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DIFFICULTIES IN LEARNING MATHEMATICS AMONG ASD STUDENTS: PERSPECTIVES FROM TEACHERS AND PARENTS

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ABSTRACT

Mathematics learning presents significant challenges for individuals with autism spectrum disorder (ASD). This study delves into the difficulties faced by ASD students in a private school in learning mathematics, according to the perspectives of teachers and parents. A qualitative study was conducted using semi-structured interviews with three special needs teachers specializing in autism and two parents of ASD students and verified from observations of six ASD students classified as level 1 severity according to DSM-IV in their mathematics classes. The difficulties identified among ASD students include difficulty processing information and working memory, need for individualized instruction, short attention span, difficulty understanding mathematical concepts and inability to express symbols. Recommendations include integrating creative art and technology to support drill and practice, mastery learning, blended learning, individualized educational programs, and visual aids. Further research is needed to develop mobile applications for mathematics that integrate creative arts.

Keywords: *Autism Spectrum Disorder, Difficulties, Learning Mathematics, Creative Art, Technology*

INTRODUCTION

Autism spectrum disorder (ASD), a neurodevelopmental disorder with an increasing prevalence globally, exists in Malaysia as well, and approximately 300,000 individuals are affected (Hodges et al., 2020; Salleh et al., 2018). The Malaysian Education Blueprint 2013–2025 emphasizes inclusive education, particularly for students with autism, aiming to prepare them for independent living (Ibrahim et al., 2021; Othman & Rahmat, 2020). However, one of the essential skills in daily life, mathematics, poses significant challenges for ASD students. About 25% of ASD students struggle with calculations, problem-solving, understanding terminology, drawing conclusions, and integrating new concepts (Ediyanto et al., 2023; Mazon et al., 2022). Special needs students often require tailored support (Witzel et al., 2024), but there seems to be limited research on the support needed for acquiring mathematical skills among ASD learners (Tonizzi & Usai, 2023). Hence, this study aims to investigate the difficulties ASD students in a selected special education school face in learning mathematical skills.

RESEARCH QUESTIONS

The following are the research questions:

1. What difficulties do teachers report regarding ASD students' learning of mathematical skills?
2. What difficulties do parents report regarding ASD students' learning of mathematical skills?

CHALLENGES IN LEARNING MATHEMATICS AMONG INDIVIDUALS WITH AUTISM

The media often portrays individuals with ASD as being exceptional in mathematics, but research reveals that cognitive impairments, such as deficits in executive function and memory, significantly hinder their learning. ASD individuals struggle to translate mathematical representations into conceptual understanding and apply them to real-world contexts (Root et al., 2017).

Mathematical comprehension involves Instrumental Comprehension (applying rules) and Conceptual Comprehension (understanding principles), both of which are challenging for individuals with ASD (Barnett & Cleary, 2019). Executive function deficits, particularly in working memory, complicated academic and social success (Sampurno et al., 2024; Tonizzi & Usai, 2023). Furthermore, unique neural processing patterns in ASD individuals make mathematical learning more complex (Siregar et al., 2020).

Attentional issues can prevent focus on key mathematical concepts, and visual-spatial processing deficits hinder understanding of geometry (Cohen & Sukenik, 2024). Difficulties with mathematical language, such as interpreting terms and symbols, can obstruct problem-solving (Peklari, 2019; Wei et al., 2023). Additionally, heightened fear of failure and emotional regulation difficulties can reduce motivation and engagement (Ediyanto et al., 2023; Losinski et al., 2019).

To support ASD students, educators should use tailored strategies like explicit instruction, visual aids, and metacognitive approaches (Ediyanto et al., 2023). Leveraging visual-spatial strengths by incorporating shapes and figures can enhance learning (Wei et al., 2023), while interventions targeting cognitive flexibility can improve problem-solving (Polo-Blanco, Suárez-Pinilla, et al., 2024). Arts-based approaches have potential as these have been shown to contribute to overall development (Sampurno et al., 2024).

METHODOLOGY

This qualitative case study involved semi-structured interviews with teachers and parents of ASD students, with observation sessions in mathematics classes with six level-one ASD students, categorized by severity per DSM-IV. The study was conducted at a Malaysian non-profit school for special needs students, selected for its holistic approach and diverse ASD student population, making it ideal for monitoring mathematics classes.

The sample was small as the school was implementing a specialized program for ASD students and had a limited participant selection. Furthermore, there was lower-than-expected participation due to lack of parental consent. This was likely due to time constraints, language barriers, and confidentiality concerns. Lastly, some parents lacked sufficient knowledge and were unable or reluctant to provide detailed responses.

Data Collection Procedures

Semi-structured interviews are essential for exploring phenomena through verbal communication and allow for flexibility in gathering data (Mathers et al., 2000). The interviews with two parents and three teachers of ASD students provided in-depth data.

The study adhered to ethical guidelines to ensure the well-being of participants. Participants were formally invited to participate in a letter with an information sheet outlining the study's purpose, procedures, and benefits. Informed consent and their right to withdraw at any time without consequence were obtained from all participants. Further, confidentiality was maintained by using pseudonyms for all participants. Interviews were audio-recorded with explicit consent and securely stored with verbatim transcription. All identifying information was removed from the transcripts for further privacy.

Participant profiles are presented in Table 1 and Table 2.

Table 1. *Profile of the Special Needs Teachers Who Were Interviewed*

Pseudonyms	Gender	Academic background	Experience (years)	Subject taught
T1	F	Bachelor of social science from university science Malaysia. Sociology and Anthropologic	32	Teacher, assistant, headteacher and then manager
T2	F	Program in house training in special needs school	5	Early Intervention Education
T3	F	Teacher educational program SPM university	23	BM, English and Mathematics

Table 2. *Profile of Parents of ASD Students Who Were Interviewed*

Pseudonyms	Gender	Children's age (Years)	Academic information
P1	M	11	Masters in computer science
P2	F	10	Masters in computer science

The researcher's observations were integral to the data collection, providing data triangulation. As a passive observer, the researcher remained physically present without actively participating or engaging with the participants. Observation sessions lasted one week, with six ASD students aged 9 to 14. The researcher used an observation checklist and recorded notes in a journal. Participant profiles are shown in Table 3.

Table 3. *Profile of the Six ASD Students Under Observation*

Pseudonyms	Severity (DSM-IV Scale)	Gender	Age (Years)	Additional Information
K	Level 1	Male	11	Communicative, Low focus
Rv, N, J	Level 1	Male	14 ,10,9	Repetitive behavior, Non-verbal
Jn	Level 1	Male	11	Shy, low confident, Minimum communications
Rq	Level 1	Male	10	Communicative, Average focus

Data Analysis

Thematic analysis, a qualitative technique for identifying, examining, and interpreting patterns in qualitative data, was used to analyze the observation notes and interview transcripts. The data were analyzed using ATLAS.ti software. During the initial coding process, the transcripts were analyzed line by line to identify key themes and subthemes. Codes were iteratively compared and refined. Once identified, the codes were grouped into broader themes, further developed through ongoing theoretical saturation.

The legend used for transcription is outlined in Table 4.

Table 4. *Legend for Transcription of Interviews and Observations*

Participants/Data sources	Legend
Three teachers from the school	T1, T2 and T3
Two parents of the ASD students from school	P1 and P2
Questions to answer	Q1, Q2, Q3, etc.
Journal notes	JN
Session observation	S1, S2, S3, etc.

FINDINGS

The findings were based on the thematic analysis from the interviews with three teachers, two parents, and seven sessions of observation of mathematics classes. The themes that emerged from the interviews with the teachers and parents and the observations from the researcher's journal notes are reported.

Difficulties Encountered by ASD Students According to Their Teachers

Teachers highlighted several themes regarding difficulties as follows:

1. Difficulties with processing information

ASD students typically require longer learning periods, often necessitating daily repetition over extended durations for a mathematical topic. The school manager stressed: "Some subjects took ASD students a long time to learn. Daily practice is needed. We must ask them to solve mathematics daily. Repeating for months or more may be necessary" (T1, Q1). The early intervention educator agreed, "For teaching one subject we need to repeat again and again…" (T2, Q1).

This was supported by the researchers' observation "The lack of growth in learning is evident. Students must repeat tasks every day and need assistive devices. They need close supervision from a teacher." (JN, S2, S4).

2. Needs of individualized instruction

Each ASD student needs an individual plan and strategy for teaching and training. The expert in early intervention programs has verbalized: "Each student is unique; thus, we must prepare strategies accordingly. They won't sit and do the exercise; therefore, we must calm them first. Each student receives customized mathematic lessons. Depends on their level... The teacher must sit beside ASD students in all classes for point-to-point engagement" (T2, Q2).

The observed phenomenon illustrates the implementation of individualized instruction in a classroom setting. "Individual training sessions lasted 10–15 minutes, giving each student 15 minutes of teacher attention and focus." (JN, S5). "One thing was evident from all the sessions: each student has distinct reactions, attitudes, and levels of understanding. This class apparently cannot train in groups; thus, each student needs individual attention from the teacher." (JN, S7).

3. Short attention span

Teachers talked about lack of interest and short attention span among ASD students, as shown in the quotes by the manager: "They may show interest and listen, but it will be maximum for 10 minutes" (T1, Q2). Another teacher emphasizes that "…we don't see interest in them... Sharp on time, they want to change activity" (T2, Q2). The mathematics teacher said: "I don't see any interest in them. They lose their focus after a short time and prefer to change the activity" (T3, Q2). The researcher observing the class noted: "Students can focus for 10 minutes maximum. After that, they walked, made noise, or asked for rest; students easily lose their focus" (JN, S2, S4).

Students' restricted and repetitive symptoms can lead to chaos and overcrowding, excessive noise, rapid movement, and frequent entry and exit of individuals from the room. The journal notes state that during this session, "Some students were impatient, walked around class, made noise, and disturbed others" (JN, S4), and "The task was refused by one student. He sobs and hits the teacher. He's uncontrollable, so the teacher stops teaching" (JN, S6).

4. Difficult mathematical subject for ASD Students

Numerical abilities

The early intervention educator stressed, "Numerical abilities are necessary... some of my students understand addition well, but they struggle with subtraction" (T2, Q9). The manager commented, "For them, learning numbers beyond 10 is challenging" (T1, Q9), while the mathematics teacher highlighted

"Difficulties observed in most of the content for numbers and addition" (T3, Q9). "I teach numerical concepts in two parts: first, I teach numbers 1 to 5, then I teach the numbers 5 to 10, and then I ask them to match or put them in order. Most of them only understand one-digit numbers (T2, Q10)." The researcher also noted, "The student needed help counting and writing numbers today because he couldn't count more than 5" (JN, S2); "The student needs additional basic number practice" (JN, S5).

Learning shapes

The teachers mentioned learning shapes is difficult for ASD students, as shown in the quotes: "…so far, we only teach basic shapes to them like square, triangle, and circle…" (T2, Q11). "Learning shapes is a very important topic, but geometry or 3D shapes are difficult for them" (T3, Q9). The researchers noticed that ASD students could not name basic shapes correctly: "Teacher instructed students to name shapes on a printed paper today, including square, triangle... Most students could not name shapes accurately or write their alphabetical names" (JN, S6).

Understanding money

Learning to use money was another difficult subject. Per the early intervention teacher: "Understanding money is very important. We use fake money and ask them to recognize the amount and count it, but only one student so far has learned coins, and they cannot purchase something alone" (T2, Q9). According to the teacher, only one of the students could recognize coins and paper notes correctly. "The teacher provided fake money for paper notes and coins practice. The task was limited to one student. He was a nonverbal student who could just recognize the value" (JN, S3).

Difficulties Encountered by ASD Students According to Their Parents

The parents willing to contribute to the study were highly educated and well-informed. According to their perspectives, ASD students have difficulties learning mathematics.

1. Difficulty with working memory

Parents mentioned difficulty in remembering tasks. "…my son cannot remember the previous task and I need to teach him again…" (P2, Q1, Q2). The researchers observed that "Students can easily forget what they just did" (JN, S5). Another session also noted, "Students practice one-digit addition for three days, yet after three days, they need help calculating problems with addition like it's their first time." (JN, S7).

2. Short attention span

One of the parents, a mother, elaborated "When my son is doing the tasks, he easily gets distracted" (P2, Q2), which shows the short attention span of the ASD student.

3. Difficult mathematical subjects for ASD Students

Numerical Abilities

The mother stressed, "Numbers and operations are very difficult; my son cannot count numbers or read numbers without mistakes" (P2, Q1).

Understanding money

Both parents mentioned the importance of understanding money: "I strongly say handling money as a life skill will be very useful to go shopping and collect the balance, but my son cannot manage" (P1, Q8). "Learning to calculate with money is what they need in their future, but it's hard for them to understand it. They need to learn real money and use calculating, and change is hard for them" (P2, Q8).

Inability to Express Symbols

Both parents mentioned that their child cannot understand the symbols used in mathematics. "Shortcuts he cannot understand. For example, if we had 10 + 20, he must first count 10 and after that 20 and then count together" (P1, Q1). And "He can't calculate like us; he knows the concept, but he can't read shortcuts" (P2, Q1).

DISCUSSION

The study identified themes, which are summarized and clarified in **Error! Reference source not found.** and 6. Furthermore, the insights overlapped from emerging from interviews with teachers and parents are illustrated in **Error! Reference source not found.**.

Table 5. *Summary of Teachers' and Parents' Insights on Challenges in Learning Mathematics Among ASD Students*

Theme	Subtheme	Data Code	Example Quotes	References
Difficulties with Processing Information	Repetition Required	(T1, T2, P1, P2, JN)	"For teaching one subject we need to repeat …"	(Laleye & Ogunboyede, 2023; Lim et al., 2012)
	Slow processing speed	(T1, P1, P2, JN)	"Some subjects took ASD students a long time to learn ".	(Peklari, 2019) (Delisio et al., 2018; Siregar et al., 2020)
	Difficulty with working memory	(T1, P2, JN)	"…My son cannot remember the previous task …"	(Beltrão-Braga & Muotri, 2017; Sampurno et al., 2024)
	Deficits in executive function	(T1, T2, P2, JN)	"The lack of growth in learning is evident"	(Sampurno et al., 2024; Tonizzi & Usai, 2023)
	Difficulty in problem Solving skills.	(T1, T2, P1, P2, JN)	"Students practice addition for three days, yet after three days, they need help..."	(Beltrão-Braga & Muotri, 2017; Bullen et al., 2020; Polo-Blanco, Suárez-Pinilla, et al., 2024)
Need for Individualized Instruction	Unique neural patterns underlying	Teachers (T2) JN	"Each student is unique; thus, we must prepare strategies accordingly…"	(Siregar et al., 2020)
	Every student needs own learning pattern	(T1, T2, P1, P2, JN)	"... This class apparently cannot train in groups".	(Wei et al., 2023)
	ASD Natural symptoms and behavior	(T1, T2, JN)	"They won't sit and do the exercise; .. we must calm them first...".	(Ediyanto et al., 2023; Losinski et al., 2019)
Short attention span	Easily distracted.	(T1, T2, T3, P1, P2, JN)	"When my son is doing the tasks, he easily gets distracted"	(Cohen & Sukenik, 2024)

	Short timing for the focus.	(T1, T2, T3, JN)	"They lose their focus after a short time .."	
Difficult subjects in mathematics	Difficulty in learning numerical	(T1, T2, T3, P2, JN)	"Some of my students understand addition well, but they struggle with subtraction".	(Beltrão-Braga & Muotri, 2017; Fauziyah & Budayasa, 2022; Peklari, 2019; Santos et al., 2017; Wei et al., 2023).
	Difficulty in learning shapes	(T2, T3, JN)	" … we only teach basic shapes like square…"	
	Difficulty in understanding money	(P1, P2, JN)	"Handling money will be very useful …, but my son cannot manage"	
Inability to express symbols	Cannot recognize symbols	Parents (P1, P2)	"… he knows the concept, but he can't read shortcuts"	(Peklari, 2019; Polo-Blanco, González López, et al., 2024) .

Table 6. *Comparison of Emergent Themes from Interviews with Teachers and Parents, and Validation from Researchers' Observation*

Emergent Theme	Teachers' Insights	Parents' Insights	Researchers' Observation to validate
Difficulties with processing information	✔		✔
Need for Individualized Instruction	✔		✔
Short attention span	✔	✔	✔
Difficult subjects in mathematics	✔	✔	✔
Difficulty in learning numerical abilities	✔	✔	✔
Difficulty in learning shapes	✔		✔
Understanding money	✔	✔	✔
Difficulty with working memory	✔	✔	✔
Inability to express symbols		✔	

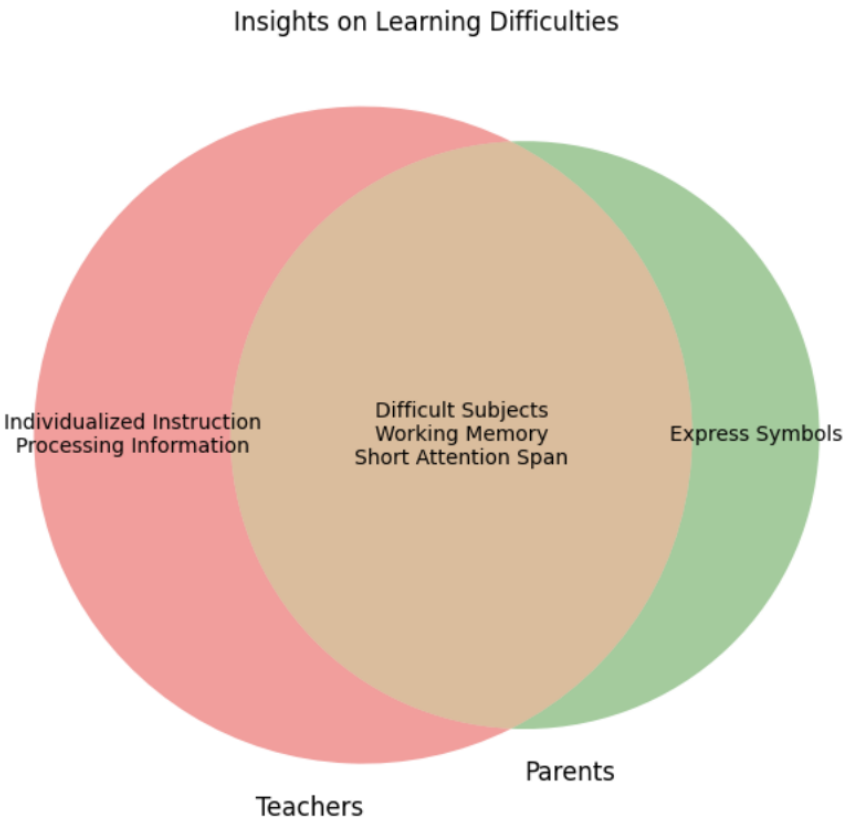

Figure 1. *Insights emerging from interviews with teachers and parents*

Difficulties Processing Information

Difficulty processing information emerged from teachers' insights into ASD students' challenges. Information processing can slow processing speed, impair memory, and hinder following instructions (Lopez & Leekam, 2003). Ewoldsen (2020) categorizes memory into sensory registers, short-term memory (working memory), and long-term memory, which is illustrated in Minshew et al. (1992) information processing model (see **Error! Reference source not found.**).

Information processing deficits can affect mathematical learning, including organization, perception, memory, and motor skills (Peklari, 2019). Technology, visual aids, and graphical organizers can help address perception and processing difficulties (Delisio et al., 2018). Additionally, drill-and-practice methods focused on mastery rather than speed are also beneficial (Lim et al., 2012).

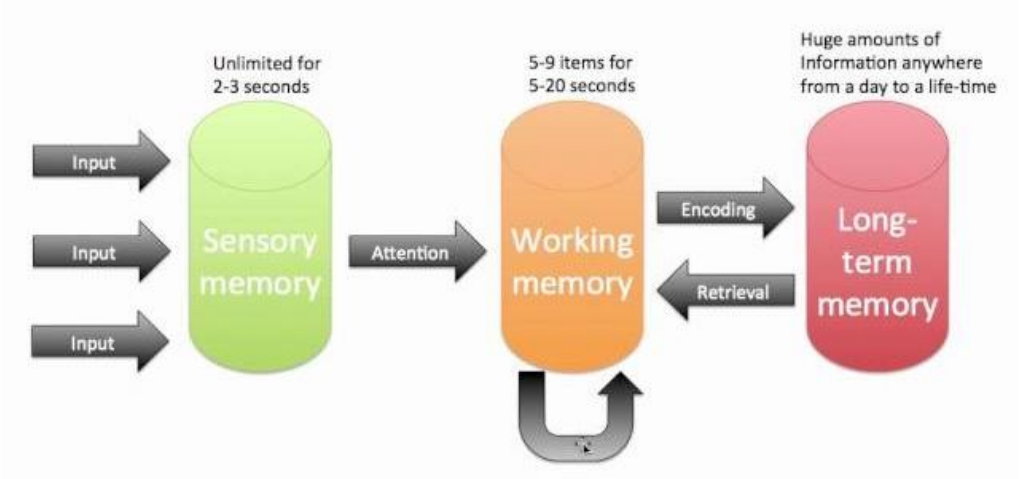

Figure 2. *Information Processing Model (Minshew et al., 1992)*

Difficulties with Working Memory

Working memory, essential for organizing and manipulating information in tasks like mathematics, is challenging for many ASD students (Fauziyah & Budayasa, 2022). Memory problems are common among ASD individuals (Beltrão-Braga & Muotri, 2017), and deficits in working memory can hinder understanding of complex mathematical concepts (Peklari, 2019). Technology can capture students' attention and enhance focus by supporting the dual-channel theory to overcome these challenges, which suggests that visual and verbal information are processed separately (Clark & Paivio, 1991). Structured methods, such as blended learning, tailored instruction, and progress monitoring, can further aid ASD students, while incorporating creative arts may boost engagement and interest in mathematics.

Need for Individualized Instruction

Teachers emphasized the need for individualized instruction. This was not highlighted by parents, likely due to their focus on their child's specific needs. Previous research underscores the importance of tailoring instruction to each student's unique requirements, with individualized methods improving educational outcomes (Thompson, 2018). Technology can support personalized learning through customized learning paths, blended learning, and progress monitoring.

Short Attention Span

Teachers and the researcher identified attention span issues which do not concern parents. Children with ASD often struggle to maintain focus for extended periods (Tan & Kastberg, 2017) and have difficulty shifting attention, concentrating on tasks, and ignoring distractions. Their limited ability to express thoughts further complicates these challenges (Siregar et al., 2020). Technology offers ASD learners interactive visual and auditory cues, promoting sustained engagement. Additionally, integrating creative arts and using blended learning or drill-and-practice methods can help maintain attention and improve learning outcomes.

Difficult Mathematical Subjects

ASD students vary in mathematical knowledge, cognitive abilities, and conceptual understanding (Peklari, 2019). Similarly, the students in this study exhibit varying levels of understanding, resulting in different challenges with mathematical subjects (Beltrão-Braga & Muotri, 2017).

Numerical Abilities

Both parents and teachers highlighted this theme. Numeracy is crucial for progress in mathematics (Aunio et al., 2021). Between 6% and 22% of children with autism struggle with numbers and calculations beyond expectations for their intellectual level (Aagten-Murphy et al., 2015).

Learning Shapes

Parents often do not view this as an issue, possibly due to their focus on numbers or practical concerns. Geometry is a critical mathematical skill for individuals with autism (Salmanian et al., 2012). ASD students may struggle to generalize their understanding of shapes, comprehend 2D representations of 3D shapes, and perform geometric transformations(Santos et al., 2017).

Understanding Money

Both parents and teachers emphasized the importance of money management for the independence of ASD students. Previous studies highlight the significance of teaching money-related skills to maximize independence for individuals with ASD (Root et al., 2017; Thompson, 2018). Hence, implementing Individualized Education Programs (IEPs) tailored to each student's needs is necessary. Blending traditional instruction with technology and creative arts, along with drill-and-practice activities, can support students in mastering challenging mathematical concepts.

Inability To Express Symbols

Some students struggled to express mathematical symbols, hindering their symbolic understanding. ASD students often face difficulties in mathematics because of the high cognitive demands, which affects learning if the processes are impaired (Peklari, 2019). Visual aids, such as manipulatives, diagrams, and technology integrated into blended learning, can improve understanding. Creative arts can also help in enabling the visualization of mathematical symbols, aiding in comprehension and retention.

The summary of the recommendations to address the emerging challenges is shown in Table 7.

Table 7. *Recommendation for ASD Student Difficulties in Learning Mathematics*

Theme and Sub-theme	Findings	Recommendation
Difficulty with processing information	• Students cannot understand or process mathematics	1. Mastery in learning 2. Drill and practice 3. Using technology 4. Visual aids: manipulative and diagram, schema-based strategy
Difficulty with working memory	• Students could not remember subjects	1. Blended learning 2. Individualized education program 3. Using technology 4. Visual aids: manipulative and diagram, schema-based strategy 5. Utilizing creative art
Need of Individualized Instruction	• Some of ASDs required more attention from teacher. understanding wasn't equal.	1. Individualized education program 2. progress monitoring. 3. Using technology 4. Blended learning
Short attention Span	• Students lost the attention to the task after 10 min or with any distraction.	1. Using technology 2. Utilizing creative art 3. Blended learning 4. Individualized education program 5. Drill and practice
Difficult subjects in mathematics • Numerical abilities • Learning shapes	• Some of the mathematical subjects are more difficult for ASD students.	1. Individualized education program 2. Blended learning 3. Using technology 4. Utilizing creative art

• Understanding money		5. Drill and practice
Inability to express symbols.	• It might be hard for ASDs to understand mathematical symbols	1. Visual aids: manipulative and diagram, schema-based strategy 2. Blended learning 3. Using technology 4. Utilizing creative art

RECOMMENDATIONS

Visual and auditory methods support ASD students in learning mathematics. For those with working memory and processing difficulties, visual aids can help clarify complex concepts and identify patterns. Traditional mathematical instruction is challenging for ASD students due to short attention spans; visual tools can engage their attention and assist with understanding abstract symbols by linking them to real-life objects. Incorporating creative arts into mathematical instruction can make the subject more engaging and accessible, enhancing students' interest and understanding.

Utilizing Creative Art in Teaching Mathematics

Incorporating creative arts into education has positively affected students with autism spectrum disorder (Bawazir & Jones, 2017). Art can enhance academic performance, and combining visual and auditory methods improves mathematical skills for ASD students. Technology-based mathematical instruction using multimedia learning (Mayer, 2002) engages students with visuals, animations, videos, and spoken text. Art educators design curricula that promote critical thinking and independent inquiry (Maloy & Thomson, 2023). However, teachers may face challenges integrating art into mathematical instruction without proper training. Professional development for academic and art teachers is essential to overcoming this barrier. Research indicates that arts-integrated learning boosts analytical thinking, intrinsic motivation, and academic achievement (DeMoss & Morris, 2002; Richter, 2022; Sampurno et al., 2020; Yücesoy et al., 2020) while also enhancing communication skills and supporting language learning (Zhang & Jia, 2022).

Using Technology for Mathematical Learning

Students with autism often respond better to technology than in traditional classroom settings. Technology provides controlled, predictable environments with visual and multisensory stimulation, enhancing motivation and focus and reducing frustration (Vlachou & Drigas, 2017). It also improves fine motor skills, reduces repetitive behaviors, and boosts academic and social outcomes (Munoz et al., 2018).

Technology supports blended learning by enabling repeated drill-and-practice sessions, personalized learning paths, and progress tracking. However, challenges include the need for suitable tools, complex interfaces, and concerns about overstimulation, cost, and device addiction. Despite its potential, research on integrating technology in mathematical instruction for special needs students is limited (Al-Attiyah et al., 2022; Campado et al., 2023; Dalmasso et al., 2023).

Blended Learning

Blended learning combines electronic and online resources with traditional face-to-face instruction, giving students control over the timing, pace, and location in learning (Zavaraki & Schneider, 2019).

Blended learning provides the special education needs of students with flexibility and accessibility, enabling them to learn anytime and anywhere. It has been shown to boost motivation for participation in vocational education (Zhou, 2023). Lo et al. (2024) found that students in blended learning, combining school-based courses and VR sessions, showed significant improvement in understanding the car washing sequence. Hence, a variety of strategies is recommended rather than relying on a single approach.

Drill and Practice

Drill and practice involve the systematic repetition of concepts and exercises to refine skills (Lim et al., 2012). They emphasize repeated practice to enhance mastery (Laleye & Ogunboyede, 2023). Butler et al. (2001) reviewed the effectiveness of extensive drills and practice in mathematical training programs for students with mild to moderate intellectual disabilities.

Mastery in Learning

The focus should be on mastery learning rather than speed. Slavin (1987) defines "mastery learning" as setting a specific performance standard, with continuous assessment and additional instruction to help students reach this standard. It is also recommended that various strategies be combined to improve mathematical learning for ASD students (Baglama et al., 2017).

Individualized Education Program

An individualized education program (IEP) is recommended for each student to provide instruction tailored to their unique cognitive needs (Wilczynski et al., 2007). Personalized support helps students with autism achieve academic success (Thompson, 2018), facilitating seamless transitions for postsecondary outcomes (Findley et al., 2022).

Educational Progress Monitoring

As defined by Deno (1985), progress monitoring involves regular assessment of student performance toward long-term goals. For ASD students, ongoing evaluation of mathematical skills is crucial (Tevis et al., 2022). Documenting progress reports accessible to both educators and parents is essential for tracking development.

Utilizing Visual Aids

Visual aids, such as graphic organizers, schema-based approaches, and manipulatives, are effective in teaching abstract concepts in mathematics, aligning with the visual learning preferences of ASD students (Delisio et al., 2018). Schema-based instruction, which uses images and diagrams to teach procedural skills, has improved problem-solving and performance in ASD students (Cox & Jimenez, 2020).

LIMITATIONS

The findings are limited due to the small number of participants who were interviewed and observed. Further, the findings may be limited to the Malaysian context as Malaysia's education system for SNE may differ from foreign countries. Lastly, only addressed ASD students classified as level 1 severity according to the DSM-IV were considered in this study, which may not represent the full range of diversity within the ASD population. However, the findings also provided valuable insights into the challenges ASD students face in learning mathematics, and further studies could be done to verify and explore the emergent themes.

CONCLUSION

This study aimed to explore the challenges ASD students face in learning mathematics through interviews with three special needs teachers and two parents and verified by observations of six level 1 (based on DSM-IV) ASD students during their mathematical classes. The emergent themes identified included difficulties with information processing, working memory, individualized instruction, attention span, mathematical subjects, and symbol expression. Recommendations included drill and practice, blended learning, mastery learning, individualized programs, progress monitoring, and visual aids.

The study's small sample size limits generalizability. Future research should involve a larger, more diverse sample and be qualitative. While technology shows promise, existing tools may not fully meet ASD students' needs, necessitating further development. Integrating creative art with technology and future validation could offer additional benefits.

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