How to Cite This Article: Khalid, M. U., & Manzoor, A. (2026). Impact of the Lingokids AI-Based Intervention on Classroom Engagement, Social Interaction, and School Attendance of Students with Autism Spectrum Disorder. *Journal of Social Sciences Review, 6*(1), 138-152. https://doi.org/10.62843/jssr.v6i1.677

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JOURNAL OF SOCIAL SCIENCES REVIEW (JSSR) **Volume** 6, **No.** 1 (2026) | **Pages:** 138–152 | **DOI:** 10.62843/jssr.v6i1.677

Impact of the Lingokids AI-Based Intervention on Classroom Engagement, Social Interaction, and School Attendance of Students with Autism Spectrum Disorder

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Abstract: *The article analyzed the effect of the Lingokids AI-based intervention on social interaction, classroom engagement, and attendance of a student with Autism Spectrum Disorder (ASD). A multiple-baseline across-behaviors single-subject experimental design (SSED) was used. One student with ASD was selected using a purposive sampling method. The assessment was done using the Structured Observation-based Rating Scale of School Participation in the baseline, intervention, and maintenance. Data analysis was done using visual analysis and Tau-U effect size. Findings showed definite improvements across all areas. The levels of classroom engagement were raised at the baseline (12) and maintained at the maximum level (4). Social interaction increased to the higher levels (3.3-4) as compared to the baseline (1-2). There was an immediate improvement in attendance and punctuality between 1 and 4. The analysis of effect size showed that baseline to intervention effects were very large (Tau-U = 0.95-1.00, p <.001) and moderate maintenance effects. The single-subject design restricts generalization. It needs more studies with more extensive samples and a longer period. The results indicate the use of AI-based applications to improve the engagement and participation of students with ASD in classrooms. The research gives empirical data about the success of Lingokids in enhancing various areas of school involvement in a natural classroom setting.*

Keywords: Autism Spectrum Disorder, Social Interaction, Classroom Engagement, School Attendance, Punctuality, AI-Based Learning, Lingokids, Inclusive Education, Single-Subject Design

Introduction

Autism Spectrum Disorder (ASD) is a condition that is marked by consistent impairments in social interactions, limited behaviors, and impairments in adaptive functioning, which greatly influence how students interact in school. Among these difficulties, a lack of social interaction, poor classroom involvement, and irregular school attendance are especially significant as they have a direct impact on academic gain and the results of inclusion.

The conventional teaching methods are usually not suitable to accommodate the various and individualistic learning requirements of students with ASD. Artificial Intelligence (AI)-based educational interventions have become a promising tool to deliver adaptive, personalized, and engaging learning experiences in the past couple of years. These technologies leverage the use of interactive content, real-time feedback, and data-driven customization to facilitate the process of developing skills within a structured and motivational setting.

Lingokids is one of such interventions, an artificial intelligence-based educational application that develops language, social, and cognitive skills, based on the principle of gamified learning. Its interactive options, such as guided activities, visual support, and reinforcement mechanisms, are consistent with evidence-based practices that are typically applied in interventions with ASD, such as structured teaching and positive reinforcements. Through the provision of individualized learning pathways, Lingokids can enhance not only the behavior of academic behavior, but also school participation in general.

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Although the use of AI-based tools has been increasingly popular, there is still a dearth of empirical research investigating their effectiveness in addressing critical areas of behavior, especially in the context of social interaction, classroom interaction, and school attendance, in inclusive and real classroom settings. This gap needs to be addressed to know the practical effectiveness of such interventions and their purpose in helping students with ASD.

Thus, the research study examines the Lingokids AI-based intervention effects on social interaction, classroom engagement, and school attendance of students with ASD. Through these interconnected areas, the study will help to add to the growing literature in the area of technology-enhanced interventions and offer evidence to educators and practitioners who want to understand effective interventions to enhance school engagement in students with ASD.

Literature Review

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that is marked by the inability to engage in social communication, inappropriate behaviors, and the inability to perform adaptive functioning, that have a profound impact on the involvement of students in school. These issues can be reflected in the form of the lack of peer interaction, lack of classroom engagement, and inconsistent school attendance, which eventually affect the inclusion outcomes of education (American Psychiatric Association, 2013; Li et al., 2024).

Social Interaction and Classroom Engagement in ASD

ASD is characterized by a deficit in social interaction, such as impairment of reciprocal communication, joint attention, and perception of social cues. Such challenges restrict the students from being able to participate in collaborative learning and to build any quality peer relationship (Bellini et al., 2007; Rao et al., 2008). Social skills interventions, including structured and peer-mediated interventions, have been shown to have moderate effectiveness in social responsiveness and interaction (Reichow et al., 2012).

The classroom engagement, which includes behavioral, emotional, and cognitive engagement, is also very important in academic success. The presence of sensory sensitivities and poor processing of instructional cues often leads to a decreased attention span, shorter task persistence, and less active engagement of the students with ASD (Keen et al., 2016). It has been shown that the structured, predictable, and visually supported learning environment can be very beneficial in terms of engagement and decreasing off-task behaviors (Wong et al., 2015).

AI-Based Interventions in ASD Education

The development of Artificial Intelligence (AI) has presented new strategies to assist students with ASD with the help of personalized and adaptive learning environments. AI-assisted interventions are based on machine learning, natural language processing, and interactive interfaces to adapt instruction based on the unique learner profiles (Kotsi et al., 2025; Holmes et al., 2019).

There is empirical evidence that tools that can be enhanced with AI can considerably enhance the outcome of social communication and engagement. As an example, AI-assisted systems such as social robots or intelligent tutoring systems have been found to improve eye contact, emotional recognition, and conversational skills in students with ASD (Scassellati et al., 2012; Pensis et al., 2016). Kotsi et al. (2025) have conducted a systematic review and found that AI interventions are effective at enhancing social interaction and engagement because they are structured, predictable, and motivating, which is consistent with the learning preferences of people with ASD.

Besides, AI technologies have real-time feedback and adaptive content essential to maintain attention and encourage active engagement. Such characteristics help to enhance the behavioral engagement and decrease the disruptive behavior in classroom environments (Holmes et al., 2019; Li et al., 2024).

School Attendance and Participation

Attendance in school is a critical measure of inclusion and overall participation of the students. Anxiety, social difficulties, and inability to engage are some of the barriers that students with ASD face, resulting in absenteeism and low participation (Munkhaugen et al., 2017). Studies indicate that there is a close correlation between engagement and attendance; as a result, students who are deeply engaged in the learning process tend to attend school regularly (Kearney, 2016).

Though there is little direct evidence that AI interventions make a positive difference in attendance, there is evidence that higher levels of engagement and positive learning experiences, which are provided by technology-based interventions, lead to feelings of motivation and desire to attend school (Lan et al., 2025). In this way, enhancing social interaction and engagement could indirectly lead to improved attendance.

Empirical Studies on App-Based and AI-Powered Interventions

Empirical studies have been a growing focus on determining the effectiveness of app-based and AI-based interventions in enhancing engagement outcomes in students with Autism Spectrum Disorder (ASD). Interventions based on technology, especially those via tablets and mobile apps, have had moderate to high impacts on communication, social interaction, and academic engagement (Grynszpan et al., 2014; Odom et al., 2015).

Video modeling, structured sequencing of instructions and guided tasks, which are incorporated into interactive applications, have been shown to improve expressive communication and receptive language, which enhances academic engagement. To a significant extent, these results can be explained by the main characteristics of the form of immediate feedback and interactive content, which support attention and encourage the continuation of the task (Fletcher-Watson et al., 2016; Wong et al., 2015). Previous studies (Luqman et al., 2025; Khalid, M. U., Fazil, H., & Qureshi, M. S., 2023; Parveen, Z., Rashid, A., & Khalid, M. U. ,2023) demonstrate the effectiveness of video modeling and simulation-based interventions in improving social and behavioral outcomes in children with ASD. However, there is limited research on AI-powered interactive platforms such as Lingokids, particularly in relation to classroom social interaction and school attendance.

In addition to mobile applications, AI-improved interventions such as social robots and adaptive learning systems have shown potential outcomes in enhancing engagement and decreasing maladaptive behaviors. Empirical research indicates the enhancement of joint attention, social responsiveness, and sustained engagement using AI-based systems with predictable and personalized interactions (Scassellati et al., 2012; Pennisi et al., 2016). These features correspond to the learning styles of people with ASD and help to achieve better behavioral results.

Longitudinal and experimental data also indicate that the protracted use of technology-based interventions correlates with a greater degree of on-task behavior, decreased disruptive behavior, and better developmental outcomes (Odom et al., 2015). These results demonstrate the possibility of meaningful and long-term involvement in learning activities with the help of immersive and adaptive digital environments.

Evidence on Lingokids and AI-Based Applications

Lingokids is an educational app based on AI that combines gamification, adaptive learning, and interactive learning to increase student engagement. These characteristics align with proven evidence-based methods to treat ASD, such as reinforcement, structured instructions, and visual aids (Wong et al., 2015).

New empirical data points to the fact that these applications are able to have a positive impact on engagement-related outcomes. According to Khalid and Manzoor (2026), the implementation of the Lingokids intervention with the single-subject experimental design led to the improvement of behavioral and academic engagement. The results highlight the importance of interactive and adaptive components in fostering active engagement and maintenance of attention.

Beyond that, larger studies on AI-based educational technologies show that they can lead to better attention, engagement, and learning outcomes among students with ASD, mostly because of the customization of the learning process and the ability to provide feedback in real-time (Kotsi et al., 2025; Lan et al., 2025).

But there is little empirical evidence in connection with Lingokids in particular, and most of it has been obtained in small-scale studies or studies of one subject. This, therefore, means that more studies with rigorous experimental designs and increased samples are needed to determine the generalizability and long term outcomes of such applications in different educational settings.

Research Gap

Although the evidence of AI-based interventions is growing, there are still a number of gaps. To start with, the majority of investigations are based on single outcomes (including social skills or engagement), and there is a lack of analysis of several domains at once. Second, the empirical evidence of the effect of AI interventions on school attendance is limited. Third, there is a paucity of research on particular applications like Lingokids in both structured experimental and reality classroom settings.

Thus, this research paper fills these gaps by exploring the overall effects of the Lingokids AI-based intervention on social interaction, classroom engagement, and school attendance of students with ASD.

Research Questions

1. What is the impact of the Lingokids AI-based intervention on the social interaction of students with Autism Spectrum Disorder (ASD)?
2. How does the Lingokids AI-based intervention affect classroom engagement among students with ASD?
3. What is the effect of the Lingokids AI-based intervention on school attendance of students with ASD?
4. To what extent does the Lingokids intervention influence overall school participation across social interaction, classroom engagement, and attendance?

Significance of the Study

The research will add to the emerging body of literature on AI-based education by offering empirical data regarding the efficacy of AI-based applications to enhance important school participation measures among students with ASD. It builds on the previous studies by investigating several interconnected areas such as social interaction, classroom engagement, and attendance, all in a systematic experimental study. The results will be beneficial to teachers and practitioners in choosing and using the effective technology-based interventions that can help to increase student engagement and inclusion in classrooms. Moreover, the research provides valuable suggestions towards the implementation of AI tools in special and inclusive education, especially in resource-scarce settings. Research-wise, the study fills a very important gap by analyzing the effectiveness of a particular AI implementation (Lingokids) through a systematic approach, which can help to fill the evidence-based practice and further massive-scale studies.

Operational Definitions of Variables

Lingokids AI-Based Intervention: An educational intervention (Lingokids), based on gamified, interactive, and adaptive learning activities through digital devices, was applied with the help of a planned schedule to assist students with ASD with the development of their skills.

Social Interaction: The observable behaviors that indicate the capability of a student to interact with peers and teachers include the initiation of communication, the reaction to social stimuli, the maintenance of eye contact, and mutual interaction during classroom tasks.

Classroom Engagement: Active engagement of a student in learning activities, which can be assessed in terms of behavioral (on-task behavior, participation), emotional (interest, motivation), and cognitive (attention, persistence) outcomes in the course of instructional activities.

School Attendance: The number of times and the regularity with which a student attends school, as indicated by the attendance that is recorded during the intervention period.

Methodology

Research Design

A Single-Subject Experimental Design (SSED) with a multiple-baseline across behaviors design was used in this study to test the efficacy of the Lingokids AI-based intervention in helping students with Autism Spectrum Disorder (ASD) to interact socially, engage in the classroom, and attend school. The use of SSED in special education is extremely popular because of its sensitivity to individual differences and the capacity to formulate functional relationships between the interventions and behavioral results (Horner et al., 2005; Kratochwill et al., 2013).

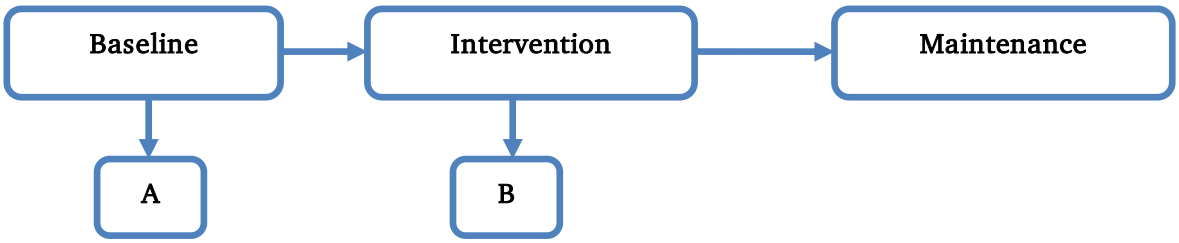
The staggered introduction of the intervention across target behaviors by the multiple-baseline design facilitated the inference of causality and reduced threats to internal validity like maturation and external effects. The intervention was credited with causing changes in behavior by showing that only after the introduction of Lingokids, changes were made in the different time points of each behavior.

The research was conducted in an AB design with a maintenance phase comprising of:

- Baseline (A): Control (No intervention)
- intervention (B): Organized use of Lingokids activities.
- Maintenance: Evaluation of long-term consequences of intervention.

Figure

Structure of the AB Single-Subject Experimental Design with Maintenance Phase



Source: (Morgan & Morgan, 2001; Kazdin, 2011)

Participants and Setting

The subject was a student with ASD diagnosed with the condition according to school records and by a psychiatrist based on DSM-5 criteria (American Psychiatric Association, 2013). The participant had been enrolled in a special education classroom and had had a long-term problem with engagement before the intervention.

During this study, the natural classroom was used as an ecological environment to guarantee ecological validity. Data were gathered in case of regular classroom interactions in order to capture natural engagement patterns.

Participant Profile

Table 1

Participant Profile

Participant	Age	Section	Gender	CARS Score	ASD Severity	Strengths	Challenges
Student 1	9	Junior	Male	32.0	Mild ASD	Visual learning, receptive language	Limited expressive communication, inconsistent behavioral engagement, and minimal group participation

Intervention Plan

Table 2

Intervention Plan

Indicators	Day 1–7	Day 8–13	Day 14–19	Day 20–25	Day 26–31	Day 32–38
Classroom Engagement	Baseline	Baseline	Intervention	Intervention	Intervention	Maintenance
Social Interaction	Baseline	Baseline	Baseline	Baseline	Intervention	Maintenance
Attendance & Punctuality	Recorded Daily	Recorded Daily	Recorded Daily	Recorded Daily	Recorded Daily	Recorded Daily

The multiple-baseline intervention plan is displayed in Table 2 above for target behaviors. The introduction of classroom engagement was at the intervention stage (Day 14-19) and social interaction was introduced later (Day 26-31) as is typical of a staggered implementation in a multiple-baseline across behaviors design. There was a maintenance stage (Day 32-38) to evaluate the longevity of intervention impacts. To track consistent school attendance and ensure that the school remains in the entire study, attendance and punctuality were measured daily in all phases (baseline, intervention, and maintenance) to ensure that there is consistent tracking throughout the entire duration of the study.

Task-Specific Intervention Activities

Table 3

Task-Specific Intervention Activities

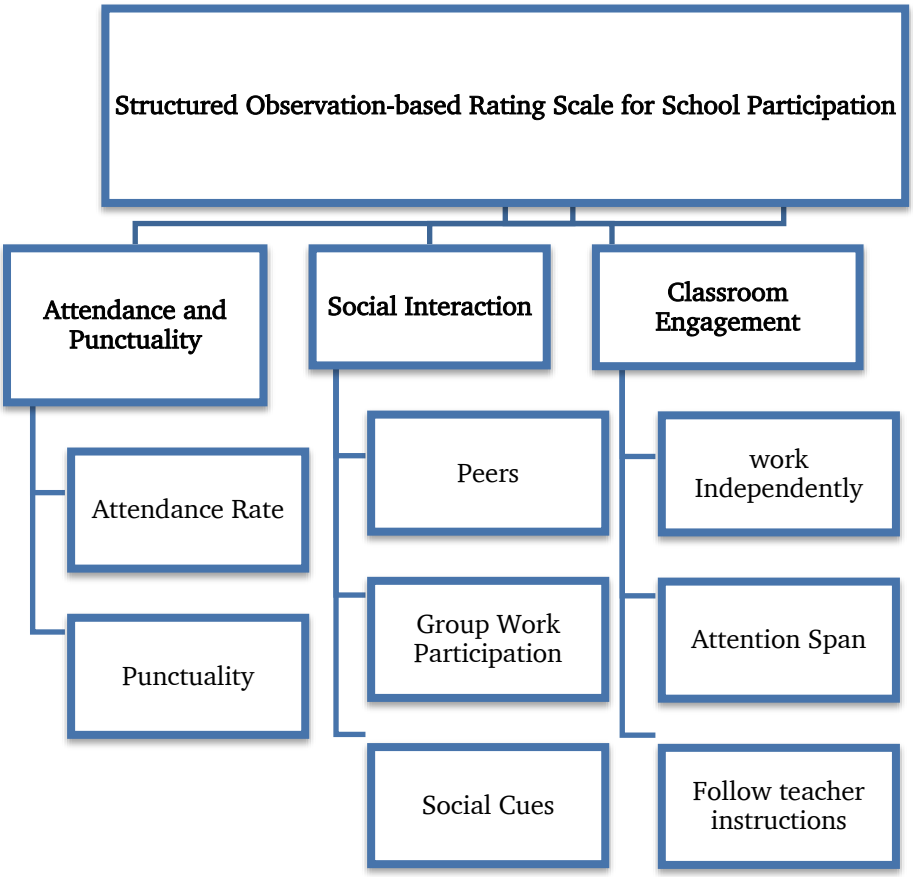
Target Behavior	Lingokids Tasks	Alignment with Tool Purpose
Classroom Engagement (CE)	Clean-Up Song	Lingokids promotes routine participation through songs
Social Interaction (SI)	Play Together	Lingokids encourages cooperative play.
Attendance & Punctuality	monitored as continuous observational variables across all sessions	

Table 3 presents the correspondence of target behaviors to Lingokids intervention activities. Structured activities (Clean-Up Song) facilitated classroom interaction and ensured regular involvement and completion of tasks. Social interaction was also provided with the help of such activities as Play Together, which was aimed at promoting cooperative behavior and peer interaction. The attendance and punctuality were not associated with a particular task in the application; they were observed as observational variables in all sessions, to constantly observe the regularity and timeliness of school attendance of the students.

Structured Observation-based Rating Scale for School Participation Framework

Figure 2

Structured Observation-based Rating Scale for School Participation Framework



Adapted from *Handbook of Research on Student Engagement (Reschly & Christenson, 2022); Participation, Both a Means and an End: A Conceptual Analysis of Processes and Outcomes in Childhood Disability (Imms et al., 2017); International classification of functioning, disability, and health: Children & youth version: ICF-CY World Health Organization*. (2007); *Perceived usefulness, perceived ease of use, and user acceptance of information technology (Davis, F. D. ,1989);User acceptance of information technology (Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. ,2003) and The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior (Deci, E. L., & Ryan, R. M., 2000)*.

The structure of the Structured Observation-based Rating Scale of School Participation presented in the figure was used to measure the key areas, such as classroom engagement, social interaction, and attendance and punctuality. The scale has been systematically used throughout the study to ensure that variation in the behavior and participation of students in each session is captured. The framework allowed the measurement of observable indicators in a consistent manner, which contributed to the combination of visual analysis and quantitative measures of reliability in the framework of the single-subject experimental design.

Validity and Reliability

The expert review was used to determine the content validity as a panel of five experts (including a psychologist, special education teacher, ASD researchers, and an AI expert) reviewed the content. They were revised to be clearer, more relevant, and construct-aligned. Confirmatory Factor Analysis (CFA) was used to establish construct validity, which showed a good model fit (CFI = .996; TLI = .994; RMSEA = .022). Factor loadings were all high which validated the measurement model.

Internal consistency reliability

Table 4

Internal Consistency Reliability (Cronbach's alpha)

Construct	Alpha	Interpretation
Classroom Engagement	0.950	Excellent
Social Interaction	0.881	Good
Attendance & Punctuality	0.896	Excellent

Data Collection Procedures

Structured observations were used to collect data for each session. Behavioral indicators were measured at all stages:

- Baseline
- Intervention
- Maintenance

Attendance and punctuality were monitored and recorded continuously throughout the intervention period, including the baseline, intervention, and maintenance phases, to provide a comprehensive measure of school participation that is not influenced by the effects of the intervention on a specific phase.

Fidelity of Implementation

The NIH Behavior Change Consortium framework helped to guarantee treatment fidelity (Bellg et al., 2004; Borrelli, 2011), including:

- Study design
- Provider training
- Treatment delivery
- Participant receipt
- Enactment

The fidelity was evaluated using a session checklist filled in by the teacher. Adherence was calculated as: (Observed components/total components) x 100 with an acceptable figure greater than 85% taken.

Inter-Rater Reliability

A trained observer coded a set of sessions independently to ensure consistency in observations. This was done by Cohen computing Kappa (κ) to identify inter-rater reliability, according to the set standards (Landis and Koch, 1977). In which two psychologists rate the whole intervention process

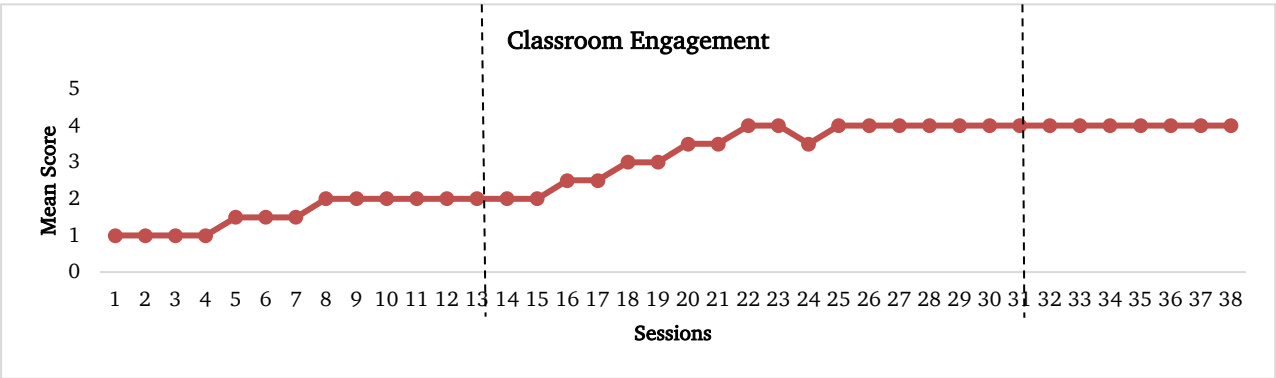
Data Analysis

The following are the graphical representations and effect sizes of the intervention:

Classroom Engagement

Figure 3

Graphical Representation of Classroom Engagement



The scores of classroom engagement in baseline (Sessions 1-13) were between 1 and 2, indicating low to moderate engagement with a little variation. After the intervention was introduced, at Session 14, the scores were 2 (Sessions 14-15), which slowly rose to 2.5 (Sessions 18-19), 3 (Sessions 20-21), and 4 (Sessions 22-23). There was a slight variation at Session 24 (3.5), but scores went back to 4 and remained there (Sessions 25-31). In the follow-up (Sessions 32-38), the engagement was at a constant 4. There was a slight overlap between the values of baseline and early intervention (both 2), but subsequent data were clear and continued to improve.

Table 5

Effect Sizes Classroom Engagement

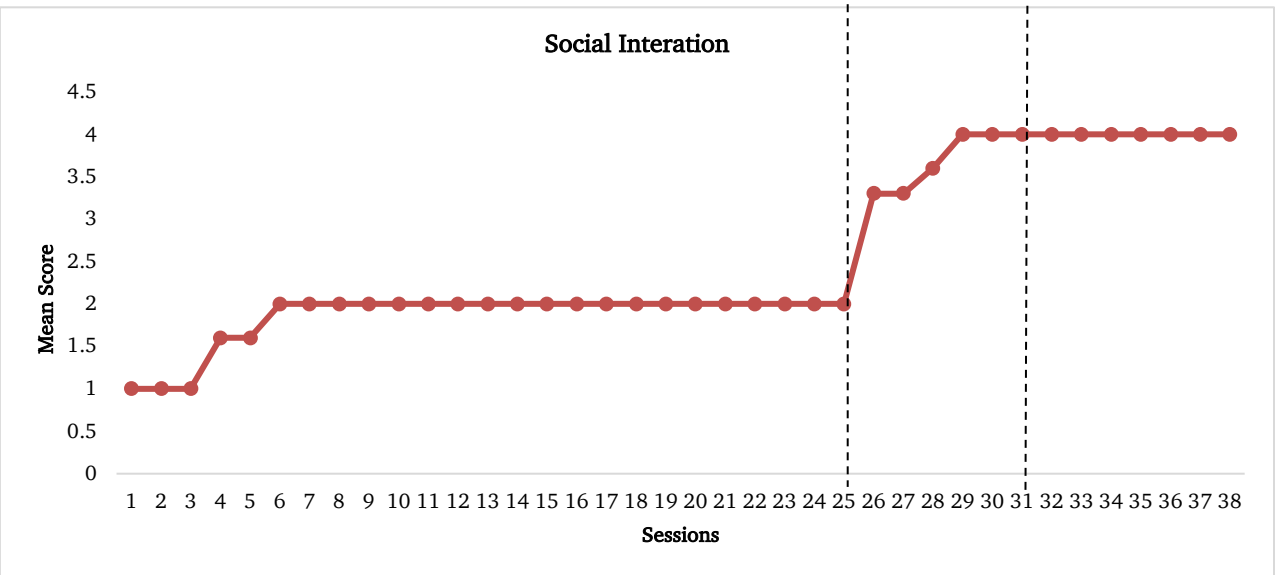
Phase Comparison	Tau-U	Z	p-Value	95% CI	Effect Size
Baseline → Intervention	0.95	4.44	< .001	[0.65, 1.00]	Very Large
Intervention → Maintenance	0.50	1.91	.057	[0.14, 0.86]	Moderate

The Tau-U analysis shows that there are high intervention effects on all the target variables. In classroom engagement, there was a very large effect between baseline and intervention phases (Tau-U = 0.95, Z = 4.44, p < .001, 95% CI [0.65, 1.00]), which showed a significant positive change after the intervention was introduced. The intervention and maintenance phase comparison had a moderate effect (Tau-U = 0.50, Z = 1.91, p =.057, 95% CI = [0.14, 0.86]), which showed that gains were partially maintained.

Social Interaction

Figure 4

Graphical Representation of Social Interaction



The baseline phase was characterized by low social interaction scores (1-2) in Sessions 1-25, which means that there was not much peer interaction and communication. As soon as the Lingokids intervention was introduced (Session 26), the scores started to improve, and the scores increased to 3.3 (Sessions 26-27), and then 3.6 (Sessions 2829), and then 4 (Sessions 29-31). In the follow-up phase (Sessions 32-38), the scores stayed at 4, which means that there was maintenance of gains. The variability was also low, and there was no overlap between baseline (maximum = 2) and intervention (minimum = 3.3), which shows a strong intervention effect.

Table 6

Effect Sizes Social Interaction

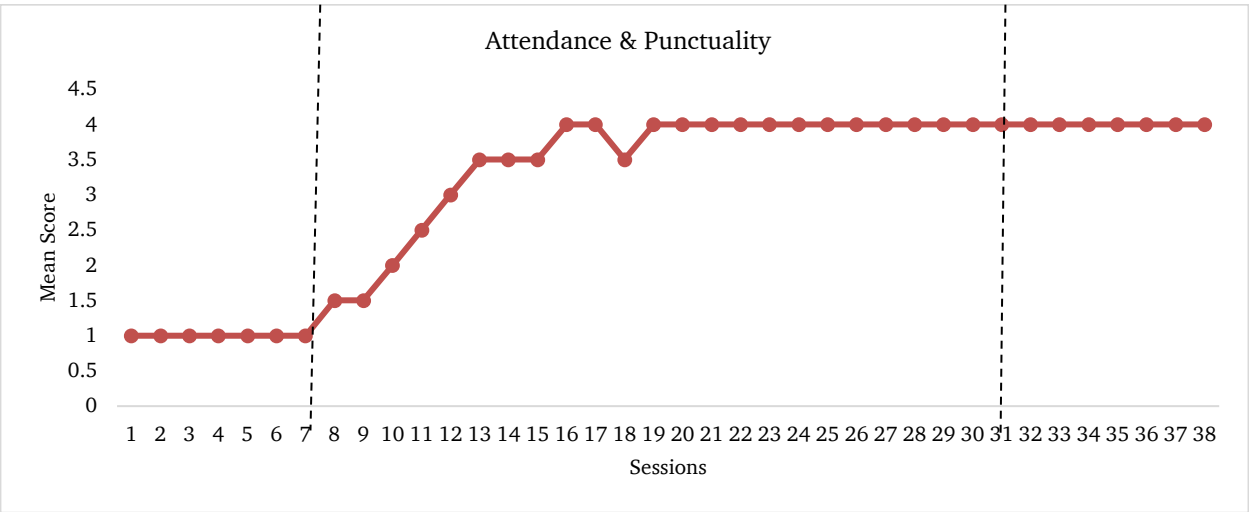
Phase Comparison	Tau-U	Z	p-Value	95% CI	Effect Size
Baseline → Intervention	1.00	3.75	< .001	[0.63, 1.00]	Very Large
Intervention → Maintenance	0.50	1.50	.13	[0.04, 0.96]	Moderate

To achieve social interaction, there was a complete intervention effect and a nearly perfect or complete effect of the intervention between the baseline and intervention (Tau-U = 1.00, Z = 3.75, p < 0.001, 95.00 CI [0.63, 1.00]), indicating an absence of overlap between the phases and a strong intervention effect. The intervention to maintenance comparison resulted in a moderate effect (Tau-U = 0.50, Z = 1.50, p =.13, 95% CI [0.04, 0.96]), indicating stabilizing improvements.

Attendance & Punctuality

Figure 4

Graphical Representation of Attendance & Punctuality



The average attendance and punctuality scores were low throughout the baseline (Sessions 1-7) and were 1 throughout the sessions. As the intervention began (Session 8), an immediate jump in scores was recorded, with scores rising to 1.5 (Sessions 8-11), 2 (Session 12), 2.5 (Session 13-15), and 3 (Session 16-17). By the sixth session, Scores reached the peak of 4 and remained within the same range with a slight variation (3.5 at the eighth session) until the last session (Session 19) when the scores reached 4 (Sessions 19-31). In the follow-up (Sessions 32-38), scores were at par at all times (4). No overlap of baseline (maximum = 1) and subsequent levels of intervention was observed, which means that the intervention has a strong and immediate effect.

Table 7

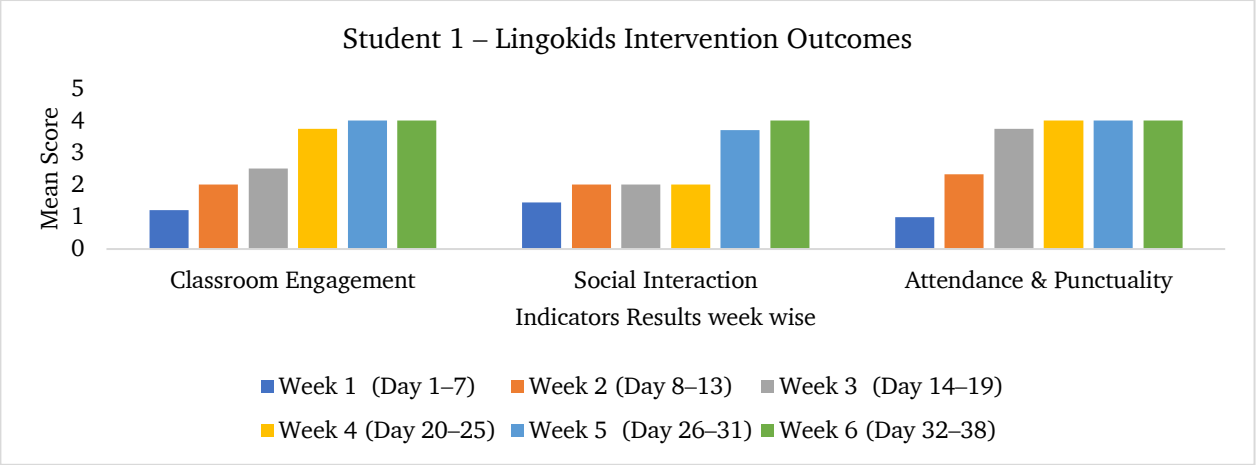
Effect sizes Attendance & Punctuality

Phase Comparison	Tau-U	Z	p-Value	95% CI	Effect Size
Baseline → Intervention	1.00	3.96	<0 .001	[0.65, 1.00]	Very Large
Intervention → Maintenance	0.38	1.48	0.13	[0.03, 0.72]	Moderate

Attendance and time were shown to have a very large effect between the baseline and intervention (Tau-U = 1.00, Z = 3.96, p <.001, 95% CI = [0.65,1.00]), meaning that the effect of the intervention was strong and immediate. The intervention-maintenance transition was moderately impacted (Tau-U = 0.38, Z = 1.48, p =.13, 95% CI [0.03, 0.72]) with gains being maintained but slightly smaller.

Figure 5

Lingokids Intervention Outcomes

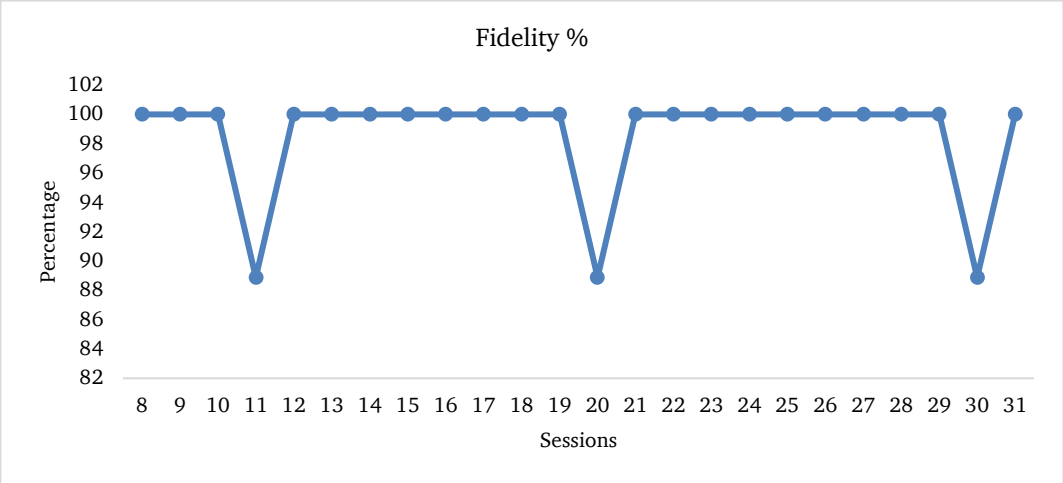


The intervention is also effective as demonstrated by weekly mean scores. Classroom engagement improved from 1.21 (Week 1) to 2 (Week 2), 2.5 (Week 3), 3.75 (Week 4), and reached the maximum level of 4 (Weeks 5 and 6). Social interaction did not change significantly in the initial weeks (1.45 in Week 1; 2 in Weeks 2-4) and then a significant rise to 3.7 (Week 5) and 4 (Week 6). The greatest improvement was noticed in attendance and punctuality, which started at 1 (Week 1) and moved to 2.33 (Week 2), 3.75 (Week 3), and went up to 4 by Week 4 and continued to Week 5 and Week 6. The values reflect the progressive, sustained, and consistent improvements in all areas after the Lingokids intervention.

Student 1: Treatment Fidelity

Figure 6

Treatment Fidelity



Fidelity to treatment of the Lingokids intervention was high throughout Sessions 8 to 31, which means that there was a high compliance with the schedule. The fidelity scores were 100 percent (9/9 components) in most of the sessions, and only three sessions had slightly lower fidelity of 88.88 percent (8/9 components) (Sessions 11, 20, and 30). These minor deviations were due to a shortened warm-up, delayed login, and partial prompting, respectively. Even though there were these differences, all the sessions had a predetermined fidelity level of 85 and above, and this confirmed that the intervention was conducted with the highest degree of consistency. The results, in general, indicate that the reported results could be explained by the fact that the intervention has been delivered in a reliable manner, with a limited number of procedural errors in the sessions.

Inter Rater Reliability

Table 8

Classroom Engagement (IRR)

Classroom Engagement	k	SE	Z	p	95% CI		%Agreement
					Lower	Upper	
Measure of Agreement Kappa	.713	.119	4.402	.000	0.47	0.94	86.84

The inter-rater reliability test showed a high agreement among observers on all the variables measured. For classroom engagement, Cohen's Kappa indicated substantial agreement ($\kappa = 0.713$, SE = 0.119, Z = 4.402, $p < .001$, 95% CI [0.47, 0.94]), with a percentage agreement of 86.84%.

Table 9

Social Interaction (IRR)

Social Interaction	k	SE	Z	p	95% CI		%Agreement
					Lower	Upper	
Measure of Agreement Kappa	.841	.088	5.193	.000	0.66	1.00	92.10

The inter-rater reliability was nearly perfect in terms of social interaction, with Kappa = 0.841 (SE = 0.088, Z = 5.193, $p < .001$, 95% CI [0.66, 1.00]) and percentage agreement = 92.10, which shows high agreement among observers on all the variables measured.

Table 10

Attendance and Punctuality (IRR)

Attendance & Punctuality	k	SE	Z	p	95% CI		%Agreement
					Lower	Upper	
Measure of Agreement Kappa	.821	.099	5.072	.000	0.62	1.00	92.10

Attendance and Punctuality showed almost perfect agreement ($\kappa = 0.821$, SE = 0.099, Z = 5.072, $p < .001$, 95% CI [0.62, 1.00]) with 92.10% agreement, confirming reliable measurement across observers.

Discussion

This research was a multiple-baseline study of the effect of the Lingokids AI-based intervention on social interaction, classroom engagement, and attendance. The results indicate the presence of a well-understood functional dependence between the intervention and the improvements in all domains, with enormous effect sizes, with little overlap, and maintained patterns.

The classroom engagement increased gradually in response to baseline (1-2) to sustained maximum (4) with a very large effect (Tau-U = 0.95, $p < .001$) and moderate long-term maintenance (Tau-U = 0.50). The sluggish yet consistent progress indicates that participation is cumulative and is acquired with repetition. This is consistent with findings that digital environments that are structured, predictable, and feedback-driven improve sustained attention and persistence in tasks in students with ASD (Odom et al., 2015; Wong et al., 2015). The adaptive and gamified nature of Lingokids must have been continuous reinforcement as it promotes gradual changes in behavior.

Contrastingly, social interaction was rapidly and strongly improved between the baseline (1-2) and higher (3.3 4) levels, with the greatest effect (Tau-U = 1.00, $p < .001$) and moderate maintenance (Tau-U =0.50). The immediate nature of change is that interactive and visually aided activities can be directly involved in facilitating social responsiveness. This observation aligns with the previous studies that have revealed that technology-mediated interventions such as AI-based and interactive systems improve social communication

by creating structured and low-anxiety interaction contexts (Grynszpan et al., 2014; Pensis et al., 2016; Scassellati et al., 2012).

Immediate and sustained improvement was greatest in attendance and punctuality changing (stable baseline) of 1 to (maximum)4 with a very large effect (Tau-U = 1.00, $p < .001$) and moderate maintenance (Tau-U = 0.38). This implies that more active participation and positive learning experiences could be generalised to larger participation behaviours. The discovery has an extension of current literature, in which attendance is less commonly studied, but is theorized to be connected to motivation and engagement (Kearney, 2016).

One of the primary contributions of this research is that it showed cross-domain improvement, with improvement being made not only in the targeted behaviors but also in overall school participation. This assists in the idea that engagement, social interaction and attendance are correlated concepts and that enhancements in one area can translate into changes in others.

The fact that the treatment fidelity is high (>=88.88) and inter-rater reliability is high (=0.713-0.841) strengthens the fact that effects observed can be attributed to the intervention instead of the procedural inconsistencies.

Nevertheless, the results are to be approached with caution because of the single-subject design that will restrict the extrinsic validity. Also, intervention time, although adequate to show functional change is not indicative of long-term sustainability. Future studies should utilize bigger samples, experimental conditions, and longitudinal designs to validate generalizability and investigate the long-term impacts of AI-based interventions.

Conclusion

The results of this paper show that the Lingokids AI-grounded intervention led to a considerable change in social interaction, classroom engagement, and attendance of a student with ASD. Visual analyses and effect size measures showed that there were high functional relationships between the intervention and the behavioral outcomes, and the gains were maintained at the follow-up stage. The findings outline the usefulness of AI-based, interactive, and structured learning settings in promoting various areas of school engagement. In general, the research confirms that AI-based educational applications have a promising future as effective interventions in the world of special education.

Recommendations

- Lingokids and other AI-based applications should be incorporated into the classroom practice to facilitate student engagement and participation with ASD.
- Teachers are to be trained to be able to implement technology-based interventions fidelity.
- In future studies, bigger sample sizes and multiple participants should be used to enhance generalizability.
- Longitudinal research is also suggested to investigate the long-term effects of AI-based interventions.
- Included in the inclusive education strategies in schools should be the use of technology-supported interventions.

Limitations

The research has its limitations because it is a one-subject research design and thus cannot be easily generalized. The study had one participant subjected to the intervention in a single environment, and a relatively short period of time was used to implement the intervention. Also, the research was limited to certain areas of behavior, and other variables that may affect school participation were not discussed. These findings should be confirmed by further research in different groups and settings.

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