The Effectiveness of Digital Storytelling on Language Comprehension of Children with Autism Spectrum Disorders: A Systematic Literature Review

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Abstract

This systematic literature review examines the impact of digital storytelling interventions on the language comprehension skills of children diagnosed with autism spectrum disorders (ASD). Given the communication challenges faced by individuals on the autism spectrum, there is a growing interest in leveraging digital storytelling as a potential tool for language development. The review synthesizes findings from relevant studies, focusing on key components such as visual support, multimodal presentation, repetition, interactivity, personalization, and the incorporation of social narratives. The research shows promising outcomes, indicating that digital storytelling improves language comprehension in children with ASD. The review emphasizes the potential benefits along with the need for more investigation to determine the best intervention settings, treatment periods, and skill generalization. The review's conclusion deepens our understanding of how digital storytelling aids in the language development of kids with ASD and has useful ramifications for educators, researchers, and special education practitioners.

Keywords: *autism, ASD, digital storytelling, language comprehension, systematic literature review*

INTRODUCTION

In the era of rapid technological and information development, digital technology has become an increasingly habitual phenomenon in the daily routines of children, including those with learning and communication disabilities. Naturally, this group has become the main users of technology, given that technology is often the only medium to facilitate their communication and social interaction with others.

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impaired communication and social interaction [1]. Previous studies have shown that children with ASD often have difficulty with their language comprehension skills [1], which is one of the important aspects in the development of language and social skills. According to Executive Functioning theory, children with ASD show deficits in one or more cognitive processes (e.g. active memory, inhibition, and goal maintenance) that determine the ability to establish an adequate response plan [2]. Therefore, there is a need for an in-depth understanding of specialized methods to support

the language comprehension of children with ASD.Digital technology allows for more complex delivery of teaching and learning materials. It is no wonder that the demand for effectively integrating technology into teaching and education has steadily increased over the past decade. However, it should be noted that integrating technology requires more than just bringing technology (hardware of software) into the classroom. Technology integration requires a curriculum that uses authentic learning activities. One of the most promising approaches in integrating technology into authentic learning spaces is digital storytelling [3].

Sadik [4] stated that through the digital storytelling experience, students can think more deeply about the meaning of the story and personalize their personal experiences. Furthermore, [5] reported that experimenting with digital storytelling using iPods enabled students to gain a critical understanding of the technology used in early childhood education. In the context of children with ASD, digital storytelling emerges as a promising intervention method in providing media to overcome the barriers faced by children with ASD in terms of sensory preferences and information processing.

Digital storytelling is an interesting approach to supporting the language comprehension of children with ASD. Based some previous studies, there had been shown that digital storytelling can improve the language skills and understanding of children with ASD [6] . However, it is a fact that language comprehension skills involve not only linguistic aspects but also require narrative

comprehension, organization of ideas, and verbal expression [7], [8], [9], [10].

This study will systematically compile and analyze relevant studies, including research methodology, population and sample, variables measured, and main findings. Therefore, there are some statements of the problems that will be answered in this study:

1. How can digital storytelling affect the language comprehension skills of children with ASD?
2. What are the specific aspects of digital storytelling that have the potential to improve children with ASD's language comprehension skills?
3. To what extent does scientific literature support the effectiveness of using digital storytelling as an intervention medium in developing language comprehension in children with ASD?

As a systematic literature review, this study can provide a comprehensive view of previously conducted research in this area. It can assist further investigation by detailing what has worked or not worked in previous studies. The results of this study can be the basis for formulating guidelines and recommendations in the development of digital storytelling-based interventions for children with ASD.

LITERATURE REVIEW

Language Comprehension in Children with ASD

Language comprehension requires several competencies that are applied on an ongoing basis, including analyzing text, understanding what is being done, and composing answers. To comprehend, learners create a mental model of the text. Creating a mental model is the same whether listening to the text read aloud or reading the text independently [11] . Children with ASD often struggle with comprehending text, even if their ability to decode words and read text is within normal limits [12]. The reasons behind these difficulties are quiet difficult to determine, as the process of understanding language involves a complex set of linguistic processes (Brown, Oram-Cardy, & Johnson 2013). Initial research on the emerging literacy profiles of young children with ASD suggest that their comprehension difficulties emerge during preschool age [11]. Specifically, they have difficulty developing the ability to understand and produce oral stories as well as knowledge of definitional vocabulary [11].

Many children with ASD have difficulties in reading comprehension [14]. Children with developmental disabilities, including ASD, have the possibility that decoding and oral language skills may be necessary but not sufficient to ensure full comprehension of text [14]. It also affects their skills in decoding and understanding spoken language. Therefore, a comprehensive language assessment for everyone is required, which then provides planning for individualized language support and intervention.

Unfortunately, using language skills more broadly presents a challenge for those with autism even after they have acquired it. Sometimes they have trouble in applying newly learned abilities to unfamiliar environments, stimuli, and people who weren't part of the original training [15]. Several studies focusing on the grammatical abilities of young children with ASD also have reported mixed findings. For example, Tek et al. [16] analyzed the spontaneous speech of 17 children with ASD from six sessions that spanned 4 months from 2 to 4 years old. As a result, children with ASD had varying degrees of grammatical impairment when measured through spontaneous speech. In addition, their production of questions and negation seemed 'scattered'.

In other side, acquiring and maintaining a large vocabulary is essential to language competency [15], since it is the foundation for both spoken communication and reading comprehension. Therefore, for many children with autism, building and strengthening vocabulary is a crucial component of intervention programmers. As a result, as soon as feasible following diagnosis, prevention programs should be started to close the gap between at-risk groups. However, there are numerous intrinsic challenges to develop language skills; motivational environments are necessary. [15]. The behavioral difficulties that speech therapists and instructors encounter, such as lack of cooperation, aggression, and lack of

motivation to communicate, create difficult situations that are not optimal for learning.

Digital Storytelling in Children with ASD

Computer-based instruction makes it possible to include talking heads rather than simply disembodied voices in lessons. The integration of visual and auditory information from a talking head is very effective and has a lot of potential for language teaching for several reasons. These consist of the visual speech's resilience, the auditory and visual speech's complementary, and the best possible combination of these two information sources [15]. Perceivers are adept at speech reading even when they are not looking directly at the talker's lips, demonstrating the robustness of speech reading—the capacity to infer speech information from the face. When visual and aural information are complementary, it simply implies that one source is more informative while the other is less so. As a result, the two information sources may support a speech distinction differently.

The potential benefits of using technology to help students with ASD academically become more proficient for quite some time [17]. Nowadays, storytelling is one of the most therapeutic methods for children with ASD. Storytelling is a simple yet powerful method of explaining complex things. People tend to pay more attention to what they are told when the information is packaged in an interesting story [3]. Typically, traditional behavioral intervention programs for autism include speech therapy to address communication deficits, but receptive language in particular has received less attention comparing to other ASD . According to Mohamad [18]. digital storytelling engages students' visual and auditory senses in ways that may be challenging with printed textbooks. Given how accustomed today's students are to this type of engagement, it is not surprising that the use of text, image, and voice encourages students to participate in deep learning.

On other hand, previous studies have highlighted the effectiveness of technology-assisted storytelling in improving language skills, literacy, and concept understanding in diverse populations, including children with special needs [1], [9], [19], [20], [21], [22]. Bosseler and Massaro [15], [23] showed that children with autism gained more vocabulary using technology-assisted intervention than traditional behavioral programs because it was more appealing to them.

These days, digital storytelling is a potential medium to stimulate language development and comprehension in children with ASD. Several studies have observed positive responses from children with ASD to the use of technology-assisted media in learning contexts [3], [18], [24], [25]. As a result, factors such as visual appeal, interactivity, and flexibility of content can influence the level of participation and engagement of children with ASD. In addition, digital media utilization can also affects learning independence in children with ASD [4].

Previous studies have also shown that digital storytelling can improve children's understanding of narrative structure and help the express ideas verbally [26], [27], [28], [29]. Suh et al. [27] divided two groups of children and adolescents with ASD in order to produced stories with idiosyncratic narratives. As a result, most of the students have positive development in comprehension and produced stories. This study broadens the knowledge of the pragmatic functioning of children and adolescents with ASD. On other hand, Xin [19] and Andreevski [20] used digital stories to reveal the effect of writing lessons. The results showed that students increased the number of words written and complete sentences when digital stories were applied to writing instruction. In addition to writing skills, digital storytelling is also influential in developing understanding of linguistic elements in stories in children with ASD [2] .

Digital storytelling is also researched across fields such as medical health [30], psychology [7], and communication [31], [32].

METHODS

This study used a Systematic Literature Review (SLR) approach to elaborate and evaluate existing empirical evidence in scientific literature. This approach allows a comprehensive and objective investigation of research findings

relevant to the effectiveness of digital storytelling on language comprehension of children with ASD.

After the research objectives and problems have been defined, a formal search strategy must be formulated so that all empirical literature related to the research objectives can be analyzed. This strategy involves search engines, including electronic databases and other elements (see table 1). The main data sources for this study are scholarly articles that have been published in Scopus-indexed English journals, scientific conferences, and related scientific literature from relevant academic databases. Articles to be included in this study had to meet the inclusion criteria involving relevance of the topic, year of publication, type of research, and a primary focus on the use of digital storytelling in interventions for children with ASD. To obtain comprehensive results, this study chose the criteria of journals published during the last decade, which is from 2013 until 2023.

In the process of searching for scientific literature, the author used databases such as IEEE XPLORE, SpringerLink, and Google Scholar using keywords including, "digital storytelling", OR "autism spectrum disorder", OR "language development", OR "comprehension skills". Through the search results, 6.310 articles were found.

Subsequently, an initial selection was made based on the journal title and abstract to determine if the literature met the inclusion criteria or not. Each search source was checked by identifying references to additional relevant studies for inclusion in the study. This led to a total of 62 articles that were suitable for the purpose of the study.

Table 1. Characterization of scientific literature research

Database	SpringerLink IEEE XPLORE Google Scholar
Text type	Scientific Journal Full text
Related journal specification	Journal of Autism and Developmental Disorders, Research in Autism Spectrum Disorders, Journal of Special Education Technology, Journal of Speech, Language, and Hearing Research

After an initial selection stage, the selected articles were extracted by identifying relevant information from the selected data sources. An instrument was then created to record elements of information from the data sources as part of the data extraction process. These elements included:

(1) The article investigates the use of digital storytelling on language comprehension of children with ASD.
(2) The research article was written in English.
(3) Research articles were published from 2013 to 2023.
(4) The research article must have an abstract as an initial selection process of articles that have relevance to the current research.
(5) The research articles address language comprehension in ASD children using digital media (e.g. reading comprehension with technology-assisted narrative interventions).
(6) The research subjects were children with ASD.
(7) The research results mainly include digital storytelling intervention in language comprehension of children with ASD.

After rigorous screening process of the data sources, the final total number of articles that met the research objective was 24. The research paradigm adopted in this study is mainly divided into two types. First, case, or single-subject experiment, including multi-baseline design across scenarios. Second, controlled experimental methods often involve comparing differences in educational effectiveness between technology-assisted interventions and traditional interventions.

RESULTS AND DISCUSSION

From a systematic review of 24 pieces of scientific articles collected, research on digital storytelling on language comprehension for children with ASD is most prevalent from 2014

to 2018, with a total of 17 papers. In addition, of the 26 papers that met inclusion criteria,

In addition, there are many papers that focus on the process of narrative comprehension for children with ASD using digital-assisted technology that produce promising results [9], [21], [22], [26], [27], [28], [33], [34].

Table 2. Content and context of studies

Type	Content	Skill	Participants Age	Freq.	Notes
Case Study	L	L2 skill potential	NS	1	-
	SS	Communication & social skills	Children & adolescents	2	-
	SS	Behavior	Children	2	-
	L	Reading comprehension, narrative comprehension, writing comprehension	adolescents	6	-
	SS	Social emotions	NS	3	-
	L	Pragmatics	Children	1	-
Experimental	L	Narrative comprehension	Children & adolescents	1	Comparing conventional vs digital-based
	L	Digital literacy, grammatical comprehension, vocabulary	Early education children	3	-
	SS	Knowledge acquisition	NS	1	-
Application Development	L	Receptive language	NS	1	-
	L	Language skills	NS	1	-
	SS	Social emotions	NS	1	-
Design-based	SS	Communication & social skills	NS	1	-
Total				24	

Notes: SS social studies, L literacy (reading and writing), NS not specified

Through the content and context of article sources, there are some studies that also focus on the social science field, but it is also possible to pay attention to linguistic elements in shaping communication and social skills in children with ASD. It also can be seen that digital storytelling yields positive results in improving the language skills and comprehension of children to adolescents with ASD. Children with ASD are introduced to vocabulary and grammatical comprehension, communication skills, and social skills through digital storytelling interventions. Meanwhile, adolescents with ASD are stimulated with reading, writing, and narrative comprehension.

14 out of 24 studies are focused on literacy skills (see table 1). One taught L2 skill potential [35], and one taught to give compliments using social story [36]. Reading, narrative, and writing comprehensions are targeted in seven studies [1], [9], [20], [21], [26], [34], [37]. Three studies focused on grammatical comprehension and

vocabulary [9], [25], [28]. Meanwhile, two studies are focused on developing a tablet-based application to enhance language skills [38], [39].

10 studies are focused on social science, including three studies focused on communication skills and social skills [18], [37], [40], two studies on behavior [41], [42] four studies on social emotions [10], [32], [43], [44].

A total of 333 children with ASD participated in related studies. Gender was reported in 11 out of 24 including studies. Most participants were boys. The age of participants varied, with many participants around 8-10 years old.

As stated above, 15 case studies type papers were reviewed and all of them used iPad/tablet application as an instructional material for comprehending language skills on children with ASD. Meanwhile, three studies are focusing on application development on digital devices [38], [39], [42].

The primary purpose of this comprehensive review was to provide a comprehensive view of previously conducted research in improving language comprehension through digital storytelling for children with ASD. Thus, we found that children with ASD have the potential to benefit from improved language comprehension skills provided by digital storytelling due to its several unique features. These elements make use of the special qualities of digital media to give children with ASD a stimulating and encouraging learning environment.

When it comes to therapies, children with ASD may indicate a preference for digital ones (such as iPad/tablet) over more conventional ones (such as writing one sentence on each page of a book printed on paper) [1], [10], [31], [41], [45].

A lot of digital storytelling uses visual components including graphics, animation, and images. Since children with ASD are frequently visual learners, visual support can be especially helpful to them. Therefore, Wainwright et al. [22] conduct a research to compare children with ASD's narrative comprehension and engagement with e-book vs paper-book. As a result, there are not many differences in measuring their narrative comprehension and engagement in narrative comprehension, but there is a difference in visual attention and communication engagement. This certainly reinforces that digital storytelling has the potential to enhance language comprehension and social understanding by portraying social events and interactions. Moreover, children with ASD have been shown to be captivated and engaged by digital media's interactive and visually appealing qualities. Thus, could encourage more people to participate in language-related activities.

According to some research, children with ASD may benefit from the repetition and consistent presentation of information found in digital storytelling [26], [27], [35]. Many children on the autistic spectrum have learning preferences that are in line with these qualities. Although there is encouraging data, literature has frequently emphasized the need for more investigation to identify the precise circumstances in which digital storytelling works best. This covers factors like the ideal exposure time, the value of interaction, and the application of learned abilities to actual scenarios.

While there is promising evidence of digital storytelling interventions that could enhance children with ASD's language comprehension, it's critical to recognize that different people with ASD may react differently to digital storytelling interventions. While some kids might react well, others might struggle or have different preferences. It is essential to comprehend each child's unique needs while creating therapies that work.

CONCLUSIONS

The result of this review leads to suggestions for several areas of future research. From the reviewed papers, the advantages of multimodal learning and visual assistance in digital storytelling for children with ASD have been emphasized. Digital storytelling with interactive and visual components can improve understanding by offering more hints and

reinforcing linguistic concepts. Another advantage that has been acknowledged is the capacity to alter and personalize digital narrative content. Customizing stories to meet the needs and interests of everyone may boost motivation and engagement to encourage language development of children with ASD.

Because research is constantly changing, it's a good idea to look for more current studies and systematic reviews to get the most up-to-date information on how well digital storytelling works as an intervention for language comprehension in kids with ASD. Scholars and instructors are still looking for creative methods to use technology to help meet the special educational demands of children or people with autism spectrum disorders.

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