

Autism Spectrum Disorders and The Development of Children's Arithmetic Aptitude and Numeracy

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ABSTRAK

Numerasi awal merupakan bagian dari keahlian matematika yang harus dimiliki setiap siswa. Namun, pada anak dengan gangguan autistik disorder belum memiliki kemampuan numerasi awal yang baik. Penelitian ini bertujuan menganalisis kemampuan numerasi awal siswa dengan gangguan autistik disorder. Penelitian ini merupakan penelitian studi kasus. Subjek dari penelitian ini adalah 2 siswa dengan gangguan autistik disorder kelas III, yaitu laki-laki dan perempuan. Teknik pengumpulan data yang digunakan dalam penelitian ini menggunakan wawancara, observasi, dan lembar tes terkait kemampuan numerasi awal siswa dengan gangguan autistik disorder. Teknik analisis data dilakukan melalui beberapa tahap yakni pengumpulan data, reduksi data, display data, dan membuat kesimpulan. Hasil penelitian menunjukkan bahwa D mampu mengenal bilangan terbatas pada satuan 1-9 secara mandiri serta mampu melakukan penjumlahan dan pengurangan terbatas pada satuan dengan bantuan. N belum mampu mengenal bilangan dan melakukan aritmatika sederhana. Namun, N dapat meniru menuliskan bilangan satuan. Ketidakkampuan menguasai numerasi awal pada siswa dengan autistik disorder didominasi oleh terbatasnya minat dan perhatian serta gangguan otak yang menyebabkan rendahnya kemampuan berbicara dan bahasa sehingga berdampak pada penguasaan atau pengenalan numerik. Sehingga guru memiliki peran penting untuk meningkatkan kemampuan numerasi awalnya.

ABSTRACT

Initial numeration is part of the math skills that every student must have. However, children with autistic disorder do not have good initial numeracy skills. This study aims to analyze the initial numeracy abilities of students with autistic disorders. This research is case study research. The subjects of this study were 2 students with autistic disorder class III, namely boys and girls. Data collection techniques used in this study used interviews, observation, and test sheets related to the initial numeracy skills of students with autistic disorders. Data analysis techniques are carried out through several stages, namely data collection, data reduction, data display, and making conclusions. The results showed that D could recognize limited numbers in units 1-9 independently and could add and subtract limited units with assistance. N has not been able to recognize numbers and perform simple arithmetic. However, N can imitate writing unit numbers. The inability to master initial numeracy in students with autistic disorder is dominated by limited interest and attention, as well as brain disorders that cause low speech and language skills that impact numeracy mastery or recognition. So the teacher has an important role in improving his initial numeracy skills.

1. INTRODUCTION

Numeration is closely related to learning mathematics. Numerical ability is part of mathematical expertise in the use of numbers, symbols, and data in everyday life (Anders et al., 2012; Chan & Scalise, 2022). Numerical learning emphasizes students' ability to channel ideas effectively, argue, analyze, solve, formulate, and interpret various mathematical problems in various situations and forms in everyday life (Shabrina, 2022). Initial numeracy is closely related to other life skills, making numeracy an important skill for students to master (Bae et al., 2015; King & Purpura, 2021).

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Students can master numeracy at school gradually. In the initial numeracy stages, students learn about number recognition and the use of simple arithmetic operations. In general, students know, recite, and write numbers and symbols and then perform simple calculations on numbers (Guo et al., 2021; King & Purpura, 2021; Méndez et al., 2019; Skwarchuk et al., 2014). Number recognition is the ability to understand the symbols of numbers and be able to count the number of objects. Meanwhile, the ability to perform simple arithmetic is the ability to work on addition and subtraction calculation problems. The early stages of numeration are generally carried out in low grades, namely grades 1, 2, and 3 of elementary school, and the scope of numeration is still simple (Rakhmawati & Mustadi, 2022).

Elementary school low-grade students include both students with and without special needs. One of the students with special needs is a student with disabilities and autism disorder (Johora et al., 2021). In general, students with autistic disorder have communication, social, and thinking disorders (Damayanti et al., 2019). Students with autistic disorder in their thinking processes tend to be able to understand instructions that are carried out repeatedly because of their characteristics, which tend to do things repeatedly (Dulay, 2017). The tendency to perform repetitive behavior is due to the relatively greater left hemisphere lateralization of language functions in the brain region (Larson et al., 2022). Thus, students with autistic disorder can learn limited initial numeracy if taught with repeated, structured, and systematic instructions (Ntalindwa et al., 2021; Tzanakaki et al., 2014). Initial numeracy skills should be given to students with autistic disorders even though they have significant learning disabilities and levels of intellectual achievement tend to be much lower (Apanasionok et al., 2021).

Facts in the field show that early numeracy learning still tends not to be the main focus of learning for students with autistic disorders, so that students' ability to understand, pronounce, and write numbers is still very low (May et al., 2015). Students with autism have difficulty speaking fluently. Therefore, reading skills are prioritized for students with autism (Ron-Ezra & Levenson, 2021). The ability to read and initial numeracy should be interrelated (King & Purpura, 2021). Numerical literacy skills are very important for the current generation to have in order to solve practical problems in various contexts in everyday life with mathematical concepts. In addition, mastery of initial numeracy is very important to support future student skills in accordance with learning objectives, including students who are expected to be able to master reading, writing, and arithmetic skills (Latifah & Rahmawati, 2022).

Based on the description above, it can be said that children with autistic disorders have difficulties in social communication, limited and repetitive behavior, and interests that cause lifelong functional difficulties. Previous research has not fully discussed the initial numeracy abilities of students with autism. The lack of initial numeracy skills of students with autistic disorder is also reinforced by the results of previous research, which stated that the ability of autistic students is still very low because they can count objects sequentially, but if there is a delay in the calculation, they cannot state the number of objects they have counted. In addition, they can only receive instructions systematically for maximum results (Cox & Jimenez, 2020). As a result, teachers have a significant impact on how to support students with disabilities (Sheppard & Wieman, 2020).

In previous research, it only focused on analyzing the social abilities of children with autism, so there was a lack of studies regarding the analysis of the initial numeracy skills of students with autism, so this research intends to examine this topic more deeply. Thus, this study aims to analyze the initial numeracy abilities of students with autistic disorder in recognizing numbers and simple arithmetic in two grade 3 students who have autistic disorder at SD Muhammadiyah 1 Candi Labschool Umsida. The implications of this research are expected to provide knowledge to teachers about how to design learning about initial numeracy so that the initial numeracy skills of students with autistic disorders can improve and develop.

2. METHOD

This study uses a qualitative research approach (Creswell, 2013). The procedure in this study focuses on the initial numeracy abilities of students with autism disorder. The type of research used is a case study. This type of research is in accordance with the research being conducted because researchers will examine the initial numeracy skills of students with autism at SD Muhammadiyah 1 Candi Labschool Umsida. The research design chart is shown in Figure 1.

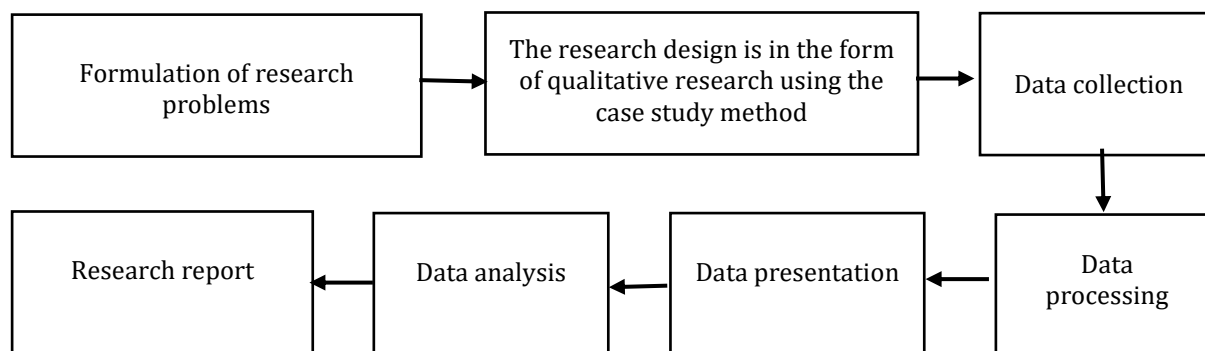


Figure 1. Research Design

The subjects of this study were 2 students with autistic disorder class III, namely boys (D) and girls (N). This research was conducted at SD Muhammadiyah 1, Candi Labschool, Umsida, Sidoarjo Regency. The data collection methods used in this study included interviews, observation, and test sheets related to the initial numeracy skills of students with autism. The first initial numeration indicator is knowing numbers, which is shown by the ability to recognize units, tens, hundreds, and thousands. The second numeration indicator is simple arithmetic, which is shown by the ability to operate numbers such as addition, subtraction, multiplication, and division. The test sheet instrument grids used in this study are presented in [Table 1](#).

Table 1. Instrument Grid

No	Components or Standards	Indicator	Sub Indicator	Item Number	Many Grains
1	Numeral Ability	1. Get to know the numbers	1. Get to know the unit	1-2	2
			2. Understand Ten	3-4	2
			3. Know hundreds	5-6	2
			4. Know Thousands of People	7-8	2
		2. Perform simple arithmetic or number operations.	1. Sum of Units	9-11	3
			2. Addition of tens	12-14	3
			3. The sum of hundreds	15-16	2
			4. The sum of thousands	17-18	2
			5. Unit decrease	19-21	3
			6. Subtracting the tens	22-24	3
			7. Savings of hundreds of dollars	25-26	2
			8. Thousands deduction	27-28	2
			9. Unit Multiplication	29-31	3
10. Multiplication by tens	32-34	3			
11. Multiplication of Hundreds	35-36	2			
12. Division of Units	37-38	2			
13. Division of tens	39-40	2			
Amount				40	

Data analysis was carried out in several stages, namely data collection, data reduction, data display, and drawing conclusions. Data collection was carried out through interviews, observation, and careful and detailed test sheets related to the initial numeracy skills of students with autism. Then, data reduction was carried out by summarizing and selecting the main points derived from the data and observations obtained related to the initial numeracy skills of students with autism. Data is presented in the form of simple narrative text to make it easier to understand. The last stage is making conclusions on data related to the initial numeracy abilities of students with autistic disorder. Testing the validity of research data was carried out in several stages, namely, making the most of research time, seeking accuracy and diligence when collecting data, triangulation, and discussing with competent people related to the topic under study.

3. RESULT AND DISCUSSION

Result

Ability Based on the results of the interview process with shadow teachers and class III teachers and the observations of D and N when working on the test sheet, accompanied by the results of working on the test sheet, the main findings obtained in the study related to the initial numeracy skills of students with autistic disorder at SD Muhammadiyah 1 Umsida Labschool Temple. The initial numeracy test for students with autism was given to D and N. Both showed different results. to recognize numbers.

Ability to Recognize Numbers

The first finding concerns indicators of the ability to recognize numbers. Students are considered capable of meeting the indicators of knowing numbers well if they are able to recognize units, tens, hundreds, and thousands. The initial numeracy skills of students with autism can be seen from the answers D and N in [Figure 2](#) and [Figure 3](#).

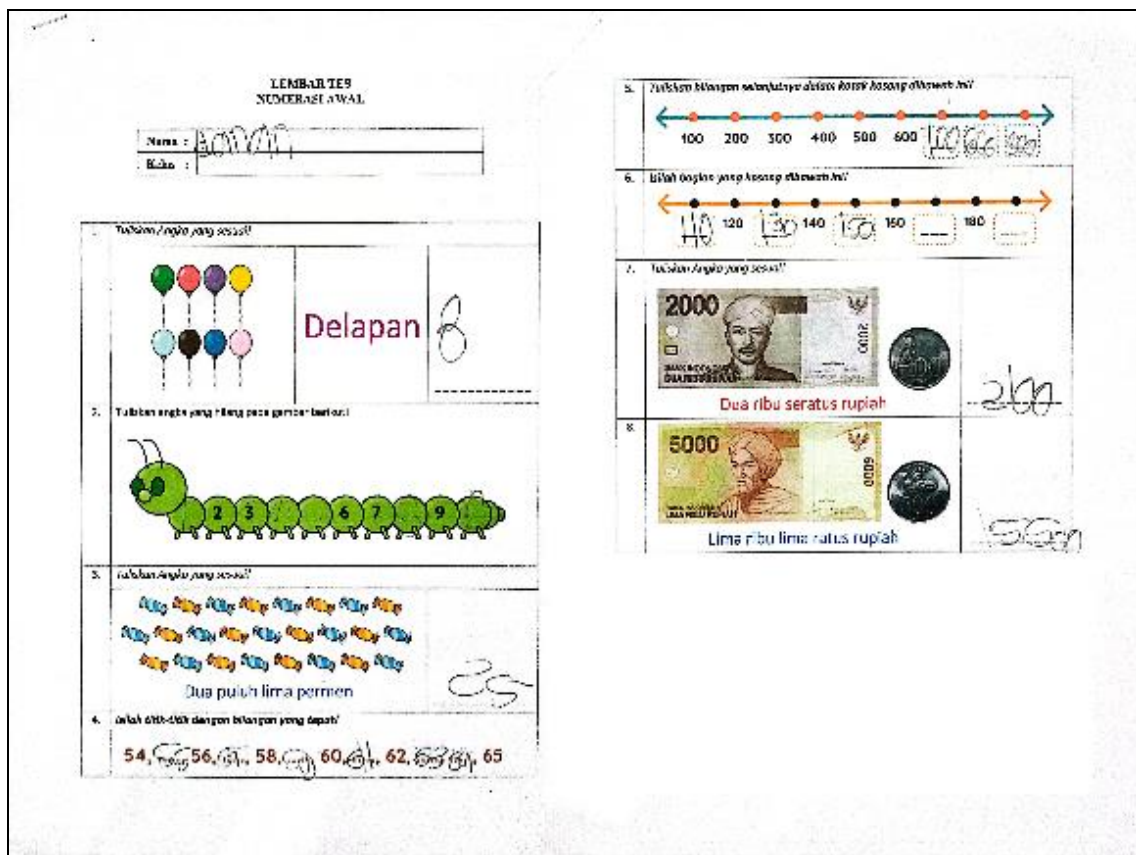


Figure 2. Results of Answer D

Figure 2 shows that D was able to answer all the questions and write down the unit numbers in tens, hundreds, and thousands according to the questions. The summary of the results of the interview with the shadow teacher shows that D can only write down the numbers 1–9 well; for dozens or more numbers, he still has to be dictated to write down the numbers. This is in line with the results of observations, which show that D can write numbers that are limited to units independently according to test questions and is assisted for answers with dozens or more results. Based on the results of interviews and observations, D was able to write down individual numbers or only 1 number, which was limited to numbers 1–9 independently.

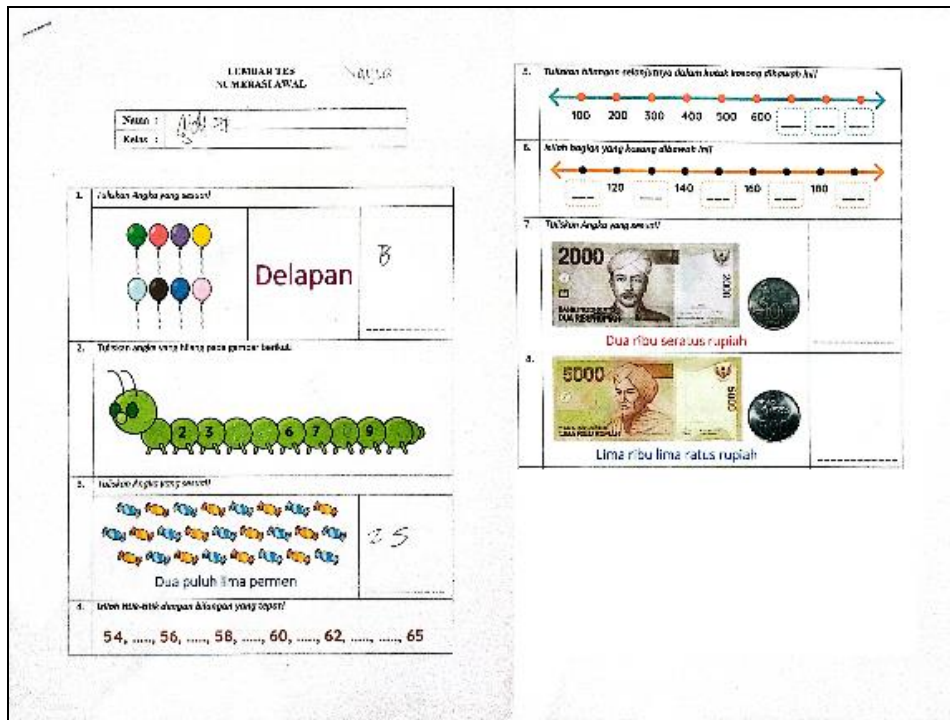


Figure 3. Results of Answer N

As can be seen in Figure 3, N was only able to write answers to numbers 1-3 well, and the others were not answered, indicating that N had not yet mastered the indicators of recognizing units, tens, hundreds, and thousands of numbers well. The summary of the results of the interview with Shadow's teacher showed that N could only imitate writing numbers, but he knew verbally the units to tens. This is in line with the results of the observations, which show that N must be given an example first, and then he writes his answers on the test sheet. Based on the results of interviews and observations, N has not been able to recognize and write numbers independently.

Simple Arithmetic Skills

The second finding concerns indicators of doing simple arithmetic. Students are considered capable of fulfilling simple arithmetic indicators if they can operate numbers in the form of addition, subtraction, multiplication, and division on unit numbers in the tens, hundreds, and thousands. The initial numeracy skills of students with autism can be seen from the answers D and N in Figure 4 and Figure 5.

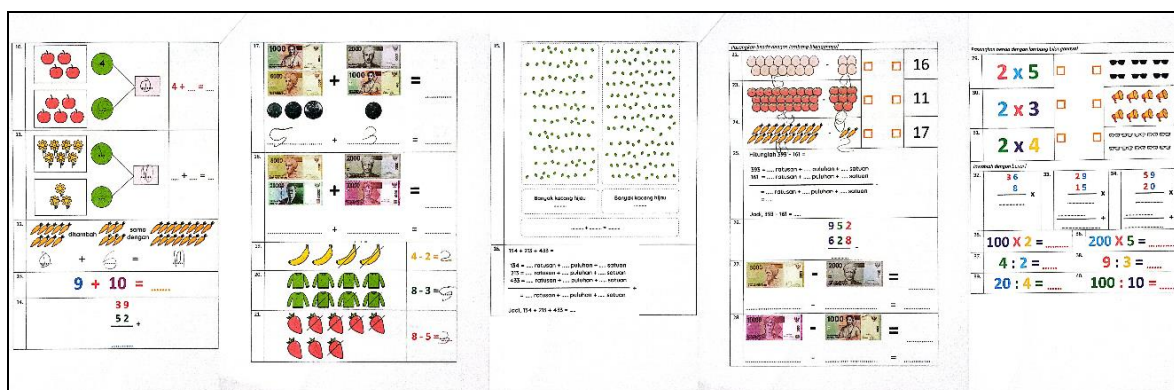


Figure 4. Results of Answer D

In Figure 4, D is only able to work on limited test questions on operating addition and subtraction on unit numbers properly. For other questions, it is still empty and not quite right. In accordance with the summary of the interview results with the shadow teacher, D was not yet able to independently work on simple arithmetic problems and was limited to adding and subtracting unit numbers with the help of directions and pictorial or concrete media. This is in line with the results of the observations, which show

that D can only work on test questions, assisted by dictating the results, and then he writes them down on the test sheet. He is only interested in pictorial questions. Based on the results of interviews and observations, D was not yet able to perform multiplication and division arithmetic operations and was limited to adding and subtracting units with assistance.

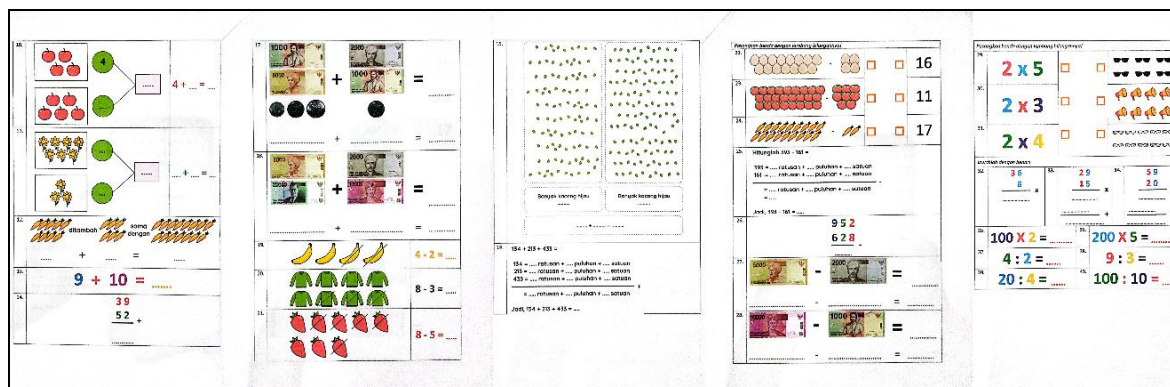


Figure 5. Results of Answer N

Figure 5 shows a blank test sheet. N has not been able to answer the test questions. Summary of the results of the interview with Shadow's teacher: N did not want to learn to count because he had previously been taught addition $1 + 1$ with his fingers, but he refused to learn by pushing his hands away. This is in line with the results of the observations showing that N was not interested in solving simple arithmetic problems and preferred to play. Based on the results of interviews and observations, N has not been able to operate numbers or solve simple arithmetic well.

Discussion

The ability of students with autistic disorder to learn initial numeracy is still very low, where D is only able to recognize numbers limited to units of numbers 1–9, while N is not yet able to recognize numbers because in writing the numbers an example must be given first. It can be concluded that D and N can complete numerations to recognize limited numbers in units with help. This finding is in line with previous research showing that students with autism still have very low numeracy skills (Trickett et al., 2022). Previous research stated that the low numeracy skills of students with autism were influenced by cognitive and linguistic skills that experienced deficits, as the theory of autism is based on historical deficits (Huntsinger et al., 2016; Ryan-Enright et al., 2022). In general, students with autistic disorder who have cognitive skills can gain knowledge about numeracy, although they need help with concrete objects or pictures. The method that can be used is to repeat the work until a knowledge scheme is formed in the memory structure (Khamid, 2011).

D and N have speech and language disorders, so D and N are able to recognize and pronounce numbers limited to units properly and correctly. They have not been able to recognize tens, hundreds, and thousands of numbers well. D is able to write the unit number symbol correctly, but N can only copy the unit number symbol. This finding is in accordance with previous studies that found that the relationship between speech and language competence was related to children's numeracy skills. So, they experience difficulties in symbol representation, verbal calculations, remembering numbers, and mathematical calculations (Kleemans et al., 2018; McLeod et al., 2019).

In carrying out simple numeration consisting of addition, subtraction, multiplication, and division of units, tens, hundreds, and thousands, D has not been able to do simple arithmetic as a whole. D can do simple arithmetic limited to adding and subtracting units with help. Whereas N is not yet interested in doing simple arithmetic as a whole and prefers to play. In students with autism disorder, their knowledge is atypical because, in the thinking process, they tend to focus too much on details and complications and have a tendency to judge visual presentations with short durations (Hannah et al., 2022). This is in line with previous research, which stated that the numeracy skills of students with autistic disorders can be caused by the difficulty in directing their attention due to their limited interest (Cox & Jimenez, 2020; Hannah et al., 2022; McDougal et al., 2020).

Another study shows that in children with autistic disorder, the part of the brain behind the forehead (the pre-frontal cortex, or PFC) usually cannot function perfectly so that numerical processing is disrupted and their cognitive abilities and long-term memory are weak (Aunio et al., 2019; Glinik, 2022; Kleemans et al., 2018; Titeca et al., 2014). One of the strengths of autistic children is visualization. Children

with autism can learn better through visual and interactive approaches (Kamaruzaman et al., 2016; Tashnim et al., 2017). D is more interested in doing tests with questions that have visualization, illustration, and color, even with assistance. Whereas N only saw the test questions with pictures, even though he was not interested in working on them.

Researchers found different results from previous studies. Previous research focused on the number sense ability of autism spectrum disorder (ASD) students in grade V (Marlina et al., 2022). Overall, in previous studies, it was found that the number sense ability of high-grade students with autism spectrum disorders (ASD), which included assessing the magnitude of numbers and the meaningfulness of symbols in numbers, was still relatively low. In particular, there are subjects who are able to master number sense, which is classified as moderate, and there are those who are not able to master it at all. Furthermore, the ability of autistic students differs from that of other autistic students. Therefore, overall, they have the same opportunity to improve their abilities. Based on the description of the research, students with autistic disorders have a tendency in their interest to improve their numeracy skills, which then requires a significant role of the teacher to help improve the numeracy abilities of students with autistic disorders (Irawan & Febriyanti, 2018).

In improving their initial numeracy skills, students with autistic disorder who are mastering number recognition and simple arithmetic operations can use teaching methods that are repeated because, generally, students with autistic disorder experience problems with their prospective memory (Hannah et al., 2022). In addition, to train students to improve their initial numeracy skills, it is hoped that in the future teachers can pay special attention to students with autistic disorder and facilitate various supporting needs in mastering initial numeracy so that students can improve their initial numeracy skills well. This research still has limitations, especially in the numeration section, which only involves grade 3 students with autism in elementary schools. It is hoped that future researchers can improve with a more in-depth analysis of the initial numeracy abilities of students with autism to be able to help students with autism understand initial numeracy.

4. CONCLUSION

Teachers have an important role in improving the initial numeracy skills of students with autism disorders. Intensive assistance by the teacher is needed in the initial numeracy learning of students with autistic disorders. Interactive learning and visual media are needed in order to attract their attention and use systematic and repetitive teaching methods so that students with autistic disorders are able to recognize numbers and do simple arithmetic. Based on the results of the study, it was found that students with autism tend to have an interest in visual problems. The inability to master initial numeracy in students with autistic disorder is dominated by limited interest and attention, as well as brain disorders that cause low speech and language skills that impact numerical mastery or recognition.

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