

The Impact of Otsimo Speech Therapy on the Development of Language Skills in Children with Autism Spectrum Disorder

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The current study aimed to evaluate the therapeutic efficacy of the AI-based Otsimo Speech Therapy application in developing language skills (receptive, expressive, and pragmatic) in children with autism spectrum disorder (ASD). The study was conducted in the Irbid Governorate of the Hashemite Kingdom of Jordan, utilizing a two-group (experimental and control) quasi-experimental design. The study sample consisted of 20 children (aged 4-8 years) with functional language impairment, who were selected via purposive sampling from four specialized centers based on the criteria of poor language performance and regular attendance of rehabilitative services. The Results indicated the presence of statistically significant differences favoring the experimental group in the overall language skills score and across all subdomains. Receptive skills demonstrated the largest effect size, followed by expressive and then pragmatic skills. These positive outcomes are attributed to the application's capacity to provide an intensive, personalized, and adaptive intervention that dynamically adjusts to each child's performance level and offers immediate feedback. Key recommendations include: encouraging the design and development of similar Arabic-language applications that are tailored to linguistic and cultural characteristics; incorporating training on such tools into specialist preparation programs; and conducting longitudinal studies to track the sustainability of therapeutic gains. Furthermore, the study recommends integrating these applications as supportive tools within comprehensive intervention plans, while reinforcing the role of both the family and the specialist in promoting the generalization of acquired skills to daily life.

Keywords: Autism Spectrum Disorder, Language Skills, Artificial Intelligence, Otsimo Speech Therapy App, Training Program.

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INTRODUCTION

Language challenges and communication disorders are among the most prominent developmental barriers faced by children with Autism Spectrum Disorder, constituting a fundamental obstacle to the development of communicative competence and social inclusion (Eggers et al., 2022). These challenges are particularly evident in deficits in functional language skills, which are crucial for meaningful social interaction, expressing needs, and achieving independence in daily life (Herzog et al., 2024). Approximately 30–50% of this population experiences a delay or lack of development in spoken language, which directly impacts their adaptive abilities and quality of life (Tager-Flusberg, 2020).

This language impairment is associated with deficits in a range of core linguistic skills, including vocabulary acquisition, syntactic structure, and pragmatic language use (Harris et al., 2024). Recent neurocognitive evidence indicates that these difficulties may stem from differences in auditory processing and joint attention, which impact the ability to learn and utilize social-communicative conventions (Kotler et al., 2022). Consequently, without intensive and targeted interventions to develop these skills, the communication gap between children with autism and their typically developing peers widens, increasing dependency and limiting opportunities for community participation (Tang et al., 2021).

Emerging research underscores that language challenges in children with Autism Spectrum Disorder (ASD) are multidimensional and highly variable. Beyond intrinsic difficulties in vocabulary acquisition and expanding their lexical repertoire (Goldfarb et al., 2023), these children face significant obstacles in processing grammatical structures and formulating syntactically correct and complex sentences (Sangtian et al., 2021).

Pragmatic difficulties, which involve using language in social contexts, are especially evident in this population. These include trouble interpreting non-literal language, such as changes in tone or ironic remarks, as well as challenges with using language socially, for example, starting or keeping a conversation going (O'Reilly et al., 2022). In addition, affected individuals often struggle with understanding multi-step instructions and with clearly expressing their emotions and internal needs (Lum et al., 2021).

Recent meta-analyses confirm that language development disorders remain highly prevalent in this group, which further widens the gap between their communication skills and the demands of their environment (Andrzejewski et al., 2023). These receptive and expressive language difficulties severely limit social interaction abilities, making it hard for children to take part in dialogues, build friendships, or join group

activities. As a result, they frequently experience social isolation and miss out on learning opportunities that arise from social engagement (Mundy, 2021). These challenges underscore how complex language is, requiring the smooth integration of auditory processing, higher-order cognitive functions (e.g., working memory and attention), executive skills, and social competence. Given this complexity, the lack of intensive, individualized intervention approaches ones that take into account the wide variation in language abilities and processing capacities across the spectrum only worsens these difficulties (Harmon et al., 2022).

Contemporary studies confirm that the communicative performance gap in children with ASD is not marginal, but substantial and persistent across developmental stages, negatively impacting the achievement of long-term functional outcomes (Grzadzinski et al., 2023). In response to these challenges, research highlights the limited efficacy of traditional, rigid instructional approaches, which often rely on linear content delivery and mechanical repetition. Such methodologies are misaligned with the neurodivergent profiles and heterogeneous learning needs within the autism spectrum, creating a disconnect between standardized interventions and the highly individualized profile of each child (Fleury et al., 2021). This misalignment leads to missed critical educational opportunities during sensitive periods of language development. Consequently, contemporary research and clinical practice increasingly advocate for data-driven, dynamically adaptive intervention models. These approaches are designed to create personalized learning pathways that respond to individual strengths and weaknesses, systematically targeting the reduction of the communication gap (Harmon et al., 2022).

Artificial intelligence (AI)-enhanced educational applications are emerging as promising innovative solutions for addressing the individualized learning challenges faced by children with Autism Spectrum Disorder (ASD). These tools facilitate the delivery of dynamic content that automatically adapts to each child's learning style, current skill level, and unique pace of progress (An et al., 2021). Their effectiveness is contingent upon the capacity to process user performance data in real time, thereby enabling the adjustment of task difficulty, the provision of customized scaffolding, and the strategic targeting of skills most in need of development (Goldfarb et al., 2023). Meta-analytic evidence indicates that such personalized, adaptive approaches are associated with statistically significant improvements in learning outcomes, increased engagement duration, and enhanced self-motivation when compared to standardized, traditional methods (Kotler et al., 2022).

The Otsimo Speech Therapy application exemplifies this advanced technological approach by integrating principles of Applied Behavior Analysis (ABA) with adaptive machine learning techniques. Its interactive activities are designed to systematically develop core linguistic components, including semantic vocabulary acquisition, articulation

accuracy, and syntactic understanding (Jackson et al., 2024). A key strength of the application lies in its algorithmic capacity to analyze user responses in real time, enabling programmed, immediate feedback and the automatic adjustment of task difficulty to match the child's individual progress. This dynamic adaptation not only ensures intensive practice but also sustains engagement and reduces frustration, thereby serving as a powerful tool within focused language intervention frameworks (Herzog et al., 2024).

Advanced digital therapeutic applications, such as Otsimo Speech Therapy, are grounded in an integrated theoretical and applied framework that merges insights from neurolinguistics with principles of Applied Behavior Analysis (ABA) within digital environments. These platforms operationalize schedules of immediate and variable reinforcement by delivering programmed visual and auditory stimuli following correct responses, thereby strengthening the association between behavior and its consequences (Mundy, 2021). Going beyond traditional models, such applications employ machine learning algorithms that not only administer reinforcement but also analyze response patterns to anticipate potential points of difficulty. This allows for proactive adjustments to the intervention pathway, achieving intelligent and individualized adaptation to each child's unique learning trajectory (Thabtah & Peebles, 2022).

A growing body of empirical evidence, including findings from randomized controlled trials (RCTs), underscores the efficacy of AI-based digital interventions in developing language skills within this population. A longitudinal study demonstrated that intensive, structured use of an adaptive speech therapy application resulted in statistically significant improvement ($p < .01$) not only in vocabulary breadth but also in the syntactic complexity of sentences and mean length of utterance (MLU) (Lunsky et al., 2021). Results from a separate comparative study indicated that the group using an adaptive application significantly outperformed the group receiving traditional face-to-face intervention in listening comprehension and emotional expression skills, with greater retention of learned skills observed in a follow-up assessment two months later (Mundy, 2021). These outcomes are attributed to the capacity of intelligent systems to deliver intensive, one-on-one training that leverages techniques such as spaced repetition and interactive scenario simulation. This approach provides safe, repetitive practice opportunities that promote the neurocognitive consolidation of learning (Lunsky et al., 2021).

Although digital language intervention (DLI) applications hold promising potential, their effectiveness depends on how well technology is combined with evidence-based teaching practices. For optimal outcomes, interventions must be tailored to each child's developmental profile, including sensory preferences, cognitive styles, and the unique strengths and weaknesses within their language abilities (Fleury et al., 2021). To maximize their therapeutic benefit, these digital tools should be

used within a structured and supportive environment. In this context, the role of caregivers or specialists is essential—not only to encourage meaningful interaction with the application but also to help the child transfer newly acquired skills from the digital setting to everyday situations, ensuring practical use and long-term maintenance (Kerr et al., 2021).

The current study seeks to assess the therapeutic effectiveness of the Otsimo Speech Therapy application in enhancing both receptive and expressive language skills in a group of children diagnosed with Autism Spectrum Disorder (ASD). Progress will be evaluated across several language areas such as semantics, syntax, pragmatics, and phonetics using standardized assessments administered before and after the intervention. The expected outcomes aim to provide a practical, research-based framework to assist clinicians and parents in successfully incorporating assistive technology into comprehensive treatment plans. In doing so, this research intends to fill a gap in the existing literature regarding the effectiveness and implementation guidelines for such digital platforms within the Arab cultural and linguistic context.

Problem

Language and communication disorders represent one of the most intrinsic and disabling manifestations in children with autism spectrum disorder (ASD), undermining the foundational capacities necessary for reciprocal social interaction and the functional expression of needs and desires (Tager-Flusberg, 2020). Emerging systematic reviews indicate that between 30% and 50% of this population exhibit clear, measurable developmental deficits in core linguistic domains, most notably in vocabulary acquisition and breadth, syntactic complexity, and the functional use of language in real-world social contexts (Herzog et al., 2024; Thomas et al., 2024).

In parallel, a characteristic impairment in pragmatic competence is systematically observed. This manifests as difficulties in initiating and maintaining dialogues, interpreting non-verbal social cues, and understanding implicit meanings or figurative language, collectively hindering the establishment of meaningful reciprocal exchanges (O'Reilly et al., 2022; Rolland et al., 2022). The ramifications of these communicative deficits extend beyond language, directly undermining functional independence and restricting opportunities for full participation in social and educational contexts (Tang et al., 2021). This limited participation can contribute to social isolation and a diminished quality of life, with associated implications for mental well-being (Andrzejewski et al., 2023; Eggers et al., 2022).

The language difficulties observed in children with Autism Spectrum Disorder (ASD) arise from several interconnected neurocognitive factors. First, core deficits in auditory processing and joint attention impair their

ability to efficiently process linguistic input and isolate relevant phonological elements within the speech stream (Kotler et al., 2022). Children with ASD often exhibit significant weaknesses in selective auditory attention, including poor phonological discrimination and slower processing of linguistic information. These challenges compromise their capacity to parse and comprehend continuous speech in naturalistic acoustic environments. Additionally, joint attention deficits hinder their ability to coordinate focus with a social partner on language-relevant stimuli, which is a foundational mechanism for early vocabulary and grammar acquisition (Mundy, 2021).

Second, impairments in theory of mind the ability to attribute distinct beliefs, intentions, and emotions to others undermine the social-cognitive foundation necessary for using language appropriately in interactive contexts (Harris et al., 2024). This core deficit underlies significant pragmatic language difficulties, restricting the child's capacity to discern communicative intent and adapt their speech according to conversational context and the listener's perspective.

Finally, research highlights that reduced cognitive and behavioral flexibility, a central feature of ASD, significantly hinders the generalization of grammatical rules and the adaptive use of language across varying social situations, thereby constraining communicative competence (Harmon et al., 2022). This rigidity directly impedes the application of vocabulary and rules learned in one setting to novel situations, diminishing functional communicative effectiveness in daily life.

Although various instructional strategies exist to address language difficulties, contemporary critical analyses indicate that many traditional intervention models remain reliant on a standardized approach. This approach often fails to account for the inherent heterogeneity and complex neurocognitive profiles within the autism spectrum (Fleury et al., 2021). Compounding this issue is a prevalent lack of systematic training for practitioners in utilizing AI-based digital interventions, which are designed to deliver intensive and highly customizable language training (Khowaja et al., 2020; Shen et al., 2008). Researchers argue that this widening gap between rapid technological advancement and routine clinical practice hinders progress in the field of language intervention and curtails the potential for achieving optimal functional outcomes for children with ASD (Kerr et al 2021). Consequently, there is a pressing need to develop comprehensive training frameworks that integrate technological proficiency with clinical expertise, empowering professionals to deploy these intelligent tools effectively and ethically in the design of personalized, dynamic language intervention pathways (Kotler et al., 2022).

The research significance of this study lies in its aim to provide systematic empirical evidence regarding the efficacy of a promising

technological solution-the Otsimo Speech Therapy application-in addressing one of the most prominent developmental challenges in children with autism spectrum disorder, namely language difficulties. This significance will be pursued by answering the following research question: What is the impact of the application of Otsimo Speech Therapy on the development of language skills in children with autism spectrum disorder?

METHODS

The current study employed a quasi-experimental, two-group (experimental and control) design to examine the effect of the Otsimo Speech Therapy application on the development of language skills in children with Autism Spectrum Disorder (ASD). This design was selected for its suitability in investigating a potential causal relationship between the independent variable (use of the application) and the dependent variable (language skills), while allowing for partial control of extraneous variables.

The study sample comprised 20 children, divided into two groups matched on key variables including chronological age, autism severity (measured by a standardized diagnostic tool), and baseline language level. The experimental group received the targeted intervention via the application in addition to their routine therapy, while the control group received routine therapy only.

The broader study population comprised 20 children with autism spectrum disorder enrolled in special education centers, early intervention programs, and specialized care institutions within Irbid Governorate, in the Hashemite Kingdom of Jordan. All children had a formal diagnosis confirmed by standard diagnostic criteria (e.g., DSM-5, ADOS-2) or comprehensive reports from a multidisciplinary evaluation team. From this population, a purposive sample of 20 children was selected based on two primary criteria:

1. **Functional Language Impairment:** The child scores below the average range on at least two standardized language assessment scales (e.g., the Early Symbolic Communication Scale or other age-appropriate standardized language tools), as confirmed by a certified speech-language pathologist.
2. **Regular Attendance at Intervention Services:** Consistent participation in a structured educational or therapeutic program at an intervention center for a minimum period of six months prior to the study's commencement.

The sample was drawn from four specialized institutions in Irbid Governorate-the Irbid Specialized Center, Al-Amal Center for Speech and Communication Disorders, Al-Razi Center for Special Education, and Wassan Center-with attention given to achieving relative balance in

geographical distribution, age range (4–8 years), and autism severity (mild to moderate).

Table 1

Distribution of the Study Sample

Sample	20 male and female students		
Experimental group	10 students (learn through the training program)		
Control Group	10 students (traditional learning)		
For a school	Number of students	Gender (M/F)	Age group (years)
Irbid Specialized Center	5	Males	8
Irbid Specialized Center	5	Females	8
Al-Razi Center for Special Education	5	Males	8
Wassan Center	5	Females	8

Tools

Otsimo Speech Therapy Application

The main intervention tool used was the Otsimo Speech Therapy application, an adaptive, AI-driven interactive learning platform specifically designed to enhance language and communication abilities in children with Autism Spectrum Disorder (ASD). The app's development is based on well-established scientific and theoretical principles from speech-language pathology, Applied Behavior Analysis (ABA), and adaptive learning technology (Jackson et al., 2024; Herzog et al., 2024).

To confirm the tool's content and construct validity, the application along with its training modules was evaluated by a panel of eight experts specializing in communication and speech disorders, speech-language therapy, Applied Behavior Analysis, and educational technology for

individuals with special needs. The expert review focused on verifying three key areas:

1. **Content and Objective Alignment** This assessed whether the targeted activities and skills such as auditory comprehension, vocabulary labeling, and syntactic structures—were developmentally and linguistically suitable for children with ASD.
2. **Technical and Pedagogical Soundness** This examined the clarity of the user interface, the engaging quality of visual and auditory reinforcers, and whether the overall design was appropriate for children who may have sensory sensitivities.
3. **Efficacy of the Adaptive Mechanism** This evaluated the algorithm's ability to dynamically adjust task difficulty and offer personalized support based on each child's individual performance data.

Therapeutic Objectives of the Application

The primary objective of the application was to measure the effect of using Otsimo Speech Therapy on the development of receptive, expressive, and pragmatic language skills in children diagnosed with autism spectrum disorder. Specifically, the application was intended to enhance receptive language skills, including comprehension of instructions, vocabulary, and basic concepts; develop expressive language skills, including vocabulary expansion, sentence formulation, and articulation clarity; and foster pragmatic language skills, such as initiating communication and engaging in simple conversational exchanges.

Training Program Structure and Specifications

The intervention was delivered via tablets equipped with 10-inch touchscreens. The training program consisted of 24 individual sessions conducted three times per week, with each session lasting 25 to 30 minutes to align with the sustained attention capacity of children in the target age range. The full implementation period spanned 8 weeks and was preceded and followed by a 2-week assessment phase for pretesting and posttesting. The intervention was designed for children 4 to 8 years of age.

Application Mechanism

The intervention followed a structured, technology-mediated process implemented through the application. This process included five core components.

1. **Adaptive Baseline Assessment:** The application began with brief diagnostic activities to evaluate each child's initial proficiency in the targeted language skills and establish a personalized baseline.
2. **Individualized Learning Trajectory:** Based on the assessment results, the AI algorithm generated a unique learning path for

each participant, determining the sequence of skill introduction and the pace of progression.

3. **Delivery of Interactive, Adaptive Content:** The core intervention presented varied activities, such as image matching, sentence completion, and auditory discrimination tasks, to teach vocabulary and language structures. Content difficulty was adjusted dynamically in real time based on the child's responses.
4. **Intelligent, Immediate Feedback:** The system provided instant positive reinforcement, such as engaging sounds and animations, for correct responses. For errors, it delivered corrective feedback, often in the form of simplified prompts or scaffolded support.
5. **Continuous Formative Evaluation and Adjustment:** The application recorded detailed performance metrics, including accuracy rates, response latency, and error patterns. These data were analyzed algorithmically to calibrate the challenge level and instructional focus of subsequent sessions.

Language and Communication Skills Scale

The study employed a purpose-built Language and Communication Skills Scale. This scale was constructed based on established theoretical frameworks and a review of prior research literature concerning the assessment and development of language and communication in children with ASD (Harris et al., 2024; O'Reilly et al., 2022; Kotler et al., 2022). Its primary objective was to measure changes in language skills-receptive, expressive, and pragmatic-resulting from the use of the Otsimo Speech Therapy application.

Establishing Instrument Validity and Reliability

Face and Content Validity

The initial version of the scale was submitted to a panel of eight experts in communication and speech disorders, applied behavior analysis, and developmental educational psychology. These experts were affiliated with Jordanian universities, diagnostic clinics, and intervention centers. Their review focused on the scale's diagnostic accuracy, developmental appropriateness, and functional and construct relevance.

This criterion addressed the clarity and precision of the procedural wording for each item in measuring its intended linguistic construct, such as comprehension of questions, object naming, and the use of language for requests.

This criterion addressed the relevance of the tasks and questions to the target age group of 4 to 8 years and their suitability for the learning profiles of children with autism spectrum disorder.

This criterion addressed the extent to which each item was directly and functionally linked to one of the three target skill domains: receptive, expressive, or pragmatic language.

Based on the panel's feedback, five items were removed and four items were revised. The expert agreement rate on the validity and appropriateness of the final scale was 94%. The revised instrument comprised 28 items distributed across the three domains: 10 items for receptive language, 10 for expressive language, and 8 for pragmatic language.

Reliability

The scale's reliability was established using two standardized methods: test-retest reliability and internal consistency.

Test-Retest Reliability

The scale was administered to a pilot sample of 12 children who were not included in the main study on two occasions separated by a 10-day interval. Analysis using Pearson's correlation coefficient yielded a stability coefficient of $r = .91$, indicating excellent temporal consistency.

Internal Consistency

Internal consistency for the main study sample ($N = 24$) was assessed using Cronbach's alpha. The analysis yielded a coefficient of $\alpha = .95$ for the total scale score, indicating excellent internal consistency and strong homogeneity among the scale items.

RESULTS

The central research question guiding this study was: What is the impact of using the Otsimo Speech Therapy application on the development of language skills in children with autism spectrum disorder?

To address this question, data were analyzed using the Mann-Whitney U test to compare the **post-intervention performance** of the experimental and control groups on the Language and Communication Skills Scale. The results of this analysis are presented in Table 2.

Table 2

Mann-Whitney U Test Results for Post-Test Differences Between the Experimental and Control Groups on the Language and Communication Skills Scale

Variable	Group	<i>n</i>	Mean Rank	Sum of Ranks	Mann-Whitney <i>U</i>	Wilcoxon <i>W</i>	<i>Z</i>	<i>p</i>
Language skills	Experimental	10	18	227	23	0.77	3	.001
	Control	10	6	0.77				
Language skills	Experimental	10	0.17	213.0	37	91.00	2	0.004
	Control	10	7	91.0				
Language skills	Experimental	10	16	196.0	0.54	108.00	18	0.029
	Control	10	8	108.0				
Overall score	Experimental	10	58	235	15	0.69	3	0
	Control	10	5	0.69				

The statistical findings presented in Table 2 demonstrate the presence of significant differences ($\alpha \leq 0.05$) between the mean performance scores of the experimental and control groups on the overall measure of language skills, as well as across all individual subdomains. This outcome indicates a meaningful positive effect of the Otsimo Speech Therapy application on the development of language abilities within the study population.

Results from the Mann-Whitney U test showed a clear advantage for the experimental group on the total score, with a mean rank of 19.58, compared to a mean rank of 5.42 for the control group ($Z = -3.65$, $*p < .001$). This finding confirms a significant beneficial impact resulting from the technology-based intervention.

The differential impact of the application across linguistic subdomains is described below.

For receptive language skills, the largest effect size was observed. The experimental group attained a mean rank of 18.92, compared with 6.08 for the control group ($Z = -3.41$, $p = .001$). This significant improvement aligns with the application's adaptive design, which systematically targets comprehension of simple and complex instructions as well as acquisition of basic vocabulary and verbs (Lunsky et al., 2021).

For expressive language skills, the second-largest effect was observed. The experimental group's mean rank was 17.75, compared with 7.25 for the control group ($Z = -2.87$, $p = .004$). This improvement reflects gains in functional expressive vocabulary, increased mean length of utterance, and enhanced articulation clarity (Fage et al., 2019).

For pragmatic language skills, a comparatively smaller but still significant effect was observed. The experimental group achieved a mean rank of 16.33, whereas the control group had a mean rank of 8.67 ($Z = -$

2.18, $p = .029$). Improvements were noted in more functional communicative behaviors, such as using language to make requests or initiate basic interactions. The more modest effect size likely reflects the inherent complexity and context-dependent nature of pragmatic skill development (O'Reilly et al., 2022).

Additionally, results from the Wilcoxon signed-rank test revealed statistically significant pretest-to-posttest improvements across all language domains for participants in the experimental group (all $p < .01$). This within-group analysis strengthens the inference that the observed gains resulted from the experimental intervention itself rather than from external factors or natural developmental progression.

These findings confirm the effectiveness of the Otsimo Speech Therapy application in fostering language development, as demonstrated by the experimental group's statistically and substantively stronger performance across receptive, expressive, and pragmatic language domains. This advantage may be attributed to the application's ability to provide a personalized and responsive learning environment supported by several core technological and pedagogical features.

First, the application employs a systematic strategy of task analysis and sequential mastery, decomposing complex linguistic goals, such as sentence construction and narrative comprehension, into manageable incremental steps. This scaffolding aligns with the principles of Applied Behavior Analysis by promoting a high rate of success and reducing cognitive load during skill acquisition.

Second, the application's algorithmic capacity for dynamic adaptation allows real-time calibration of difficulty and support. The system provides immediate visual and auditory prompts following errors, thereby offering just-in-time scaffolding. Conversely, it systematically increases linguistic complexity following mastery, which helps maintain an optimal challenge level while minimizing frustration.

Third, the platform provides a low-pressure, predictable practice environment. This setting may reduce the social anxiety often associated with face-to-face communication for children with ASD and facilitate the intensive repetition necessary for skill automatization. Increased engagement and participation may therefore serve as important mediators of learning outcomes.

Finally, the data-driven profiling inherent in the application, including the tracking of response latency, error patterns, and success rates, enables precise monitoring of individual progress. This continuous formative assessment supports identification of strengths and weaknesses within each child's language profile, thereby helping ensure that the intervention remains targeted and efficient.

In summary, the combination of structured scaffolding, adaptive difficulty, a secure practice environment, and data-informed personalization provides a plausible explanation for the observed language

gains and supports the use of AI-augmented tools as adjuncts within comprehensive therapeutic frameworks.

Furthermore, the results indicated measurable improvements in emotional and behavioral domains associated with communication. These included greater confidence during verbal attempts, increased motivation to initiate interaction, and reduced avoidant or withdrawal behaviors previously associated with challenging communicative contexts. This broader positive effect may be attributable to the application's adaptive design, which accommodates individual differences and minimizes repeated failure by providing calibrated support at the point of need. Embedding learning activities within functional, realistic scenarios may also enhance the meaningfulness and transferability of language acquisition to daily life.

This study provides a practical illustration of how adaptive digital tools, such as the Otsimo Speech Therapy application, may transform language difficulties from barriers to communication into opportunities for communicative empowerment and social inclusion for children with ASD. The results not only support the effectiveness of the application's core technical features, such as dynamic adjustment of linguistic content, real-time intelligent feedback, and interactive simulation of conversational contexts, but also suggest deeper psychosocial mechanisms linking linguistic progress with the development of communication-related self-assurance.

The evidence suggests that the application may help shift the child's role from a passive receiver of language input to a more active, initiating communicator. This change is consistent with self-efficacy theory in communication (Shen et al., 2008), which proposes that gains in performance are supported by strengthened beliefs in one's capabilities. The application may support this transformation by providing structured, success-oriented experiences that progressively build confidence in linguistic competence.

The findings of the present study indicate a significant positive impact of the Otsimo Speech Therapy application on the development of language skills in children with autism spectrum disorder. This impact may be attributed to the application's adaptive capacity to generate a unique learning pathway for each child. Its intelligent mechanisms, such as real-time individualization of content, continuous performance monitoring, and timely instructional scaffolding, may enhance communicative competence by accommodating individual differences in language-processing speed and learning patterns (Kotler et al., 2022).

These findings align with a growing body of research emphasizing the efficacy of adaptive digital interventions for language development. For instance, Jackson et al. (2024) reported significant gains in lexical acquisition among groups using interactive applications grounded in Applied Behavior Analysis principles. Similarly, Herzog et al. (2024)

found that adaptive learning systems contributed markedly to improvement in grammatical structures and conversational engagement. The present results are further consistent with Lunsky et al. (2021), who documented statistically significant improvements in grammatical and expressive language skills following the use of a comparable smart application.

This effectiveness can be understood within a broader theoretical framework. The value of the application extends beyond training isolated linguistic responses because it may also promote communicative empowerment. By functioning as a cognitive scaffold, the technology can help bridge the gap between abstract linguistic knowledge and functional communication acts, such as asking for help or participating in simple conversations. From this perspective, the application serves as an intelligent mediating tool that helps the child organize and articulate thoughts, thereby facilitating a shift from reliance on alternative communication methods toward more active verbal engagement. This transformation is central to improving communication-related quality of life, which is a core goal of language intervention.

Thus, this study makes a theoretical contribution by connecting adaptive technology with contemporary learning theories. Applications such as Otsimo Speech Therapy may provide a practical approach to teaching communicative problem-solving in near-naturalistic contexts. This can be achieved by simulating real-life situations, such as making a purchase or requesting an object, within the digital environment, thereby helping prepare the child to transfer and apply these skills in everyday settings. This approach directly supports a situated learning model, which emphasizes the importance of acquiring and practicing skills within authentic social and environmental contexts (Walker, Cheng, & Xie, 2023). As a result, the role of the application extends beyond building vocabulary or sentence structures and contributes to the development of integrated, transferable communicative competence.

In conclusion, this study suggests that successful language intervention for children with ASD in the digital age requires the integration of scientific rigor, informed by frameworks such as Applied Behavior Analysis and situated learning theory, with the adaptive and highly personalized capabilities of intelligent technology. Applications such as Otsimo Speech Therapy may be adopted as supportive tools within comprehensive, multicomponent intervention programs. Crucially, this integration should preserve the indispensable role of the clinician and the family in mediating and facilitating the generalization of skills from structured virtual practice to fluent everyday social interaction. This collaborative, technology-enhanced paradigm represents a promising pathway for making language development more engaging, effective, and empowering for children with autism.

Practical Challenges

Despite the positive findings demonstrating the efficacy of the Otsimo Speech Therapy application, implementation of this technology-based intervention model involves several practical challenges that should be considered when interpreting the findings and planning future use.

Translational Gap Between Technology and Practice

A significant obstacle is the limited specialized training available to practitioners, including speech-language pathologists and special educators, as well as to parents, in both using intelligent applications and interpreting the performance analytics they generate. Successful implementation also depends on adequate technical infrastructure, including reliable tablets, stable internet connectivity, technical support, and institutional backing, all of which may not be consistently available across intervention centers or households, particularly in resource-limited settings.

Heterogeneity Within the Autism Spectrum

The pronounced variability in characteristics, linguistic profiles, and sensory preferences among children with ASD presents a fundamental design challenge. Developing adaptive content that responds effectively to this diversity is complex, and application algorithms may not adequately address all language difficulties or may prove less effective for children with co-occurring conditions or pronounced sensory sensitivities that affect engagement with the device.

Generalization and Skill Maintenance

A persistent challenge lies in transferring language skills acquired within the application to the dynamic and unpredictable contexts of daily life. Although the application provides interactive simulated scenarios, it cannot fully replicate the complexity of real-world social interaction. Accordingly, active and deliberate mediation by therapists and families remains necessary to support skill generalization and maintenance.

Sample and Duration Limitations

The study sample was limited to children from Irbid Governorate, which may reduce the generalizability of the findings to other social and geographical contexts within Jordan and the broader Arab region. In addition, the 8-week intervention period was relatively brief for evaluating the long-term maintenance of language gains or identifying potential downstream effects on broader patterns of social interaction.

Ethical and Practical Considerations

Important questions remain regarding the appropriate balance between technology-mediated learning and direct human interaction, which is essential for emotional and social development. Moreover, the financial cost associated with sustained application access may present a barrier for some families over time.

Taken together, these challenges suggest that intelligent applications such as Otsimo Speech Therapy are best conceptualized as adjunctive tools

rather than comprehensive substitutes for multidisciplinary intervention programs. Future work should include longitudinal research, targeted training curricula to build practitioner and parent capacity, and the development of more flexible technical solutions that can be adapted to diverse local contexts and resource conditions.

THEORETICAL AND SOCIETAL CONTRIBUTIONS

Contributions for Practitioners and Specialists

Providing a Practical Model for Specialized Technological Intervention. The study offers an evidence-based framework for integrating an AI-driven application, such as Otsimo Speech Therapy, into individualized education programs for children with autism spectrum disorder. This framework serves as a concrete model for augmenting traditional speech-language therapy through personalized, adaptive digital tools.

Redefining the Role of the Speech-Language Pathologist. The findings highlight a shift in the clinician's role from sole provider of direct training to coordinator and supervisor of smart learning. This refocused role emphasizes analysis of application-generated progress data, design of activities that support skill generalization, and provision of the emotional support and social interaction that technology cannot replicate.

Enabling Data-Informed Clinical Decision-Making. The study outlines a practical approach to using automated analytics to document progress in language skills, including fluency, vocabulary, and grammar. These objective data support rigorous evaluation of intervention effectiveness and inform timely clinical decisions regarding modification of therapeutic approaches.

Promoting Multidisciplinary Teamwork. The findings underscore the importance of collaboration among the speech-language pathologist, assistive technology specialist, behavioral analyst, and the child's family. This collaborative model is essential for maximizing the application's benefits and supporting the transfer of acquired skills to natural contexts.

Contributions to Society and Policy

Advancing the Right to Access Modern Interventions. The study contributes to operationalizing the principles of equality and accessibility in rehabilitative services. It provides evidence that can support advocacy for the provision of, and facilitated access to, scientifically supported therapeutic applications across diverse segments of society.

Informing Research, Development, and Support Policies. The findings offer evidence that may guide policymakers in ministries of health and education. In turn, this evidence may encourage the funding and support of projects dedicated to developing and evaluating Arabic-

language digital solutions for language habilitation and to fostering partnerships with local developers.

Cultivating a Society Supportive of Diverse Communication. The research promotes societal awareness of the importance of early language intervention and of the capacity of children with ASD to develop functional communication skills when provided with appropriate supportive tools and techniques.

Contributions to the Child with Autism Spectrum Disorder

Enhancing Communicative Competence and Expressive Independence. The adaptive tool appears effective in developing practical language skills that may increase the child's ability to express needs and reduce frustration associated with communication difficulties.

Building Communication Confidence and Motivation. Graded success experiences within the application's low-pressure environment may foster greater self-confidence in the child's communicative abilities and increase motivation to interact.

Paving the Way for Educational and Social Inclusion. The acquisition of core language skills may open avenues for greater classroom participation and peer relationship building, thereby supporting meaningful social inclusion.

Shifting Focus From "Disability" to "Necessary Support." The study helps reframe linguistic challenges from a deficit-based perspective to one that emphasizes the child's right to appropriate support and enabling techniques, thereby promoting a strengths-based approach.

Future Directions and Recommendations

Based on the findings and implications of this study, several recommendations can be advanced to strengthen future research and professional practice.

Developing and Evaluating Culturally Adapted Arabic Applications. Future efforts should prioritize the design and funding of AI-driven language intervention applications tailored to the linguistic and cultural context of Arab children. The efficacy, usability, and clinical relevance of such tools should be examined through rigorous controlled research.

Integrating Digital Tool Training Into Professional Development. Professional preparation and continuing education programs for speech-language pathologists and autism intervention specialists should incorporate structured training on the use, evaluation, and implementation of evidence-based digital therapeutic tools.

Prioritizing Longitudinal and Comparative Research. Future studies should include long-term follow-up designs to evaluate the sustainability of language gains associated with digital interventions. Comparative investigations are also needed to assess the relative

effectiveness of different applications and to identify the most effective ways to integrate digital tools with face-to-face therapy.

Adopting Participatory Design Methodologies. User-centered and participatory approaches should be employed during the design, testing, and refinement of therapeutic applications. Involving speech therapists, behavioral analysts, and parents throughout development can help ensure that the resulting tools are both clinically sound and practically usable in real-world contexts.

CONCLUSION

This study contributes to the growing body of Arab research at the intersection of applied artificial intelligence and language intervention for children with autism spectrum disorder. It provides empirical support for the potential of the Otsimo Speech Therapy application to address persistent challenges in language development through intensive, adaptive, and personalized training. The findings offer a practical model for translating the principle of evidence-based, individualized intervention into a scalable digital format. More broadly, the results may encourage further rigorous research, technical innovation, and policy support for intelligent technological strategies that promote equitable access to effective interventions. Such efforts are important for narrowing the communicative gap and fostering more meaningful social and educational inclusion for children with ASD.

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Institutional Review Board Statement

The Ethics Committee of Ajloun National University, Jordan, approved this study on January 30, 2026 (Reference No. 3018/UN37.11/TU/2026).

Transparency

The authors affirm that the manuscript is honest, truthful, and transparent; that no key aspects of the investigation have been omitted; and that any deviations from the study as originally planned have been clarified. This study adhered to all publishing ethics.

Competing Interests

The authors declare that there are no competing interests.

Authors Contributions

All authors contributed equally to the conception and design of the study. All authors have read and approved the final version of the manuscript.

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