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THE EFFECT OF THE USE OF ASSISTIVE TECHNOLOGY ON READING COMPREHENSION IN STUDENTS WITH AUTISM SPECTRUM DISORDER

Research article

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THE EFFECT OF ASSISTIVE TECHNOLOGY ON READING COMPREHENSION IN AUTISM SPECTRUM DISORDER STUDENTS

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Abstract

In this study, the effect of technology use on reading comprehension skills of students with moderate ASD was examined. Male students who are attending the first grade and have an intermediate level ASD were determined as participants. All three students are reading by swinging. In the research, one of the single-subject research methods, the multiple-probe design across participants was used. The stories used in the training are written in such a way that they consist of 40-45 words. The story difficulty level is 1. It is determined in accordance with the grade level. The level of initiation in the analysis of the data, the ability to understand reading data in the intervention, generalization and maintenance sessions were collected using the data registration form. The reading comprehension a skill was first examined while preparing the form, based on the correct responses supplied to the reading comprehension questions. The research was conducted out by a special education teacher who graduated from the Department of Special Education. In the application of the multiple-probe design across participants as a research model, firstly, the data were gathered in order to decipher the participants' performance in terms of reading comprehension skills by using the data registration form which was prepared for each student. The data were collected in individual sessions and recorded in the relevant sections. While the baseline level data was taken by the practitioner, the related stories were presented in the form of a pen and paper study and the data were collected. In the intervention, generalization and continuity data, the iPad-mediated application was used. The participant opens the story and reads it himself. The teacher shows the questions about the story on the iPad. The reading comprehension data of the participant were performed through multiple choice questions. Consequently, it was found that all participants exhibited appropriate behaviors in keeping on task and completing tasks during the reading comprehension studies process. It has been determined that students with ASD have higher performance when using iPad only compared to traditional books when more than one experiment is performed. The content is one of the most significant aspects in reading comprehension. In this study, the stories were developed by selecting from among the content preferences of children with ASD. Although popular contents were used for children during the baseline phase like other phases, it was determined that pencil and paper works were not preferred. Furthermore, it was discovered that when students began at the most basic level of reading comprehension, their motivation increased when they could answer the questions, and this situation increased the on-task processes and positively affected the comprehension success.

Key Words: autism spectrum disorder, assistive technologies, reading comprehension

1. Introduction

There is an increasing need for technology to demonstrate appropriate behaviors and to support and reinforce the teaching of academic skills (Southall, 2013). In addition, it is stated that students with Autism Spectrum Disorder (ASD) are sometimes able to learn skills faster when using mobile devices and usually prefer to use such devices (Ayres, Mechling and Sansosti, 2013). It is of the utmost importance that the instruction received in the classroom be adapted to meet the special requirements of each kid. The vast majority of students, even those who have been diagnosed with autism spectrum

disorder (ASD), benefit academically from participating in direct instruction, which is connected with improved academic achievement. The instruction might take place in a small group or one-on-one, and the process could involve the instructor leading the lesson, active student engagement, appropriate and positive teacher feedback, and tracking the progress of student performance over time. Direct instruction is a type of teaching that involves giving pupils precise and explicit feedback on their performance and employing methods of positive reinforcement for characteristics such as attentiveness and the accuracy of their responses. Direct instruction teachers provide their students with specific and explicit feedback on their performance (Kuo, 2023).

In addition to direct instruction, Agrawal (2013) suggests that classroom instructors make use of tablet computers like iPads, as well as manipulatives wherever it is feasible to do so. As a direct consequence of this, the utilization of tablet computers and iPads is rapidly expanding within educational settings. According to Vargo (2013), the utilization of tablet PCs in the classroom can be beneficial for both the enhancement of teaching and the management of student conduct. Tablet PCs, according to another of Vargo's arguments, are effective in helping students stay focused on their work and finish assignments. Students can achieve fluency in the skill and explain that they give a higher number of correct responses when using tablet PCs because they allow for more exercises and repetitions. In addition, students can explain that using tablet PCs allows them to gain fluency in the skill. This cycle of practice and intervention helps to develop the fluency in one-on-one structuring that teachers are frequently unable to deliver, especially in an environment that is inclusive or mainstream. This is because the cycle of practice and intervention builds on the previous cycle. According to Narkon, Wells, and Segal (2011), students with autism spectrum disorder (ASD) prefer to read using a computer, which is analogous to using a graphical editor. Furthermore, these students appear to be more engaged with reading instruction when it is delivered via a computer. In addition, it has been found that students achieve achievement in a shorter amount of time when they are taught using a computer-based or computer-assisted method rather than when they are taught only by a teacher. This is the case regardless of the method of instruction. These researchers have shown that using the E-Word Wall program as a visual reference for words during reading instruction yields positive outcomes. This application enables multi-sensory interaction for students because it incorporates components that are visual, audio, and kinesthetic in nature.

A growing number of schools are looking to technology as a means of assisting children with autism spectrum disorder (ASD) in developing their communication and socialization abilities. There are a number of studies that use various pieces of technology to carry out communication interventions, such as (Cafiero, 2012). These pieces of technology include tablet PCs, desktop computers, iPads, and smart boards. Picture Exchange Communication System (PECS) or other forms of educational video games (e.g. In a similar fashion, technological tools like social storytelling, video modeling, and virtual learning environments (e.g. Schmidt, 2014) are used to aid individuals in the process of developing their social skills. Even though there are a large number of empirical publications that discuss the use of technology in communication and social areas for students with autism spectrum disorder (ASD), there is significantly less evidence that discusses the use of technology to improve the academic skills of students with ASD.

1.1. Reading Comprehension Skills

Although there are different performances in academic skills in students with ASD, reading comprehension is generally seen as a common problem involving many students with ASD (Jones, et al., 2009). In particular, it has been found that reading comprehension deficits are common in many

students with ASD (Brown, Oram-Cardy, & Johnson, 2013; Nation, Clarke, Wright, & Williams, 2006; Roux, Dion, & Barrette, 2015). Various explanatory interventions are proposed to explain the reading. Among these interventions, there are also applications in which technology is involved. The basic feature and area of deficiency of ASD includes limited behavioral patterns, limited interests and activities (American Psychiatric Association, 2013). Restricted interest is defined as "highly restricted, fixed interests that are abnormal in intensity or focus" (American Psychiatric Association, 2013, p50). It is generally thought that restricted interests affect social interactions and academic learning in ASD. However, students' limited interests can also be used strategically in teaching activities (Marshall and Myers, 2021). It may be a tactic that has been used for many years to include the limited interests of students with ASD in the intervention strategy (Charlop-Christy and Haymes, 1996).

1.2. Technology for educational abilities

The perception is that computer-based methods are an effective means of enhancing visual word recognition (Miller, 2013). Students with ASD can link the meanings of words with the accompanying images thanks to the benefits of the education provided in PowerPoint format, which stand out in a distinctive way. According to Miller, explaining their relationships is successful with both basic (visual picture) and complex (visual image and word) examples, but complex examples boost output. It has been determined that the teaching process is more effective since it requires less instruction because sophisticated examples produce almost the same result with fewer attempts. Similar to this, Yaw et al. (2011) found that after a computer-based intervention was introduced, reading fluency acquisition made quick progress. With the use of iPads, students with ASD have also succeeded in developing mathematical computation fluency. According to O'Malley et al. (2013), pupils performed much better when completing problem sets on iPads as opposed to the standard circumstance. Additionally, studies show that when students use iPads in math lessons, their attention and participation levels rise. The findings of O'Malley et al. (2013), incorporating technology into the curriculum is critical to achieving success. They underlined that educators require technology to fulfill both their own needs and the requirements of their students. A related study conducted by O'Malley, Lewis, Donehower, and Stone (2014) found that the use of an iPad in the classroom for the purpose of teaching mathematics led to a reduction in the number of instructions that teachers required to give in order to motivate students to engage in and complete projects. iPads are able to be added to the list of students participating in each and every classroom instruction, as stated by O'Malley et al. (2014). It has been established that not every child in the class needs to learn how to use iPads for the therapies to be effective. Rather, children who exhibited a need for them were able to do so with very little additional instruction when they were given the opportunity to do so. The researchers made note of the fact that technical help and effective iPad use require meticulous planning, which indicates that professional development or some other training is required prior to the implementation of iPads during training.

The existing body of research produces results that are in conflict with one another. The research on assistive technologies for children with autism spectrum disorder has produced mixed results, despite the fact that mobile devices and visually engaging media formats offer possibilities for students with ASD. For instance, Grynszpan, Weiss, Perez-Diaz, and Gal (2014) contend that a potential drawback in the research is the limited size of the samples that were used. In light of the contradictory findings of Knight, McKissick, and Saunders (2013), teachers are advised to proceed with extreme caution when using technology-based therapies with students who have ASD. According to the researchers, only four of the twenty-five single-subject research studies were even marginally effective for completing evidence-based instruction, while group-based experimental designs were of poor quality and ineffective. However, when using technology-based interventions, they are required to reveal their impressions of overall progress. This is done to ensure that any improvements in student performance

can be attributed to the intervention and not to evidence-based teaching in general. Similarly, Ploog, Scharf, Nelson, and Brooks (2012) found that therapies using computer-aided technologies to improve social and communication skills in children with ASD were not more effective than programs without using computer-aided technologies. This was the conclusion reached by the researchers after comparing the two types of interventions. The vast majority of assistive technology designed for students with special needs is not designed particularly to cater to the one-of-a-kind requirements of individuals who have autism spectrum disorder (ASD). According to Arthanat, Curtin, and Knotak (2013), there is no one technology that can be prioritized above another in order to improve academic performance for children who are dealing with developmental challenges. Their research indicates that kids with developmental impairments who use iPads do not outperform traditional desktop PCs in terms of academic performance. The purpose of this study was to evaluate the effect that using technology has on the reading comprehension skills of kids diagnosed with mild ASD.

The aim of this study is to reveal the effect of assistive technology (AT) applications successfully used in educational environments for first-grade students with ASD on the reading comprehension (level-1) ability of integration students who have a moderate form of ASD, primarily by using iPads-tablet personal computers.

2. Method

2.1. Research Design and Participants

In the research, one of the single-subject research methods, the multi-subject polling model with an experimental Decontrol was used. Because the designs are experimental, they allow exploration for functional relationships between an independent variable and a dependent variable, something the diary studies or case studies do not allow. These experimental designs add a sophisticated methodology for establishing sources of control over variability in a behavior, the goal of treatment and of many scientific endeavors. In experimental studies treatment is introduced while other variables are held constant, thus allowing isolation of the treatment in order to determine if it is responsible for changing the behavior. Single subject experimental designs, then, provide a strategy for gathering empirical data on the effects of clinical interventions (Byiers, Reichle, & Symons, 2012). The dependent variable of this research is the ability of individuals to understand reading, and the independent variable is ipad-mediated teaching, which is one of the assistive technology tools.

During the course of the study, one of the single-subject research methods included. Because of the experimental nature of the designs, it is possible to investigate the functional linkages that exist between an independent variable and a dependent variable. This is something that cannot be done within the confines of diary studies or case studies. These experimental designs add a complex approach to the process of generating sources of control over variability in a behavior, which is the goal of treatment as well as the objective of many scientific activities. In experimental studies, a treatment is implemented while other variables are maintained at the same level. This enables the treatment to be isolated, which enables researchers to establish whether or not the therapy is responsible for a change in behavior. According to Byiers, Reichle, and Symons (2012), single subject experimental designs offer a method for collecting empirical evidence on the impact of treatment interventions. The capacity of individuals to comprehend what they are reading serves as the dependent variable of this study, while ipad-mediated instruction, which is one of the different types of assistive technology aids, serves as the independent variable.

2.2. Participants

Male students who are attending the first grade and have an intermediate level ASD were determined as participants. All three students are reading by swinging. The reading speed is 1 according to the norm

study. it is slightly below the reading level of the classroom. Normal level: 45.30 dur (Erden, Kurdoglu, & Uslu, 2002). The reading fluency data of the students vary between 35-40 Dec. The percentages of correct readings are between 96-99%. However, in their reading comprehension skills, they can answer an average of 1 out of 10 questions.

2.3. Creation of educational material

The stories used in the training are written in such a way that they consist of 40-45 words. Only the stories in the generalization phase were written longer, with a content of 46-55 words. The story difficulty level is 1. it is determined in accordance with the grade level. In order to determine the appropriateness of the story level, the support of two classroom teachers with more than ten years of experience in the field was used. According to the feedback given by the classroom teachers, the stories have been revised and created. In addition, when creating story contents, the list of subject options taken from the students was adhered to and thus the subjects preferred by the students were included in the stories. The stories written on the Word document were written in 12 pt and Alphabet91 font with 1 line spacing and then translated into a PDF document (Adobe Acrobat DC) and uploaded to the tablet.

2.4. Data Collection Tools

The level of initiation, the ability to understand reading data in the healing, generalization and continuity sessions were collected using the data registration form. When preparing the form, first of all, the reading comprehension ability was analyzed based on the correct answers given to the reading comprehension questions. Ability to understand reading The data registration form consists of two parts. In the first section, identification information; student name, surname, date, practitioner's name-surname are included. In the second section, there are two columns. These are; the story number and the percentage of correct answers given to the related comprehension questions. This prepared form was used in the initiation level, healing, generalization and continuity sessions.

2.5. Application Process

The application of the research was carried out by a special education teacher graduated from the undergraduate program of the Department of Special Education. In the application of the multi-survey model between the participants as a research model, firstly, the data were collected in order to decipher the performance of the participants regarding their reading comprehension skills. In order to collect the initiation level data, a data registration form was prepared for each student, the data were collected in individual sessions and recorded in the relevant section. While the baseline phase data was taken by the practitioner, the related stories were presented in the form of a pen and paper study and the data were collected. In the application, generalization and continuity data, the ipad-mediated application was used. The participant opens the story and reads it himself. The teacher shows the questions about the story on the ipad. The reading comprehension data of the participant were performed through multiple choice questions. Each stage that the participant did correctly was marked with a + sign on the data registration form and the continue directive was presented. When he could not, there was no sign. For the first student, the data were collected until stable data were obtained Decently for three consecutive sessions at the initiation level. When the initiation level data for the first student started to be collected, one session polling data was taken for the other two students. When 80% of the data obtained in the study were within the December of acceptability, the initiation level data were considered stable. When teaching started with the first student, repeat polling data was collected for the other two students, and when the first student provided data that met the 80% criterion, start-up level data was started to be collected with the second student, and repeat polling data was taken with the third student. When the data meeting the criterion of 80% and above were reached in the teaching sessions with the second student, continuity was taken in the first student, and the initiation level data were started to be collected

in the third student. The teaching sessions were carried out in the form of one-on-one teaching arrangement in the classroom where the research was conducted. After the third student obtained three stable data of 80% and above, the teaching was terminated.

2.6. Treatment Fidelity and Reliability

Two types of reliability data were collected in the study. They are: 1. Inter-observer reliability data and 2. It is the application reliability data.

1) Inter-observer reliability

In applied research, it is critical to collect measurements of interobserver agreement on the dependent and independent variables in addition to regularly describing and quantifying behavior during an experiment. That is, agreement between observers about crucial occurrences in an experiment must be examined. In single-subject designs, intervention research relies heavily on observational data or direct observation of behavior by human observers (McReynolds & Thompson, 1986).

Inter-observer reliability is the comparison of the assessments of two independent observers decoupling from each other but simultaneously whether the target behavior is occurring. In single-subject studies, it is expected that the reliability between observers is at least 80%. The inter-observer reliability data of the research were collected by a doctoral degree Decedent lecturer who works in the Department of Special Education at a private university and has knowledge about the assistive technologies method. It was collected in 30% of all sessions. The reliability data between the observers was calculated as 98%.

1) Application Reliability

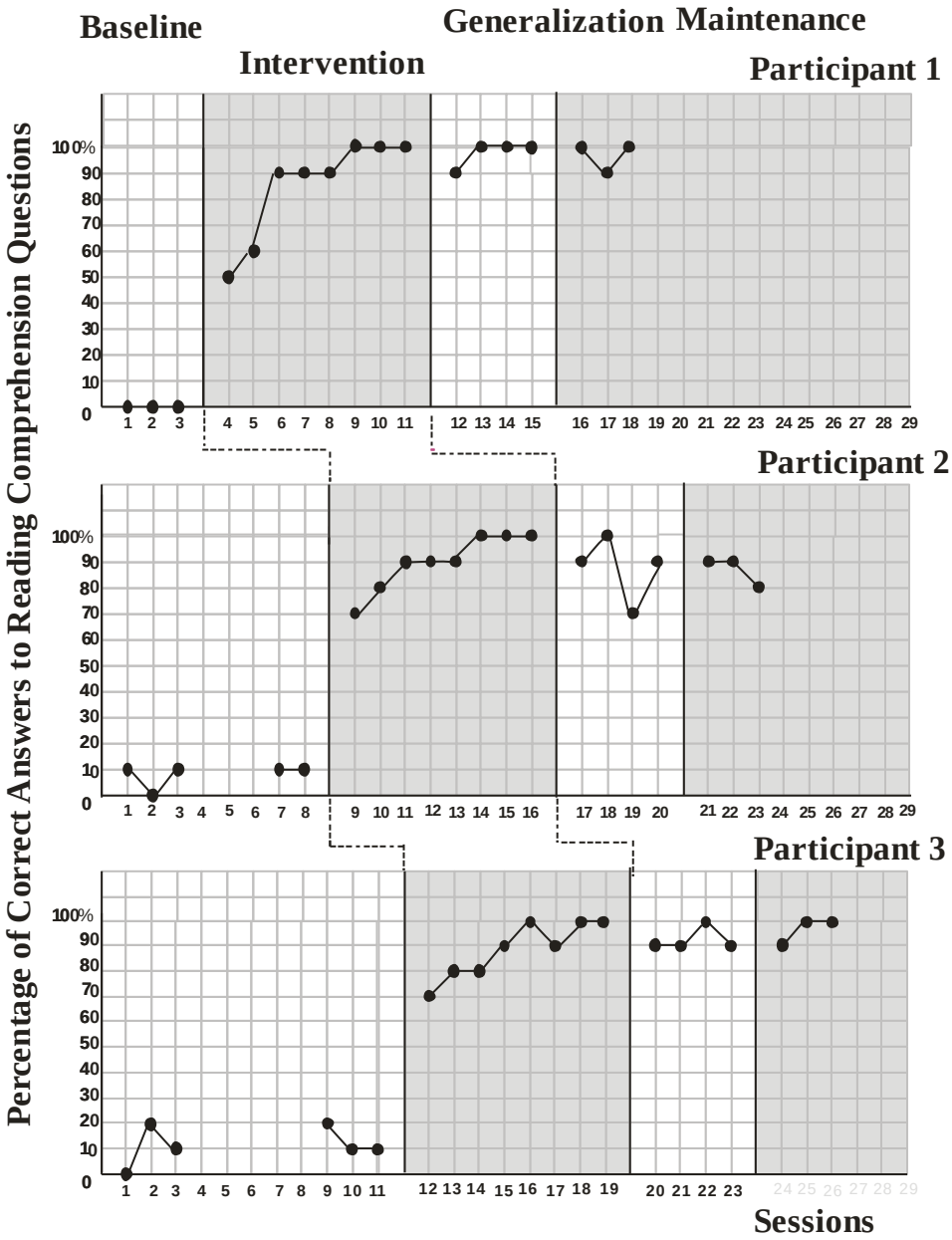
Application reliability is to determine the extent to which the application performed by the implementer complies with the prepared application plan. The application reliability data were calculated using the formula “Observed implementer behavior / Planned implementer behavior X 100" (Byiers, Reichle, & Symons, 2012). In the research, it is considered appropriate to collect application data in at least 30% of the application sessions. The application reliability has been calculated as 95%.

2.7. Analysis of the Data

In this research, the data were analyzed graphically. The level of initiation of the participants, the number of correct responses on the data registration forms at the end of the polling trials, teaching sessions, generalization and continuity sessions, that is, the number of + signs, were converted into percentiles and recorded on the graph.

3. Results

The findings related to the effectiveness of teaching auxiliary technologies in teaching reading comprehension skills to individuals with autism spectrum disorder are included in participant 1. In the horizontal axis shows the number of sessions and the vertical axis shows the percentages of correct responses of the participants in the evaluation sessions. The obtained data were examined in four stages: baseline phase, intervention, generalization and maintenance phases. The maintenance data are based on the reactions of the participants in the maintenance phase held one, three and four weeks after the end of the training, while the reactions of the participants in the end-of-training evaluation sessions are continued. The values at the end of the training and the maintenance phase have significantly differed with the baseline phase data for all three of the participants.



Graph 1. For participant 1 and participant 2 and participant 3, the starting level, generalization and continuity sessions for the effectiveness of teaching with auxiliary technologies in the teaching of reading comprehension skills, the correct response percentages were shown. Findings for teaching with auxiliary technologies in the teaching of reading comprehension skills

Participant 1 findings on reading comprehension skills with assistive technologies

The level of initiation for teaching reading comprehension skills with assistive technologies, the percentages of correct behavior shown by Participant 1 in generalization and continuity sessions are shown in the graph. The average at the starting level is zero and has reached % 100in teaching. A total of 8 teaching sessions were organized for Participant 1.

Participant 2 findings on reading comprehension skills with assistive technologies

The percentage of correct behavior shown by Participant 2 in the initiation level, generalization and continuity sessions for Participant 2's reading comprehension skills, which are taught with assistive technologies, is shown in the graph. The average at the starting level is %8. At the end of the training, this number has reached %100. A total of 8 teaching sessions were organized for participant 2.

Participant 3 findings on reading comprehension skills with assistive technologies
The percentages of correct behavior shown by Participant 3 in the initiation level, generalization and continuity sessions for the reading comprehension ability taught by auxiliary technologies are shown in the Participant 3 graph. The average at the initiation level is %11.7. After teaching, reading comprehension has reached %100. A total of 8 teaching sessions were organized for 3 participants.
As a result of the teaching sessions conducted by participant 1, 2, 3, it was obtained that all three participants realized their reading comprehension skills using assistive technologies.

4. Discussion and Conclusions

Reading comprehension is an essential skill that ought to be developed in children at a young age and should be a focus of instruction. It is essential to have a command of the language in order to engage in communicative interactions, regardless of whether those encounters take place through written or verbal speaking. Even though people with ASD typically have a delay in the development of their language skills, it has been discovered that exposure to written text can actually help individuals acquire language skills more quickly. This is the case even though people with ASD typically have a delay in the development of their language skills. For example, printed material is both visually appealing and "permanent" in the sense that readers can return to major portions of the text and reread it in order to develop meaning and fill in gaps in their grasp of the content. Memory-impaired people are at a greater risk of easily losing track of a speaker's narrative since they do not have the choice to go back to earlier statements like readers do. This increases the likelihood that they will become confused and lose their place in the story. It is only logical to say that written text is particularly significant for these people due to the fact that written material is permanent. This is because written text can never be changed. According to Losch and Capps (2003), people who have autism have a particularly difficult difficulty providing acceptable referents for their audience while they are telling stories. Autism makes it difficult for a person to understand what another person is thinking, which is why this is the case. However, when presented with written text, individuals with ASD can be prodded or reminded to read for meaning, to locate antecedent events that caused subsequent events, to generate questions and read in order to find the answers, to reread in order to repair understanding, to locate referents, and so on. This can be done through a variety of methods, including prompting, reminding, and prodding. There are many different approaches that might be taken to achieve this goal. The findings of these few studies on "read for meaning" are positive, including the use of computer-assisted education in the process of instructing children who have ASDs (Chiang, & Lin, 2007). In addition, according to the findings of the research conducted by Shapley, Sheehan, Maloney, and Caranikas–Walker (2010), it is believed that it is necessary to collect data by taking into consideration professional development, application loyalty, clear expectations, and monitoring the use of devices in order to guarantee the quality of presentation in technologically supported interventions.

In this study, it was found that all participants exhibited appropriate behaviors in keeping on task and completing tasks during the reading comprehension studies process. It has been determined that students with ASD have higher performance when using iPad when repeated measures were collected. Finding the answers to the multiple-choice questions and answering the reading comprehension questions this way gave the impression that it could be considered as the first step in the acquisition of reading comprehension skills, even though the answers were not completely reconstructed by the child with ASD. This gave the impression that using technology and multiple chose questions could be considered as a motivation-enhancing and learning-supporting step in the acquisition of reading comprehension skills.

Given the wide variety of strengths and weaknesses displayed by people with ASD, it is reasonable to anticipate that parents and educators will look to researchers to provide a wide range of interventions to address individual needs. This is because of the enormous array of strengths and weaknesses displayed by people with ASD. It is reasonable to predict that parents and educators will seek to researchers to provide a wide range of interventions to address individual needs given the vast range of strengths and

weaknesses demonstrated by persons who have ASD. This is due to the fact that individuals with ASD exhibit a wide range of both strengths and shortcomings.

5. Limitations

This study, had a number of limitations that should be addressed by future researchers. To begin, a multiple-probe design was employed across. This study's sample size was limited to three first-grade students. Future research should replicate these findings with children that have ASD and among varied disabilities in order to generalize the study's conclusions. Second, only a single special education teacher performs the implementation to determine the reading comprehension level of the participants. Third, this study did not assess the reading performance of all participants in terms of word recognition, word reading accuracy, and reading fluency. Future research should repeat the study using reading performance measurements additional to reading comprehension. Future studies should look into the effects of using delayed maintenance probes. Future research should be conducted to determine whether such an intervention is equally effective in small-group or whole-class settings. Additionally, all texts in this study were narrative type and expository text passages can be used for detecting efficiency of technologic devises versus pen and pencil style. Future study should focus on generalization inquiries that identify whether or not participants can apply their performance skills in other settings or real-world classrooms.

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