

# The Promise of Apps-Based Reading Comprehension for Students with Autism Spectrum Disorder: Implications for Practice

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**How to cite this paper:** Alharbi, N. H. (2024). The Promise of Apps-Based Reading Comprehension for Students with Autism Spectrum Disorder: Implications for Practice. *Creative Education*, 15, 1087-1099. <https://doi.org/10.4236/ce.2024.156066>

**Received:** May 19, 2024

**Accepted:** June 22, 2024

**Published:** June 25, 2024

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## Abstract

Literacy skills are essential for learners' development and future success. This literature review explored using assistive technology applications (apps) for literacy instruction of students with autism spectrum disorder (ASD), specifically reading comprehension. The primary aim was to identify strategies for implementing app-based literacy instruction to support students with ASD in school and home settings. Studies focusing on reading comprehension skill development were reviewed. The results indicated apps are an effective educational tool for promoting reading comprehension skills of students with ASD. Further, parents and teachers have positive attitudes toward app-based instruction. Implications for practice such as planning interventions, choosing appropriate apps, providing professional development, and establishing school-home collaboration are presented. Successful case examples of applying effective apps within classroom settings are also discussed. While promising, a significant literature gap was identified, suggesting future research should examine integrating apps into applied behavior analysis interventions and replicate past studies.

## Keywords

Reading Comprehension Skills, Literacy Skills, Students with ASD, Assistive Technology, Apps, Teachers

## 1. Introduction

Learning literacy is one of the essential skills needed to access information throughout different academic content areas, increase knowledge, and improve the quality of life for all learners, including students with disabilities. Regardless of this, and although characteristics of autism spectrum disorder (ASD) already

threaten their literacy outcome, children with ASD are frequently excluded from the literate community in school because it is expected that they are not prepared for literacy instruction (Spooner et al., 2014; Travers et al., 2011; Vacca, 2007). ASD is a pervasive developmental disability. This complex neurological disorder can be identified in early childhood and is characterized by deficits in social communication, social functioning, and behaviors. Individuals with ASD display restricted and repetitive behaviors and activities. Their functioning in terms of education, employment, and society is consequently hindered by these many challenges. The complexity of this disorder, therefore, introduces the need for inclusive intervention focusing on these deficits to make certain they function well in society (American Psychiatric Association, 2013; O'Malley et al., 2014; Ulzii, 2019).

According to Pham et al. (2019), visual information processing by individuals with ASD is more conducive than other data types (Quill, 1997). Analyzation, as well as system-based construction of rules, are two of their many strengths, which signify the appeal and far-reaching benefit of technology-aided interventions for them (Quill, 1997). Technology is defined as hardware enabling connectivity, devices (e.g., smartphones and tablets), content (e.g., apps and games), and assistive technology devices. In turn, originating from the Assistive Technology (AT) Act of 1998, the term AT device is defined in Section 602 (1) of the Individuals with Disabilities Education Act (IDEA, 2004) as any item, equipment, or system used to increase, support, or advance the functional abilities of a child with a disability (Lee, 2016).

Nonetheless, the existing literature on the effectiveness of implementing literacy apps in literacy interventions for students with ASD is limited. The aim of this research, therefore, is to develop and examine strategies for utilizing app-based interventions to enhance literacy skills, specifically reading comprehension, for students with ASD through inspecting the available information in the literature to reduce the current knowledge gap. Accordingly, this paper is organized into two main sections: constructing strategies and recommendations for implementing and utilizing apps for reading comprehension instructions for children with ASD and cases of app-based reading comprehension interventions in practice.

This paper is organized as follows: Section 2 discusses the strategies for implementing app-based reading comprehension interventions for students with ASD, including planning interventions, choosing appropriate apps, and providing professional development. Section 3 reviews cases of app-based reading comprehension interventions in practice, highlighting successful applications and their outcomes. Finally, Section 4 presents the conclusions and future research directions, addressing the gaps identified in the current literature and suggesting potential areas for further investigation.

The literature review process for this study involved several key steps to ensure a comprehensive and systematic approach. Databases such as PubMed,

ERIC, and Google Scholar were searched using keywords like “ASD,” “reading comprehension,” “assistive technology,” and “apps,” with the search limited to articles published between 2010 and 2022. Studies were included if they focused on the use of apps for reading comprehension among students with ASD, provided empirical data, and were published in peer-reviewed journals; studies that did not specifically address ASD or reading comprehension or lacked empirical data were excluded. The selected studies were analyzed using thematic analysis to identify common themes and strategies, and quantitative data were extracted and summarized to assess the effectiveness of app-based interventions. Each study’s methodological quality was evaluated using a standardized checklist, considering factors like sample size, study design, and the validity of the measures used.

## 2. Strategies for Practice Implications

Both the Individual with Disabilities Education Act (IDEA) of 2004 and AT Act ensure the right of students with disabilities to access AT and related services in accordance with the educational program that is individualized based on need (Pham et al., 2019). Educators and parents have an opportunity, offered by technology innovation and recent federal policies, to transform education through utilizing technologies and professional development (Crossland et al., 2018). Their usefulness is demonstrated by supporting students with ASD in accessing and developing fundamental literacy skills, creativity, and critical thinking. Thus, helping to enhance the students’ autonomy and participation in other academic activities and overall advance the educational process, and promote their inclusion (Stone-MacDonald, 2014; Spooner et al., 2014; Kagohara et al., 2012; Howorth et al., 2019). They also should generally prompt a positive attitude in both parents and teachers. These technologies should produce such a positive impact as increasing the engagement of students with disabilities with their peers (Dra-per-Rodríguez et al., 2013). Accordingly, it is imperative to develop appropriate strategies to maximize the utilization of app-based interventions and limit possible drawbacks and adversities. Since similar to other interventions, this approach deals with numerous obstacles such as schools’ resources, high-speed internet availability, highly trained educators, proper planning, and student engagement (Howorth et al., 2019).

A successful application is accomplished through careful planning and implementation of such technology-based interventions in addition to other contributing factors, including examining the parents’ and teachers’ perceptions and readiness, comprehensive intervention planning, and choosing appropriate apps. Additionally, providing continuous professional development programs, establishing a collaboration between school and home, and effective transition between environments. Since the current research indicates the effectiveness and popularity of using apps for literacy instruction of children with ASD, the following implications for practice are presented.

## 2.1. Parental and Professional Perceptions

Before initiating any intervention in special education, it is imperative to explore the readiness and perception of the recipient audience (i.e., parents and teachers) for the said intervention. Accordingly, several studies investigated their perceptions and willingness using surveys and interviews. These studies indicated that parents and educators have a positive attitude regarding these interventions and their immense benefits for students with disabilities, especially those with ASD, attention deficits, and fine motor control deficiency. It was reported that it was mainly used to promote language and literacy skills. The reported benefits included improving students' motivation, focus, engagement, and task completion. Additional advantages of these interventions are improving instructional planning through the devices (e.g., iPads, tablets, computers, apps, information and communication technology (ICT), and smart boards), customizability, transportability, and accommodating different learning preferences features (Johnson, 2013; Sulaimani, 2017; Clark et al., 2014).

Furthermore, parents reported their children's high use of iPad on a daily basis, whereas professionals reported limited use in their practice (Clark et al., 2014); nevertheless, they did recommend the application of these technologies (Sulaimani, 2017).

## 2.2. Planning Interventions

While planning the implementation of apps-based interventions for students with ASD, educators must consider several points. First, how many students will share the device (e.g., iPad) with the chosen app, as well as when and where to use it. As for managing the classroom, rules for using the device must be established, taught to students, and accordingly implemented. Further, the most appropriate approach to integrating the device into the learning process must be determined. Throughout the planning process, educators should consider what this high-tech AT brings to the table and the advantages that otherwise would not be obtainable (Murray & Olcese, 2011). For instance, the high capacity for customization of these devices and apps should be taken advantage of, as each student with ASD must benefit from the high-tech features of both the device and apps, which are easily modified and personalized to cover a wide range of educational needs in one classroom. The proven benefits, including increased motivation and development of skills, should guide the planning process. Educators should consider an application that positively extends the learning environment and promotes students' learning.

Further, the use of technology to support the learning of students with ASD should constantly evolve as technological developments become more mainstream in education as mandated by the legislation and policies (Pham et al., 2019). They also should generally prompt a positive attitude in both parents and teachers. A successful application requires an effective planning process, staff training, process evaluation (e.g., using rubrics), focus on student transition, and

parent collaboration (Draper-Rodríguez et al., 2013).

### 2.3. Choosing Appropriate Apps

The market is flooded with various educational apps due to the increasing popularity of using tablets in the educational process. The enormity of developed apps for individuals with ASD makes the necessity to inform practice apparent. Apps should be chosen to match the needs of teachers and students alike, and accordingly, educators should review and assess sites dedicated to educational and behavioral apps (Cumming & Rodríguez, 2013). They need to understand the app and determine if it is appropriate for utilization. These apps must positively contribute to the educational process and not obstruct it. Establishing certain selection criteria is essential in terms of capacity for customization, needed time and resources, and cost-effectiveness (Boyd et al., 2015).

### 2.4. Professional Development and Training

Local educators have an exceptional opportunity, offered by technology innovation and recent federal policy, to transform education through utilizing technologies and professional development. Therefore, professional development and training on using AT are essential for effective implementation in the educational process, which, according to Clark et al. (2014), is especially needed for teaching children with ASD. Therefore, school administrators should ensure that teachers have the necessary support and training to implement effective apps-based literacy instruction. However, providing comprehensive professional development programs involves some aspects, especially as teachers may need various forms and levels of training on the successful application since they may have educational backgrounds. For instance, it may consume cost and time; accordingly, Cumming & Rodríguez (2013) recommend that training be offered to groups or individuals, online or face-to-face. Further, there are numerous accessible online resources from which teachers could improve their knowledge, including journals, review websites, wikis, etc.

### 2.5. Communication and Collaboration

Parent input is important on many levels, including efficiently customizing utilized devices and apps to the child's needs. Thus, making the need for parent training apparent as well. Therefore, collaboration could be promoted by including parents in teachers' training. Efficient parents, on the other hand, might share their knowledge and experience, which consists of some advantages such as supporting this collaboration and contributing to the success of the intervention. Thus, the student, parent, and teacher will form a team permitting proper communication that redounds to the benefit of all involved and increases the chances for a successful intervention supporting the student in both the home and school environment (Cumming & Rodríguez, 2013). Therefore, clear and explicit communication and collaboration between practitioners and parents are essential for successful implementation.

### 3. Cases of App-Based Reading Comprehension Intervention in Practice

It is imperative for educators to ensure literacy skills development for students with ASD since it influences their academic accomplishments. Further, ATs such as apps play an essential role in enhancing the educational process for students with ASD. Therefore, educators identifying and appraising appropriate strategies and approaches for implementing these technologies is crucial for positive results. This section reviewed successful cases of applying effective apps (e.g., ATs) within classroom settings in relation to this paper's recommendations.

The use of technology especially facilitates participation in literacy activities within the classroom setting. This is due to the adaptation features these devices offer, thus, enabling more independence for students in various academic activities. Stone-MacDonald (2014) studied the use and integration of iPad apps for the literacy development of children with ASD in the classroom to support their Individualized Education Program (IEP). The review included apps for supporting literacy activities (e.g., iBook), apps for reading (e.g., Collins Big Cat Books), and apps for improving literacy skills (e.g., Splingo). iPads are inexpensive, flexible, and offer a variety of relatively economical apps for many purposes. Therefore, iPads and their apps could be customized to meet the demand and needs of children with disabilities such as ASD, making them a sufficient substitute for the more expensive Augmentative and Alternative Communication (AAC) devices. In comparing costs, AAC apps were found to be expensive compared to those in the iTunes store. Children can communicate with others more freely and fluently using the more cost-effective iPad. The findings indicate additional activity and communication, which led to improvement. Using apps for literacy instruction contributes to the development of students with disabilities, the influential factors being individual educational needs, strengths, preferences, and the associated cost with using these apps (Stone-MacDonald, 2014).

Arciuli and Bailey (2019) investigated the efficacy of an app called ABRACADABRA (ABRA) to promote literacy development, explicitly reading accuracy and reading comprehension, for children with ASD. In accordance with technology-based literacy instruction recommendations for at-risk learners, this web application is developed to improve early literacy skills through learning activities consisting of games (Savage et al., 2010). Previous research indicated the potential benefits of this app when implemented within a home setting. However, group-based instruction within the school setting is more economical than individualized instruction in participants' homes; therefore, Arciuli and Bailey (2019) administered ABRA instruction in small groups of students within the school setting. Twenty-three children aged five to eight years were randomly assigned to receive ABRA literacy instruction (i.e., intervention group) or receive literacy instruction as usual (i.e., control group). This randomized controlled trial (RCT) included several dependent variables: adaptive ability, vocabulary, accuracy, phonological awareness, and reading comprehension. Each dependent variable was evaluated using valid and reliable standardized tests. The

results suggest that ABRA literacy instruction was statistically significant in improving reading literacy skills, with substantial effect sizes. However, the intervention was less effective in improving reading comprehension compared to reading accuracy findings. The authors argued that social communication skills are critical in the program's activities; thus, they may contribute to these findings. Accordingly, educators must critically consider the needs of their students with ASD when determining the selection criteria of the appropriate app, especially if the students have poor social communication skills that demand further support.

Caron et al. (2018) examined the effect of AAC app with a transition to literacy (T2L) software, consisting of features such as dynamic text and speech output when choosing graphic symbols, on sight word reading skills and communication needs for students with ASD. The study used a single-subject, multiple-probe design implemented across one group of three participants, followed by another group of two participants to test the generalization of results. All participants were boys with ASD and complex communication needs, ages ranging from six to 14 years, receiving speech and language services. The participants being only boys may limit the generalizability of the results. Participants were exposed to the AAC app in the intervention phase. The independent variable was measured during highly structured tasks, whereas the dependent variable, reading 12 target words accurately, was measured during all phases. The four phases of this study were baseline, intervention, maintenance, and generalization. To evaluate the reading accuracy of the target words, probes were carried out during each phase and included laminated text cards and graphic symbols of the terms. All participants exhibited increased accuracy in identifying sight words using the AAC app during highly structured tasks. The effectiveness of this AAC system design suggests its possible usefulness in supporting literacy instruction and perhaps integrating literacy learning into daily communication, thus, requiring sufficient parents' and teachers' collaboration.

On the other hand, alternative educational methods such as global reading methods appear to be beneficial in the instruction of children with ASD due to their adequate visual competence. Gomez et al. (2018) investigated the effectiveness of using a mobile app called Leo con Lula (i.e., reading with Lula in English), a global reading learning method. This particular method for individuals with ASD forms the app's foundation aiming to offer a visual, customized, and flawless learning experience that would decrease dependency while increasing autonomy. The app presents picture and words extracted from the vocabulary the educator selects for the student; accordingly, the students must connect the word with the matching picture. A drag-and-drop movement is needed to accomplish the previous, which means the app engages reading skills as well as other motor abilities, including good eye-hand coordination.

The study consisted of nine children, seven boys and two girls, aged three to eight years, with the inclusion criteria of being under the age of ten with ASD, having low or no reading abilities, and exhibiting no visual nor severe motor

disabilities. The pilot study was based on questionnaires as well as direct observation to obtain teachers' perspectives, find probable limitations, and determine the app's appropriateness as an educational tool in the classroom. The app was used once a week without any constraints on session time, and teachers were required to complete a weekly questionnaire.

The findings indicated that the app was easy to use. Further, some students needed help to stay focused on tasks and accomplish them successfully. Students were generally motivated during the intervention; however, there were two isolated incidents where students experienced frustration because the app crashed and finished abruptly. It is therefore concluded that software issues have a negative effect on a population such as this. Accordingly, to avoid causing frustration and potential rejection, the study recommends that the development process must consist of intensive and end-user testing.

Students with ASD generally struggle with reading comprehension, even when maintaining good word reading skills. [El Zein et al. \(2015\)](#), therefore, aimed to improve the reading comprehension skills of students with ASD. The study includes three students with ASD, ranging from 9 - 12 years of age, who could speak complete sentences and respond to easy questions, were able to decode reading texts on a second-grade level or higher, could copy and write words, had prerequisite attentive skills, and without challenging behaviors. The study investigated the effect of teacher-directed instruction (TDI) and iPad-assisted instruction (IAI) on reading comprehension skills and challenging behaviors. Several components were involved in TDI teaching, including text reviews, graphic organizers, and a token economy system.

On the other hand, IAI used the Space Voyage game that provides similar instruction to TDI and the same token economy system. The results indicate that TDI is superior to IAI in improving reading comprehension, whereas IAI is better in reducing challenging behaviors and task completion time. Therefore, individualized one-on-one sessions meeting the needs of students with ASD are recommended. Teachers should also consider a strategy combining both TDI and IAI with a comprehensive assessment of iPad applications.

Research indicates that direct vocabulary instruction can impact word knowledge, conceptual development, and children's comprehension (e.g., [Coyne et al., 2010](#)). Accordingly, [Dennis et al. \(2016\)](#) applied adapted alternating treatments design (AATD) consisting of teacher-facilitated and iPad-facilitated instruction, specifically an app called AutisMate, to compare their impact on children's vocabulary. Instruction was offered for seven weeks to five participants and included 42 verbs distributed between treatments equally—sessions were facilitated either by the teachers or the app. The results show an improvement in expressive and receptive knowledge of verbs, which did not vary across the different delivery methods.

Students need to be able to spell and write words correctly to enhance their academic achievement by writing competently and finishing tasks independently. Although using dictionaries, for instance, in the learning process may be

helpful for other students, the case differs for students with ASD as they face challenges in using such materials independently. Kagohara et al. (2012) developed a multiple baselines study to utilize video modeling and common word processor programs to teach children with ASD words spelling and improve their writing and reading skills.

This study included two children with ASD that were offered a stakeholder questionnaire before initiating the experiment, which aimed to gain perspective into 1) their willingness to work with computers, 2) why they like to use a computer, and 3) their inclination toward learning by watching videos on an iPad. Thus, the questionnaire offers input on the study design by using the produced data to develop a reward system after finishing each intervention session. During the baseline setting, one student uses the pages app on an iMac while the other uses Microsoft's word program on a Windows-based desktop without watching an instructional video. The application selection was based on the availability of equipment in the classroom. However, during the intervention phase, students watched an instructional video on how to use each program before use.

The results indicated a successful improvement in word spelling and writing skills. Moreover, video modelling is a useful tool for developing their academic skills. The study attributes its results to teacher encouragement received during the intervention, which offered additional motivation besides the given rewards. Teachers also provided additional verbal instruction when students answered incorrectly, which would have affected the results as well. Furthermore, the attitude of both teachers and students towards video modelling was highly positive. Finally, in using the Stakeholders' questionnaires, the study was able to increase students' cooperation and self-determination. Table 1 provides a summary of these cases with their limitations, advantages, and effectiveness of each intervention.

**Table 1.** Summary of studies involving apps for reading comprehension.

Study	Literacy skills taught using app(s)	Effectiveness of using app
Stone-MacDonald (2014)	Vocabulary, phonics, reading, writing. Story Creator, Pictello, Puppet Pals, and Collins Big Cat	Improved literacy and communication skills, increased independence
Arciuli and Bailey (2019)	Adaptive ability, vocabulary, accuracy, phonological awareness, reading comprehension. ABRACADABRA (ABRA)	Significant improvement in reading comprehension
Caron et al. (2018)	Sight-word reading. Transition to Literacy (T2L)	Increased accuracy in identifying sight words, enhanced sight-word reading
Gomez et al. (2018)	Global reading Leo con Lula	Improved student motivation
El Zein et al. (2015)	Reading comprehension skills Space Voyage	Reduced challenging behaviors, better task completion
Dennis et al. (2016)	Vocabulary AutisMate	Improved expressive and receptive verb knowledge
Kagohara et al. (2012)	Writing and reading skills Video modeling.	Improved spelling, writing, academic skills

## 4. Discussion

While app-based interventions offer numerous benefits, they also present several challenges. For instance, the cost of apps and required devices can be prohibitive for some schools and families. Additionally, there is a risk of over-reliance on technology, which may limit the development of other essential skills. Educators and parents must also be cautious of screen time, as excessive use can lead to issues like reduced physical activity and eye strain. Moreover, the effectiveness of these apps can vary widely depending on the specific needs and abilities of each student with ASD, necessitating careful selection and customization of apps to meet individual requirements.

Several studies have provided quantitative evidence supporting the effectiveness of app-based interventions for improving reading comprehension among students with ASD. For example, [Arciuli and Bailey \(2019\)](#) conducted a randomized controlled trial with 23 participants, demonstrating significant improvements in reading accuracy and comprehension, with effect sizes ranging from 0.5 to 0.8. Similarly, [Caron et al. \(2018\)](#) found that the use of AAC apps resulted in a 40% increase in sight word reading accuracy among participants. While short-term benefits of app-based interventions are well-documented, there is a paucity of research on their long-term effects. Longitudinal studies are needed to assess whether these improvements in reading comprehension persist over time and how these interventions can be integrated into broader educational goals. Educators must consider the sustainability of these interventions and their alignment with individualized education programs (IEPs) to ensure long-term success.

This review identifies several gaps in the current literature on app-based reading comprehension interventions for students with ASD. While many studies demonstrate the effectiveness of these apps, there is limited research on their long-term impact and integration into comprehensive educational plans. Additionally, existing studies often focus on small, homogeneous samples, which may not capture the diversity of the ASD population. Future research should aim to include larger, more diverse samples and examine the sustainability and broader educational impact of these interventions over time. Moreover, a critical approach is needed to avoid oversimplification and ensure that app-based interventions are seen as one component of a multifaceted educational strategy.

## 5. Conclusion

The implementation of ATs in the instruction of learners with ASD is well documented in research. This paper investigated the application of apps in teaching reading comprehension skills to children with ASD, given the importance of learning literacy to their development and success. Findings indicate that the limited research suggests that apps are effective in developing reading comprehension skills, among other benefits. This technology allows practitioners to transform special education and advance the learning of students with ASD.

This paper has presented several methods with which children with ASD could be supported in the learning process, thus helping them become autonomous learners with developed skills that would prepare them for independent, prosperous lives.

Although this paper indicates that apps are promising educational tools for children with ASD, the significant gap in the literature has become more evident. Therefore, future research should examine the effectiveness of integrating apps on smart tablets in applied behavior analysis (ABA) interventions as well as replicate past studies in the endeavor to reduce the knowledge gap.

### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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