Digital Visual Support for Pre-School Students with Autism: Challenges and Supporting Tools

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Abstract
Every year, more students are being diagnosed with autism spectrum disorder. The key purpose of this article is to focus on the challenges surrounding digital visual support and the support tools utilised in the classroom for preschool students with autism. Various tools have been introduced to improve academic and non-academic skills in students with autism. However, the interventions are focused on older students with autism and the emphasis is on academic skills, making it challenging to implement digital visual support. It would be beneficial to have supporting tools for numerous visual support applications that are made accessible locally and globally, with an emphasis on pre-schoolers with autism. In this article, suggestions are made to advance and change the paradigm in education research for students with autism. This research hopes to enhance interventions for students with autism and offer valuable insights to special education teachers, parents, and other stakeholders, thereby fostering positive outcomes in the future.
Keywords: Autism, Challenges, Digital Visual Support, Intervention, Preschool Students, Technology

Introduction
Globally, autism spectrum disorder is a very common diagnosis. In 2020, it was predicted that one in 36 children aged eight had autism spectrum disorder (about four percent of boys and one percent of girls) (Maenner et al., 2020). In the year 2018, this figure was one in 44. Similarly, around 9000 children with autism spectrum disorder are born in Malaysia each year (The National Autism Society of Malaysia, 2023). These statistics have caused great concern about the rising number of students with autism spectrum disorder globally.
The term "autism spectrum disorder" is commonly known to present itself through different levels of social behaviour, communication, ritual, and stereotype inadequacies (Zulkefli & Mat Rabi, 2023). Therefore, schools should be more proactive in adopting suitable educational strategies to educate students with autism. There is a considerable amount of literature on using picture exchange communication system strategies, tablet-based educational

applications, and visual support (Almaki, 2023; Barczak, 2020; Omar et al., 2020). In addition, when instructing students with autism in a classroom context, conventional and technological application tactics are employed sparingly. It has been recommended that more training and resources are needed for teachers who work with autism in special education schools (Yazici & McKenzie, 2019). A critical open question is whether the strategies introduced are deemed effective or not.

A parallel strategy on the use of visual support will not only help educate students with autism spectrum disorder but also be seen as a fun and engaging tool if introduced at the pre-school level. Pre-school levels vary according to continent. For example, in Western countries, preschool starts as early as 3 years 3 months to 5 years 10 months; whereas in Asian countries, preschool starts at a later age, at least from 3 years 8 months to 4 years 3 months (Lee & Lee, 2015; Wicks et al., 2020). Visual support includes movies, labels, maps, object cues, written words, the layout of the surroundings, schedules, timelines, scripts, photographs, and words that help students understand what is being said and what is required of them (Barczak, 2023; Caceres, 2020; Guseva, 2020; Solano, 2020). As students with autism spectrum disorder are known to be visual learners, questions have been raised as to whether introducing technology into visual support could bring about improvements in classroom activities. This area of study is still underexplored.

Studies involving autistic people are more prominent in medical settings. These studies have explored the significance of improving the outreach of medical facilities for autistic patients (Caceres, 2020; Gallagher, 2019; Ong et al., 2022). However, research in the academic setting has mainly focused on older adults and university students (Barczak, 2023; Halif et al., 2020; Ong et al., 2022; Pérez-Fuster et al., 2017; Rutherford et al., 2020; Rutherford et al., 2023). Few studies have explored the use of visual support for students with autism in a classroom setting. Although there are many studies on autism spectrum disorder, research on the use of digital visual support in an educational setting remains limited. Hence, digital visual support needs to be explored as a supportive strategy for students with autism. This study was conducted based on the following research questions:

1. What are the challenges of introducing digital visual support to preschool students with autism?
2. What are the available tools for digital visual support among preschool students with autism?

The findings of this study will benefit preschool students with autism and serve as a baseline for training special education teachers. By addressing the issues of challenges and current support available when introducing digital visual support, this study will give special education students and teachers insights into adopting a technology-savvy approach to their teaching and learning in the classroom setting. Instead of conventional visual support, teachers are expected to be more optimistic about using technology with students with autism. Other stakeholders, such as teacher administrators and teacher assistants, should also be supportive of the new method of teaching and learning in the classroom. A joint effort among the teachers, school staff, and administrators will shift special education to a new level of efficacy.

Digital Visual Support In Classroom
Technology can be utilised in a variety of ways to provide visual support for students with autism spectrum disorder. Visual support includes diagrams, pictures, or objects (such as

timers) that are included in the physical environment to communicate information about the expected progression or steps in an activity (Wong et al., 2015). Recently, technology has been incorporated into visual support tools, giving rise to digital visual support. Previous research has introduced digital games to support pre-schoolers with autism spectrum disorder in improving their academic skills (Elimelech & Aram, 2019). Digital storytelling is another method that encourages the sharing of opinions and experiences in a visual-video form that is approachable and inclusive (Parsons et al., 2023). In pre-schoolers with autism spectrum disorder, visual-video scenes, which illustrate the use of visuals, have a positive impact on their participation in communication opportunities (Chapin et al., 2022). Although this study is at an early stage, it is widely accepted compared to the conventional way of doing research.

Globally, other skills are also emphasised in digital visual support tools, such as turn-taking behaviours among pre-schoolers with mild autism spectrum disorder, shared book reading with digital storybooks, museum visits with parents with autistic children, and visual cues with light-emitting diodes for students with autism who have difficulty completing daily living tasks (Costa et al., 2022; Huang et al., 2022; Wicks et al., 2020; Varriale et al., 2023). Thus, the skills are catered to concentrate on not only non-academic and functional abilities but also on academic and functional skills.

In the Malaysian context, children with autism are taught a range of skills via tablet applications, including numeracy, management, daily living, and communication skills (Ahmad & Zulkharnain, 2020; Kamaruzaman, 2016; Omar et al., 2020; Rani et al., 2016). There are some similarities between the global and local scopes; however, students with autism will benefit more from a school environment. Very little intervention has been introduced, and findings have reported that 58% of teachers indicated the need for extra supporting strategies involving the use of technology in educating students with autism spectrum disorder (Yazici & McKenzie, 2019). There is still a lack of research on living skills to assist in independence among pre-schoolers with autism spectrum disorder.

Challenges Of Using Digital Visual Support In Classroom

Students with autism spectrum disorder face various challenges in the classroom setting. For example, in Turkish special education schools for mild autism spectrum disorder, there are three main challenges: (1) the challenge of heterogeneity among students in these classrooms (emotional, social, and academic); (2) exclusion and labelling; and (3) identity confusion (Zakai–Mashiach, 2023). In special education classrooms, overuse of visuals in the picture exchange communication system may lead to problems in the social lives of students with autism spectrum disorder (Yazici & McKenzie, 2019). An inconsistent finding from a previous study stated that students with autism spectrum disorder are assisted in developing their social communication skills using handcrafted visuals like the Picture Exchange Communication System (PECS) (Hussin et al., 2008). Although further research on conventional visual tools has been proposed, suitable solutions must be identified to help with better visual support in the classroom.

Teachers' perceptions of the Autism Aid application use in classrooms with young children with autism have led to conflicting opinions on the use of tablets for teaching (Omar et al., 2020). Furthermore, while new teachers are skeptical of using technology to teach, experienced teachers are the ones who encourage it. Compared to word-for-word options, the picture-to-word strategy produced higher scores on exercises in the classroom. This suggests that students with special needs such as autism learn best visually (Jose et al., 2017).

The challenge is that when the teachers are not ready to accept a change in the strategies used, it is difficult to implement the use of new strategies such as digital visual support.

Apart from difficulties in changing the mindsets of teachers, another problem that has arisen is the use of robotics and artificial intelligence in visual programming for older students with autism spectrum disorder (Hughes et al., 2022). A major drawback in a previous study is that the strategy introduced was ineffective when the student with autism covered their face or moved away from the tablet (Ali & Hughes, 2020). For situations like solving an arbitrary arithmetic issue that the learner is having trouble with, the learner is not yet ready to approach it using artificial intelligence. Thus, technology can be useful, but only to a certain extent. Instead of relying exclusively on technology, the integration of teachers and technology is a more helpful approach.

In European school settings, when selecting the day of the week, morning tasks are visualised: use the restroom, brush teeth, get dressed, eat breakfast, make the bed, put on shoes and a jacket, pack a lunch, and head to school (Muchagata & Ferreira, 2019). This audio-visual application is customised and used during school days. The Portuguese visual schedule smartphone software helps students with autism spectrum disorder perform their daily tasks; however, language barriers make it difficult for teachers to use these digital visual supports effectively because most applications are only readily available in English (Muchagata & Ferreira, 2019). Additionally, religious factors and a failure to use mobile applications as a platform to teach kids with autism spectrum disorder are two more specific cases with limited findings (Zamry et al., 2022). Given the advantages of digital applications and visuals, it is somewhat surprising that many factors remain unexplored. Table 1 depicts a summary of challenges related to the use of digital visual support.

Table 1

A Summary of The Challenges Affecting The use of Digital Visual Support In Students with Autism

Sources	Summary of the findings
Zakai–Mashiach (2023)	There are three primary barriers: 1) the difficulty of emotional, social, and intellectual variability among students in these settings; 2) exclusion and labelling; and 3) identity confusion.
Yazici & McKenzie (2019)	Teachers prioritise other primary tactics above digital technology, which is just a supplement.
Omar et al. (2020)	There are divergent views among teachers on the usage of tablets to educate pupils with autism spectrum disorder.
Hughes et al. (2022)	Another issue is when the visual programming that employs robotics and artificial intelligence is used for older kids with autism spectrum disorder.
Ali & Hughes (2020)	The approach used in this research was unsuccessful when the students with autism covered their faces or looked away from the tablet, which is a significant drawback.
Muchagata & Ferreira (2019)	Students with autism spectrum disorders may complete daily work with the use of the Portuguese visual schedule smartphone app. Since most programmes are only easily accessible in English, it might be challenging for teachers to employ these digital visual supports successfully.
Zamry et al. (2022)	The use of mobile apps as a platform to educate children with autism spectrum disorder in a religious environment and without success are two additional situations with little evidence.

Supporting Tools For Managing The Use of Digital Visual Support In The Classroom

In digital visual applications for autism, the main components that require attention are the text, images, and sounds. The guidelines for tools intended for students with autism spectrum disorder suggest a simple visual and textual language on the text element, image magnification for enhanced visualisation of the images, and distinctive audio and visual effects (Muchagata & Ferreira, 2019). Previous studies on digital stories using video guides and visuals have shown that they easily capture what cannot be conveyed in words (Parsons et al., 2023). Therefore, it is suggested that having digital visual support in the classroom will benefit the school community, teachers, and students with autism spectrum disorder.

To support teaching and learning in the classroom, "Smiley," a schedule application, was created (Niwa et al., 2014). This application enables students with autism spectrum disorder to complete tasks without the need for parental or teacher guidance. In Japan, "Smiley" is already being used as the foundation for schedule applications in many special education schools. Other older applications are "vSked" and "PECS," which allow teachers to manage their classroom activity on an interactive visual schedule and move images around by touching a mobile screen (Hayes et al., 2010; Song et al., 2010). Recent applications, such as "Pictotempo," refine and define more appropriate routines or support therapies for children with autism spectrum disorder (Vila-Muñoz et al., 2021). It is interesting to see how the innovative use of these applications may benefit students with autism spectrum disorders and help them efficiently achieve their goals.

There are two modules in "Pictotempo", one for the student and one for the teacher. The function of the teacher's module is adapted to simplify the main actions, such as creating tasks and routines, managing users, and obtaining and analysing statistical results. The student's module features an application that is set up to display the user's current task or activity based on the current date and time. These studies have proven that the transition of visual support and technology to involve teachers and students is very promising for future work in this field. The use of digital visual support in classrooms requires tools or applications that compensate for the use of text, images, and sound for learning among autistic students, as previous studies have highlighted (see Table 2).

Table 2:
Summary of findings on the use of digital visual tools to support students with autism in the classroom

Sources	Summary of the findings
Muchagata & Ferreira (2019)	The requirements for students with autism spectrum condition include basic visual and textual language on the text element, picture magnification for better visualising the images, and unique audio and visual effects.
Parsons et al. (2023)	Digital tales can effectively communicate ideas that cannot be expressed in words by employing video guidance and pictures.
Niwa et al. (2014)	"Smiley," a scheduling application, was developed to assist students with autism spectrum disorders in performing activities independently, without the help of their parents or teachers.
Hayes et al. (2010) Song et al. (2010)	Older programmes like "vSked" and "PECS" allow teachers to manage their classroom activities on an interactive visual timetable and move the graphics around by touching the mobile screen.
Vila-Muñoz et al. (2021)	More suitable routines or support treatments for kids with autism spectrum conditions are defined and refined by recent programmes like "Pictotempo." There are two modules in "Pictotempo"—one for the teacher and the other for the learner.

Recommendations For Practical Application of Digital Visual Support
The practical application of digital visual support for students with autism has several limitations due to the various stakeholder groups, which include teachers working together in the classroom setting. To address this, several solutions are suggested for a better teaching and learning environment (Table 3).

Table 3

Limitations of Digital Visual Support at The Preschool Stage and Recommendations For Its Practical Application

Limitations	Recommendations
Commonly associated with academic-oriented skills	Associate with daily living skills to encourage independence
Introduced more frequently to older students with autism	Increase exposure to digital support at the pre-school stage
Teachers' lack of readiness to use digital visual support	Receive training from a psychologist and therapist to improve readiness
Conventional visual tools are both resource and time consuming	Acknowledge the benefits of digital use in the classroom

The current application of visual support for preschool students with autism is limited as the focus is on academic skills. Daily living skills can be introduced through virtual means to encourage independence and functional skills among preschool students with autism. Furthermore, it is recommended to introduce the digital visual support intervention at a younger age; at present, schools mostly introduce it to older students with autism. Additionally, teachers lack the knowledge and readiness to introduce the use of digital visual support in their teaching and learning in the classroom. To improve teachers' readiness to accept digital support at the preschool level and impart therapy techniques to the teacher, it could be useful to implement training given by psychologists or therapists. Visual support can be upgraded digitally to reduce the barrier of resources and time spent by teachers making the visual support manually.

Conclusion
The use of digital visual support in students with autism spectrum disorder has both challenges and advantages. To achieve better education strategies in school for students with autism spectrum disorder, a shift in teaching to foster the inclusion of technology is needed. When students are taught the way they learn best, learning will occur without any need for repetition.

The collaboration between parents and teachers also has incredibly important implications. This is to add to the staff and administrators in the school setting being agreeable and working hand in hand towards the same goal of a more skilled student with autism spectrum disorder. Therefore, the skills that can be improved in students with autism spectrum disorder will be significantly impacted as teachers and parents collaborate on visual support.

Acknowledgement

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