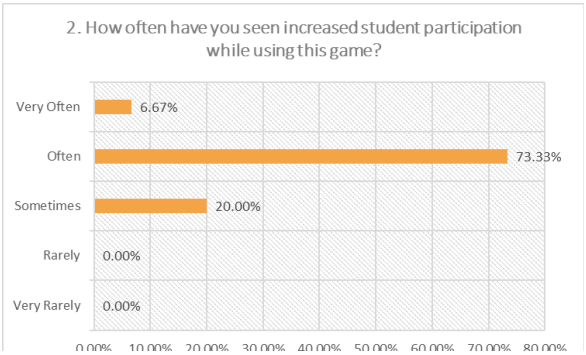

Figure 11. Frequency of observed increased student participation when using the game

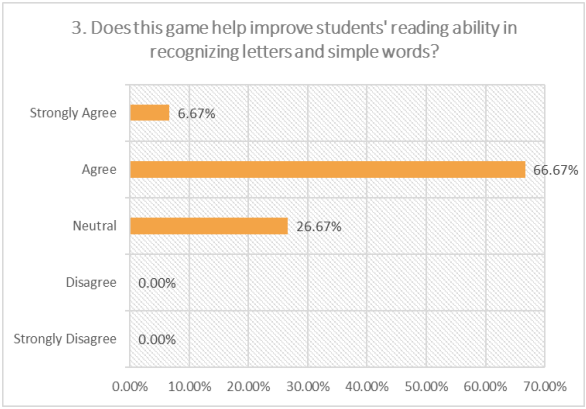

Figure 12. Impact of the game on students' reading ability

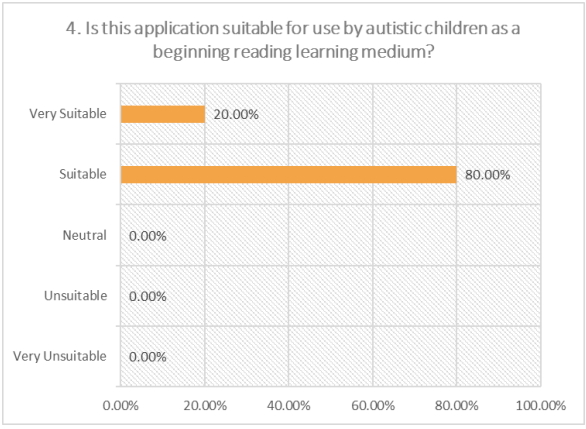

Figure 13. Suitability of the application as a beginning reading learning medium for autistic children

Discussion

Autism Spectrum Disorder (ASD) is a multifaceted neurodevelopmental condition that influences how individuals perceive and interact with others, resulting in difficulties with social interactions, communication, and behaviour (Lord, Elsabbagh, Baird, & Veenstra-Vanderweele, 2018). The disorder spans a broad spectrum of symptoms and severity levels. Students with ASD commonly encounter specific obstacles in developing reading skills (Sari, Luijk, Jansen, Prinzie, & van IJzendoorn, 2023). Many children with ASD struggle to understand both spoken and written language, which hampers their ability to grasp text (Maemonah, Hamidah, Notobroto, Sulystiono, & Widarti, 2021). Besides, maintaining focus and attention can be challenging for students with ASD, which affects their engagement with reading activities (Cook & Ogden, 2022). Difficulties in social communication may impair their capacity to interpret context, understand metaphors, and participate in discussions about reading material (Wiklund, 2016).

Gamification can significantly enhance the learning experience for students with ASD by addressing their unique challenges (Hasugian, Sidik, Winanti, & ..., 2024). Gamified applications incorporate rewards, progress tracking, and interactive elements, which can make learning more enjoyable and motivating for students. This can help sustain their interest and engagement in reading activities (Hellín et al., 2023)automated evaluation capabilities, which are crucial for giving students fast and correct feedback, are frequently lacking in currently available gamification technologies. This study proposes a novel web-based application that combines automated programming assessment features with gamification concepts; the aim is to provide students taking a programming course with an engaging learning environment. A survey conducted with 215 undergraduate students assessed how the tool affected the motivation and engagement of students. The findings show that the tool had a beneficial impact on students' willingness to participate in class, study, increase their self-confidence, engage in healthy competition with peers, and learn from their mistakes. The qualitative feedback that students offered regarding the features of the tool that they liked best is also covered in the study. This paper contributes to the field of programming education by presenting a detailed gamified tool, incorporating automated evaluation and gamification in a web-based platform (Sari, Luijk, Jansen, Prinzie, & van IJzendoorn, 2023). Gamification provides instant feedback and rewards, which can boost students' confidence and reinforce positive (Smiderle, Rigo, Marques, Peçanha de Miranda Coelho, & Jaques, 2020). Reading games can enhance phonemic awareness, vocabulary, comprehension, and fluency. The interactive nature of gamified reading applications can cater to the sensory preferences of students with ASD, making learning more enjoyable and less stressful (Ramos Aguiar et al., 2023). By providing immediate feedback and positive reinforcement, gamified applications can help students build confidence and a sense of achievement, which is crucial for sustained engagement and progress in reading (Smiderle et al., 2020).

Personalized learning is a key advantage of gamification. Gamified applications can be designed to adapt to the individual learning pace and style of each student. Adaptive learning technologies can provide

customized content and challenges based on the student's progress and performance (Hassan, Habiba, Majeed, & Shoaib, 2021). This personalization can be particularly beneficial for students with ASD, who may have varying strengths and areas for improvement. By tailoring the learning experience to meet each student's needs, gamification can help ensure that all students have the opportunity to succeed (Honorato et al., 2024).

Gamification can also promote collaboration and peer learning. Multiplayer games and team-based challenges can encourage students to work together, share knowledge, and develop social skills. For students with ASD, collaborative gaming environments can provide opportunities to practice communication and teamwork in a structured and supportive setting. By fostering a sense of community and cooperation, gamification can enhance the overall learning experience for all students (Silva et al., 2023)i.e., the use of game elements in non-game contexts, is an effective tool to help children learn using educational technologies. When properly utilized together with pedagogical approaches that foster stu-dents' interactions with learning materials, gamification has consistently been shown to increase students' participation, motivation, engagement, and learning gains. Nevertheless, when we consider children with autism, there is little evidence about the benefits of gamification for learning. In addition, to develop gamified educational technologies for this public, it is necessary to know a method of psychology, and few practitioners in this area have this knowledge. A collaborative design in which the collaborators come from different knowledge backgrounds, known as co-design, may deal with this issue. We conducted a single-subject design experiment to assess the effect of a gamified co-design. In this co-design, one practitioner in game design and two psychology experts in autism elaborated a prototype of an application, and DTT (Discrete Trial Training.

The result of this research highlight the effectiveness of a gamification-based learning application in enhancing the reading skills of students with Autism Spectrum Disorder (ASD) and improving teachers' knowledge and skills in using such tools. The comprehensive training program was well-received, as evidenced by the significant improvement in teachers' knowledge and the positive feedback from participants regarding the gamification application's interface, ease of use, and educational impact. The significant increase in pre-test and post-test scores indicates that the training program effectively enhanced teachers' understanding of gamification in educational contexts for students with ASD. With a P-value of 0.014, the improvement in mean scores from 78.67±11.87 in the pre-test to 88.00±10.14 in the post-test suggests that the training provided valuable knowledge and practical skills. This aligns with previous studies that emphasize the importance of well-structured professional development programs in empowering teachers to integrate new technologies and teaching methodologies effectively (Theodorio, 2024).

The findings have several important implications for the future of educational interventions for students with ASD. First, the success of the training program highlights the need for ongoing professional development opportunities for teachers, ensuring they are equipped with the latest knowledge and skills to support their students effectively. Second, the positive reception of the gamification application suggests that similar tools can be developed and implemented in other educational contexts, potentially benefiting a broader range of students with diverse learning needs.

Future research should explore the long-term impact of gamification on reading skills and other academic outcomes for students with ASD. Additionally, studies could investigate the scalability of such interventions, examining how they can be adapted for use in different educational settings and with various age groups. By continuing to innovate and refine gamified learning tools, educators can create more inclusive and supportive environments that cater to the unique needs of all students.

CONCLUSION AND SUGGESTION

Conclusion

The implementation of a gamification-based learning application has shown promising results in improving the reading skills of students with ASD. The training program effectively increased teachers' understanding of gamification in educational contexts, as evidenced by the significant improvement in pre-test and post-test scores, with a P-value of 0.014 indicating statistical significance. Feedback from participants highlighted the application's engaging interface, ease of use, and positive impact on student motivation, participation, and reading abilities.

Suggestion

The study underscores the effectiveness of gamification as an educational strategy for students with ASD, suggesting that gamified applications can make learning more enjoyable and effective. The positive reception of the training program and the application indicates the potential for broader implementation of similar tools in various educational settings. Ongoing professional development for educators is essential to ensure they are equipped with the latest knowledge and skills to support students with ASD effectively. Future research should focus on the long-term impact of gamification on academic outcomes and explore the adaptability of such interventions across different educational environments and age

groups. By continuing to refine and expand gamified learning tools, educators can foster more inclusive and supportive learning experiences for all students.

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