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Thematic Article

The Use of Interactive Teaching Aids by Special Education Teachers in Teaching Science to Students With Autism Spectrum Disorder (ASD)

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Abstract

This study explores the use of interactive teaching aids by special education teachers in teaching science to students with autism spectrum disorder (ASD). It identifies effective tools, challenges educators face, and strategies for optimizing their use. Research questions focus on commonly used aids and barriers to implementation, given the need for inclusive and tailored educational approaches. Existing literature underscores the benefits of interactive teaching aids for students with ASD, particularly digital tools like interactive whiteboards, tablets, and digital storytelling. These resources enhance engagement, support visual and kinesthetic learning, and improve social interaction skills. However, challenges persist, including insufficient teacher training, limited access to technology, and the need for individualized adaptations. A qualitative methodology was employed, involving semi-structured interviews with 10 special education teachers. Thematic analysis using NVivo software provided insights into teacher experiences. Findings indicate that interactive teaching aids improve engagement and comprehension but are hindered by resource constraints, technical issues, and variability in student attention. Despite widespread recognition of their benefits, research on the specific application of interactive teaching aids in ASD science education remains limited. The long-term impact on learning retention and tool adaptability across contexts also requires further investigation. This study concludes that interactive teaching aids significantly enhance science education for students with ASD. Addressing barriers through targeted training, better resource allocation, and regular maintenance is crucial. Future research should explore long-term effects and optimize strategies for integrating these tools in diverse educational settings.

Keywords: interactive teaching aids; special education; science education; autism spectrum disorder

Introduction

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition characterized by difficulties in social communication and restrictive or repetitive behaviors (Hodis et al., 2025). These manifestations vary widely among individuals but can significantly impact cognitive and social development. Science education poses unique challenges for students with ASD, as it requires abstract thinking, collaboration, and multi-step problem-solving (Moody et al., 2018). However, traditional teaching methods are often inadequate in meeting the sensory, cognitive, and social needs of these students, leading to barriers in learning and engagement (Al Jaffal, 2022). To address these challenges, interactive teaching aids such as multimedia tools, hands-on demonstrations, and digital applications have gained attention as effective strategies in special education. These tools provide individualized and engaging learning experiences that help students with ASD grasp scientific concepts, even if they struggle with deeper comprehension (Payano, 2024). Moreover, research suggests that interactive teaching strategies enhance learning retention and reduce cognitive overload, which is often a

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challenge for ASD learners in conventional classroom settings (Le Cunff et al., 2025). Hence, by incorporating these methods, educators can create an inclusive learning environment where students with ASD can develop their scientific understanding more effectively.

Despite the potential benefits of interactive teaching aids, their use in science education for students with ASD remains limited. Traditional teaching strategies are often rigid, failing to accommodate the diverse learning needs of ASD students, which can lead to inconsistent educational outcomes (Damyanov, 2024). Furthermore, there is a lack of empirical research identifying the most effective interactive tools for science education in ASD contexts. The need for further exploration into the design, implementation, and impact of these teaching aids in special education is highlighted by this gap. This study was conducted with a focus on teachers who teach Science in Malaysia. The decision to select Malaysian educators as the participants for this study is based on the notable effectiveness of interactive digital learning tools, which have been integrated into the educational system by the Malaysian government, as outlined in the Education Blueprint 2013–2025 (Ministry of Education Malaysia, (2013). The use of qualitative methods in this study is intended to provide the teachers the opportunity to tell stories freely and transparently. Therefore, this study aims to address this research gap by investigating how special education teachers integrate interactive teaching aids into science education for students with ASD. Specifically, it seeks to examine the effectiveness of these tools, identify challenges faced by educators, and propose evidence-based strategies for optimizing their use. The study contributes to the growing body of literature on inclusive education and provides practical insights for teachers and policymakers.

The research focuses on the following questions:

1. What types of interactive teaching aids are most commonly used in science education for students with ASD?
2. What challenges do special education teachers face when implementing these tools in the classroom?

The structure of this paper is as follows: Section 1 presents a detailed literature review on ASD and science education. Section 2 outlines the study's methodology, including participant selection and data collection methods. The results are presented in Section 3, followed by a discussion of their implications in Section 4. Finally, Section 5 provides conclusions and recommendations for educators and policymakers.

Literature Review

Interactive Teaching Aids in Education

Interactive teaching aids are guided tools made to captivate students actively in the learning process using multimedia, technology, or physical objects. These aids can help learning make sense as they engage students with lessons that are more vibrant, tailored to the individual, and digestible for all sorts of learners. Interactive teaching aids include digital tools such as interactive whiteboards, tablets, and educational software; physical aids like manipulatives and flashcards; and experiential aids such as virtual reality (VR) and augmented reality (AR) applications. For instance, general education, interactive whiteboards, tablets and computers are benefits for group discussion and self-paced learning (Guðmundsdóttir et al., 2014). In the current special education class, adaptive technologies such as text-to-speech software, Braille devices and sensory manipulatives address individual needs (Ayantoye, 2023). They can be used flexibly and adapted to different learning styles and levels. Interactive teaching aids keep in touch with students, help them think critically and help them remember the concepts better. For instance, digital aids encourage collaboration and allow real-time feedback, which supports constructivist learning theories (Isik, 2018). Results show that the use of interactive aids in special education improves functional skills and confidence among students with disabilities (García-Carrión et al., 2018). These tools can help close communication gaps for students with language or speech difficulties by providing resources to express and learn concepts (Anis & Khan, 2023). Yet, the use of interactive aids does come with some challenges. The high cost of purchasing and sustaining these types of tools can be prohibitive for educational budgets, especially in under-resourced areas (Global Education Monitoring Report 2023, 2023). Therefore, teachers might need comprehensive training to utilize such aids efficiently. Nevertheless, not every teacher possesses the crucial technical skill set required (Shunkov et al., 2022). Moreover, accessibility and usability remain concerns, especially when tools are not universally designed to accommodate diverse needs, including those of students with disabilities (Choi & Seo, 2024). Lastly, overdependence on technology might result in diminished in-person interaction, potentially stifling the social facets of learning.

Overview of Autism Spectrum Disorder in Education

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that impacts people's ability to engage in social communication as well as leads to restrictive interests and repetitive behaviors. Prevalence rates of ASD have risen sharply in the prior few decades, such that, by 2023, an estimated 1 in 36 children in the USA have an ASD diagnosis (Centers for Disease Control and Prevention, 2022). The broad spectrum of skills and challenges that characterize ASD, on the other hand, require intensely individualized educational approaches. Depending on whether students are high functioning or low functioning, this may translate into learning difficulties in social interaction and sensitivities in social situations, response to stimuli, and communication; and preference for communication mechanisms (Alvares et al., 2020) as well as positive attributes like pattern recognition, narrowing their interest focus, and memory (McDougal et al., 2020). This diversity requires individualized methods of instruction, which may include structured routines, visual supports, and direct teaching of social and adaptive skills. As a result, inclusive education has represented a powerful paradigm for the specific educational needs of students with ASD. Inclusive practices seek to encourage social interactions and peer learning by facilitating participation in general education classrooms. However, inclusion necessitates significant adjustments, including the provision of individualized education programs (IEPs) and cooperation among teachers, therapies, and families (Humphrey & Symes, 2013). Trained teachers are the keys to successful implementations with supports for ASD-specific strategies in the classroom such as Applied Behavior Analysis (ABA) and Social Stories (McDonnell, 2014). Despite these advances, however, challenges remain in developing an understanding of and supporting educational environments for learners with ASD. Discrepancies between teacher preparation and systemic consistency of service provision (Meda et al., 2023). Additional research examples include culturally responsive practices and longer-term effects of educational interventions.

Teaching Science to students with ASD

Students with ASD come with a variety of needs, learning styles, and social communication challenges that make teaching science a uniquely challenging endeavor. The types of problems associated with ASD such as difficulty with abstract concepts, social relationships, and sensory sensitivity are all key components of traditional scientific education (Mallory & Keehn, 2021). Therefore, personalized education approaches are necessary to enhance learning and student engagement. Perhaps one of the biggest problems that science education struggles with is a dependence on theory and abstract knowledge. Research shows that students with ASD may flourish under learning experiences that involve physical, visual, and hands-on activities. However, traditional methods of teaching science can fail to accommodate different tastes and learning styles, which can hamper students' understanding of the material. Furthermore, González & Merino (2016) affirmed that over-reliance on collaborative learning activities is a problem for students with ASD because they lack skills in group dynamics and communication. Basically, there are already approaches based on technology, structured environments, and tailored education to teach science to students with ASD. There is evidence that complex scientific concepts can be efficiently explained through the use of visual aids (Eilam & Gilbert, 2014) such as diagrams and animations. Furthermore, Zhang et al (2022) found that some technologies, such as interactive simulations and virtual reality, were able to improve engagement and conceptual comprehension in students with ASD. Virués-Ortega et al (2017), structured educational technologies including the Treatment and Education of Autistic and Communication Handicapped Children (TEACCH) model, generate conditions that are consistently organised and visually understandable to help improve students' consideration and reduce their stress levels. Encouraging the integration of students special interests into science learning and teaching processes also emerges as a reflective strategy for promoting student motivation and engagement (Hulleman & Harackiewicz, 2009). Creation of peer-assisted and individualised support opportunities focused on equal access for students with ASD (Manjur, 2024).

Theoretical Framework

In education research, various theories or models typically underpin particular research. According to Universal Design for Learning (ULD), the theory of universality is designing learning environments for groups of learners with differences (Setiawan & Qamariah, 2023). For example, the UDL is based on neuroscience and aims to target learning differences by suggesting some choices to be applied in a classroom which will facilitate the learning of all students. This model shifts away from the one-size-fits-all model in favor of a learner-orientated system that reflects the ground principles of inclusive education (Hasan et al., 2023). On the other hand,

behaviourist theory introduced by B.F. Skinner, is based on incentives and responses tied to specific behaviour (Skinner, 1953). In education, it has created reinforcement and operant conditioning practices. For example, positive reinforcement —the provision of reinforcers with the intent of increasing targeted patterns of behaviors or skills— is integral in classroom management programs and in many skills-habituation programs (Rafi et al., 2020).

Although it is sometimes criticized for only paying limited attention to cognitive and affective aspects of learning behaviorism is still the basis for the development of instructing packages with an emphasis on learning faculties. Also, from constructivist theory, it is accepted that learning is not a passive act of receiving knowledge, but rather it is a process that takes place in a specific context and through which knowledge is constructed. This is based on Piaget and Vygotsky philosophies which emphasize collaboration and learning through doing or practical (Rovegno & Dolly, 2006). In fact, the model focuses on the concept of scaffolding on how a student is taught, dependent learning in one level takes them to the next phase, independent learning. In the digital age, Siemens (2007) defined connectivism theory as the multiple elements of the technological world and networks that can be part of the learning process. As a theory, connectivism emphasizes learning through the process of making connections, an idea that fits nicely with various e-learning delivery models. Collectively, these frameworks provide different vantage points on the nature of learning and guidance for teachers on how to design a lesson that is more inclusive, meaningful, and motivating.

Methodology

This section aims to present a thorough overview of the methods that were applied to investigate the use of interactive teaching aids by special education teachers in teaching science to students with ASD. The methodology is designed to gather insights from experienced teachers through qualitative research.

Research Design

The study adopts a qualitative research design to explore the experiences, perceptions, and practices of special education teachers who teach science to students with ASD. Qualitative research allows for an in-depth understanding of how teachers use interactive teaching aids and how these tools impact their teaching methods and student engagement. The study focuses on gathering detailed, descriptive data rather than numerical or statistical analysis, allowing for a deeper exploration of the effectiveness and challenges of these teaching aids in special education settings.

Participants

The study will involve 10 special education teachers who teach science to students with autism spectrum disorder (ASD). These teachers must meet the following criteria: (1) must have been teaching science to students with ASD and (2) teaching science to students with ASD for more than 5 years. All participants have experience incorporating interactive teaching aids into their lessons. This ensures that the study focuses on teachers who are familiar with the use of these tools in their educational practices. The selection of these participants will be based on purposive sampling, as the focus is on experienced teachers who can provide rich, relevant data related to the research questions.

Data Collection Tools

This study's main method of gathering data is semi-structured interviews. Participants in interviews obtain the opportunity to express their individual experiences, perspectives, and ideas about the application of interactive teaching tools in science instruction to students with ASD.

Procedure

Teachers fulfilling the inclusion requirements will be contacted through the WhatsApps application or via email. Semi-structured interviews were conducted with each participant using the Zoom application. The interviews were audio-recorded with the participants' consent and lasted about 30-45 minutes. Open-ended questions were developed to examine the types of interactive teaching aids used in science lessons, and challenges they encounter when using these aids and recommendations enhance the effectiveness of interactive teaching aids. All interview recordings were transcribed verbatim. The transcripts were then analyzed using the Nvivo software to identify patterns and themes related to the use of interactive teaching aids.

Ethical Considerations

Prior to their participation in this interview, the teachers were provided with comprehensive information regarding the purpose of the study, the procedures to be followed, and their rights as participants. Consequently, teachers are obliged to sign a consent form to confirm their comprehension and willingness to participate in this study on a voluntary basis. The researchers also informed the teachers that their confidentiality as study participants will be maintained throughout the study. Teachers' identities will be anonymised, and any identifying details will be removed from the data to ensure privacy. Interview recordings were securely stored and only accessible to the researcher. Participants have been notified that they may withdraw from the study at any moment without penalty.

Results and Findings

The research data was obtained through interviews that were conducted with 10 study participants who are Special Education teachers who teach Science subjects in several schools in Malaysia. The following is a table (Table 1) of the demographic findings of the study participants:

Table 1. Participants Demographic Data

Participants	Gender	Age	Qualification Background	Teaching Science Experience	Type of School
Teacher 1	Male	37	Bachelor's Degree	12 years	Inclusive School
Teacher 2	Female	38	Master's Degree	13 years	Inclusive School
Teacher 3	Female	41	Bachelor's Degree	17 years	Special Needs School
Teacher 4	Female	47	Bachelor's Degree	21 years	Inclusive School
Teacher 5	Female	37	Bachelor's Degree	10 years	Inclusive School
Teacher 6	Female	39	Bachelor's Degree	13 years	Inclusive School
Teacher 7	Female	45	Bachelor's Degree	20 years	Special Needs School
Teacher 8	Female	39	Bachelor's Degree	14 years	Inclusive School
Teacher 9	Male	39	Bachelor's Degree	13 years	Inclusive School
Teacher 10	Male	44	Master's Degree	18 years	Inclusive School

Types of interactive teaching aids

Interactive whiteboard

As a result of the interviews that have been conducted, there are three themes of interactive teaching aids that are mentioned by these teachers, such as the use of interactive whiteboards, tablets or computers and digital storytelling tools. There are four teachers who have stated about the use of interactive whiteboard in the science learning process. One of those teachers is Teacher 2 who has given the following statement: *"I primarily use visual aids like interactive whiteboards and digital presentations to help my students with ASD understand scientific concepts more clearly" (Teacher 2).*

According to Gaines et al. (2014), teachers who teach students with ASD are more likely to use interactive whiteboard because most individuals with ASD often respond well to visual stimuli. Interactive whiteboards allow for interactive, visual presentations of information through images, videos, animations, and diagrams, which can help make abstract concepts more concrete. This can be especially helpful for students who struggle

with verbal communication or abstract thinking. Teachers recognize that many ASD students struggle with verbal communication and abstract thinking. Thus, interactive whiteboards offer engaging, structured, and visually enriched lessons.

Tablets and computers

Apart from the use of interactive whiteboards, there are 3 teachers who have stated that they use tablets or computers when teaching science to students with ASD. Teacher 3 has stated as follows: *"My school has been provided with tablets. Using tablets in the classroom helps engage my students better, as they're more motivated by interactive content like videos and games" (Teacher 5).*
Meanwhile, a study by Aspiranti et al. (2020) regarding the use of tablets and computers in the science learning process by students with ASD has shown positive development in mastering topics that are difficult to explain through the teacher's presentation or explanation. Interactive teaching tools provide sensory-rich, engaging, and personalized learning experiences, which are crucial for students with ASD who may struggle with attention, comprehension, or processing abstract concepts. Besides, one of the teachers also stated that he uses an interactive whiteboard and also a tablet: *"I teach science using an interactive whiteboard and students use tablets to do exercises" (Teacher 6).*

Hence, correspondence with special needs perception suggests that tablets provide multisensory learning and individualized pacing, which are crucial for students with ASD who struggle with conventional teaching approaches.

Digital storytelling

Aside from the interactive whiteboard, tablets, and laptops, three instructors have indicated that they employ digital storytelling tools while teaching science to kids with autism spectrum disorder. Teacher 9 stated: *"Digital storytelling helps me make science lessons more interactive, which is key for keeping students with ASD engaged in the content" (Teacher 7).*

According to a study by Elenein (2019) teachers who use digital story telling in the teaching and learning process can help students who have verbal communication problems. This is because digital storytelling often includes narration, which helps students practice their verbal communication skills. For those with speech or language difficulties such as in some students with ASD, this can be a therapeutic and supportive activity. Teachers believe storytelling enhances comprehension and social interaction, making scientific topics more relatable. In addition, digital story learning also helps in building the social skills of autism students as research has been done by Smith et al. (2021). This was also stated by Teacher 4 as follows: *"I have found that digital stories not only support learning in science but also help build social skills, as students can relate to the characters and scenarios in the stories" (Teacher 4).*

Interviews with teachers revealed three main interactive teaching aids for students with ASD which are interactive whiteboard, tablets/computers, and digital storytelling tools. Teachers highlighted that these tools enhance engagement and understanding, particularly for students with communication challenges. Visual aids and interactive content like videos and games support learning, social skills, and communication development.

Challenges

Lack of teacher preparation

Kassabolat et al. (2020) stated that the willingness of teachers to use interactive teaching aids is important to encourage students to actively participate in their learning, as opposed to passively receiving information. Nonetheless, some special education teachers may not have sufficient training in using interactive whiteboards, tablets, or digital storytelling tools. This can hinder the effective use of these tools in the classroom: *"I strongly believe that interactive teaching aids, like digital storytelling tools and whiteboards, can really engage students. But, I have to admit that I have not received adequate training to use them effectively" (Teacher 1).*

Teachers acknowledge the potential of technology but feel unprepared to integrate it effectively, which limits its impact on special needs students: *"Technology like tablets and interactive whiteboards excites students about learning, but limited training hinders their full use" (Teacher 2).*

Interactive teaching tools have the potential to transform classroom learning by fostering greater student involvement and participation. For students in special education, such tools like digital storytelling platforms, tablets, and interactive whiteboards can offer meaningful and engaging learning experiences. However, a major

barrier remains- many special education teachers are not adequately trained to use these technologies. Without the necessary skills and confidence, the benefits of these tools may go unrealized, reducing their effectiveness in supporting active learning.

Lack of suitable resources

In term of resources, many science materials assume a certain level of cognitive development or language skills that may not align with the abilities of students with ASD. For instance, complex texts, abstract concepts, or detailed instructions may overwhelm them. Without differentiated materials that match the students' cognitive and language abilities, they may feel frustrated, disengaged, or unable to participate meaningfully in lessons (Damyanov, 2024). This has been stated by Teacher 8: *"Since many scientific books are too difficult and abstract for kids with ASD, there is a disconnect between the resources that are accessible and the requirements of the students" (Teacher 8).*

The absence of ready-made materials means that students may miss out on engaging content or struggle to understand standard lesson plans. Thus, with the absence of reference resources suitable for students with ASD, teachers may have to create or adapt resources themselves, which can be time-consuming. This was stated by Teacher 4 as follows: *"I often have to create my own resources for digital learning using Microsoft PowerPoint because the ones available don't match the abilities of my students with ASD" (Teacher 4).*

Therefore, teachers understand that ASD students require simplified, visually engaging content but struggle due to the lack of ready-made, differentiated materials.

Maintenance of teaching aids

The challenges faced by special education teachers who teach science to autistic students using tablets or computers involve several aspects, especially related to technological facilities that are not well monitored by the school. The school must play an important role in ensuring that teaching aids such as tablets and computers are constantly monitored to avoid the spread of viruses and malware (Microsoft Threat Intelligence, 2024). When a tablet or computer is infected with a virus, it will disrupt access to important applications or learning resources. For autistic students, who may rely more on visuals and digital interactions to understand science concepts, losing access to these tools will affect their learning process. While teachers see digital tools as essential for ASD students, they also recognize that unreliable maintenance reduces their effectiveness: *"I often find that the technology provided to us is not always up to par. If a virus affects a tablet or computer, it disrupts everything" (Teacher 5).*

It is well known that students with ASD are attached to routine activities in their daily lives. Therefore, if their routine is to use a tablet to learn something and the tablet cannot be used on that day/time, it will definitely affect the learning of students with ASD. Teachers also definitely need to give explanations and teachers may have to look for other alternatives in a hurry, which can make teaching time more limited and ineffective: *"When the tablets and computers used to teach do not work properly due to virus infection, this will cause interruptions in the delivery of lessons" (Teacher 9).*

Difficulties arising from poorly monitored technological facilities, such as tablets infected with viruses, have a major impact on the learning process of autistic students. Better monitoring by schools, adequate technical support, and regular maintenance of devices are essential to ensure that these devices can be used effectively to support special education, especially in subjects such as science.

Issue with student's attention and focus

Many students with ASD struggle with attention and focus, particularly when interacting with digital tools that require sustained engagement. Lane & Radesky, (2019) found that children with ASD may engage with digital tools differently than neurotypical children. Alhough they might find some of these types of tools initially engaging – due to bright colors, or repetitive actions – such engagement can easily lead to distraction and withdrawal once novelty wanes or the activity becomes too complex (Greenfield and Verma 2012). Teacher 1 stated: *"In my experience many of my ASD students struggle to concentrate on digital screens for lengthy periods. Attracted by bright images and sounds, distractions or frustration often result" (Teacher 1).*

Besides, teachers must carefully select content and pacing to keep students engaged. This was stated by Teacher 3 as follows: *"Digital storytelling can be a fantastic tool, but it's important to tailor it to the class's energy levels. For example, when the class is more restless, I choose shorter, more dynamic stories to keep them engaged" (Teacher 3).*

Problems with attention and focus have been reported in students with ASD while working within digital tools (Gunnars, 2024; Escobedo et al., 2014). Furthermore, these students can be extremely sensitive to sensory inputs and may be unable to sustain attention to highly stimulating digital media and screens over long periods of time. The difficulties related to attention and focusing in students with ASD when they participate in activities with digital tools are well documented (Gunnars, 2024; Escobedo et al., 2014). It is stated that some of the ASD students can be highly sensitive to sensory stimuli, making it difficult for them to remain engaged with overly stimulating digital devices for extended periods. Teachers play a crucial role in tailoring the use of digital tools to the needs and energy levels of their students, ensuring that the content is paced appropriately and delivered in a structured, manageable way. Teachers acknowledge that digital tools must be tailored to ASD students' sensory and attention needs to remain effective.

Discussion

The study has addressed the intended purpose of the study: to examine how the identified teaching aids in teaching science to students with ASD are used interactively. Overall, teachers recognize the potential benefits of interactive tools but highlight key barriers such as training gaps, unsuitable resources, maintenance issues, and attention challenges that must be addressed to optimize their effectiveness for ASD students. The rapid development of technology tools such as interactive whiteboards, tablets, computers and digital storytelling in the world education system today, assist teachers in meeting the learning needs of these students. This can be seen how the use of interactive whiteboards can improve the learning progress of ASD students. Ironically, most students with ASD respond better to what they see than to abstract verbal instructions. Similarly, the use of tablets can increase student motivation and engagement through games and interactive exercises. Digital storytelling tools do not only domesticate the teaching of science concepts, but it equally promotes the development of social skills. Such findings highlight the role of interactive aids in improving science learning that aligns with the research questions of the study with reference to their use, challenges and effects. The study corroborates earlier studies that indicate the effectiveness of the use of interactive tools in teaching learning activities of special education. Ediyanto et al. (2020) and Smith, Spooner and Wood (2013) similarly support the findings that students with ASD favour hands-on, visual, and technology learning in sciences. Further, Chatzara et al. (2024) indicated how digital storytelling enables students with ASD to effectively communicate and enhance their social relationships, hence confirming the findings of this study as highlighted by teachers. However, the challenges, such as inadequate training and technical problems, support the study by Ghavifekr et al. (2021) and Johnson et al. (2016), where teachers are not well-prepared in technology teaching and need more support. These similarities imply that, despite interactive aids' enormous potential, structural and practical challenges still stand in the way of their successful use.

While this study provides important insights into the types of interactive teaching aids used and the practical challenges encountered by teachers, it represents only an initial phase of a broader qualitative inquiry. The current analysis focuses primarily on thematic patterns drawn from descriptive responses, which naturally emphasizes dominant topics and broad trends. As such, the deeper interpretive dimensions of teachers' experiences such as their personal definitions of success and failure, detailed pedagogical strategies, and how these relate to their evaluations of interactive tools remain underexplored. Future phases of this research will involve a more nuanced analysis aimed at unpacking the subjective meanings teachers attach to their instructional practices and the complex classroom contexts in which these tools are employed. This layered exploration is necessary to fully understand how interactive aids shape learning environments for students with ASD beyond surface-level engagement. Teachers can improve the use of the interactive teaching aids by developing particular approaches. For instance, teachers can interactively present the concepts in science using the diagrams or animations on the interactive boards. Student engagement and participation can be increased by incorporating students' specific interests into lessons through digital tools. The training programs for teachers should therefore be given high priority with the aim of preparing them to properly apply these tools. Schools should also periodically ensure regular maintenance and upgrade the technology tools in a way to avoid technologically induced disruption of the educational process. To make the use of technology tools in learning more efficient, the TEACCH framework has proposed a structured learning environment. TEACCH has focused on providing a predictable and supportive learning environment that reduces anxiety among ASD students. Like other qualitative studies, this study also has some limitations. One of the limitations in the study is that the number of participants may lead to certain limitations in the scope of generalisation of the results obtained. The data collection creates some methodological problems, as participants can exaggerate the efficiency of the

practices they applied or, vice versa, omit difficulties they faced. Also, the research centres on teachers with more than five years of work experience and can therefore exclude information on teachers with less working experience and who may encounter different challenges. Furthermore, this study does not include detailed analyses of the contextual factors—for example, in the form of differences in school resources—that might affect the utilisation of interactive aids.

Conclusion

This study explored the role of interactive teaching aids in science education for students with autism spectrum disorder (ASD), highlighting both their benefits and the challenges educators face in their implementation. Findings from interviews with special education teachers indicate that tools such as interactive whiteboards, tablets, and digital storytelling significantly enhance student engagement, comprehension, and motivation. These resources serve to facilitate the connection between abstract scientific concepts and the teaching style for students with ASD, which is predominantly visual, hands-on, organised instructional strategies. However, a few problems impede the utilization of interactive teaching aid in special education. Teachers also claimed that they have not been provided with formal training, thereby rendering the tools to be under-utilized. Many participants also encountered challenges in finding appropriate resources, as traditional science materials tend not to address the cognitive and linguistic requirements of students with ASD. Furthermore, there were technical barriers such as inadequate management of devices and concerns about digital distractions were also recognized to impede the efficiency of these instruments. In order to optimize the use of interactive teaching aids, focused education programs also should be designed so that teachers learn how to use technology in their teaching. Schools and policymakers must also ensure the availability of well-maintained and accessible digital resources tailored to students with ASD. Frequent software upgrading, virus protection, and lesson design that meets the learning requirements of ASD students will add to their effectiveness. Another crucial aspect is the careful selection and pacing of digital content to accommodate students' varying attention spans. Teachers should customize lessons using a mix of digital tools, ensuring that interactive elements do not overwhelm students but instead enhance their learning experience. Strategies such as integrating students' personal interests into science lessons can further improve engagement and retention. the study underscores the value of interactive teaching materials in creating an inclusive and efficient learning for students with ASD. While challenges remain, addressing issues related to training, resource availability, and technology maintenance will enable special education teachers to harness the full potential of these tools. Further research is required in the form of longitudinal studies that can investigate the effects of interactive teaching aids on learning retention and the practices of adopting teaching aid integrations which are adaptive for varying educational contexts. With the right support and implementation, interactive teaching aids can transform science education for students with ASD, making it more accessible, engaging, and meaningful.

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