

Analysis of Number Sense Ability in Children with Autism Spectrum Disorder (ASD) in Solving Mathematical Problems

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Abstract: Children with autism have disorders that distinguish them from typical children, but children with autism can also learn in school. The learning abilities consist of cognitive, affective, and psychomotor abilities. In cognitive abilities, there are various types of abilities, one of which is the ability to number sense. This study aims to analyze the number sense ability of children with autism in solving math problems. This research belongs to the type of qualitative research that uses a descriptive approach. From the research results, the number of sense abilities in autistic children is still low and different for each autistic child, depending on their communication and concentration skills. SA1 satisfies several indicators: it determines the size of the numbers, the meaning of numbers and symbols in the set, and estimates.

Keywords: Number sense; children with autism; solving mathematical problems.

INTRODUCTION

The 1945 Constitution in Article 31, paragraph 1 states that every Indonesian citizen has the right to education. Every citizen is no exception to those with physical or mental disorders. This means that children with special needs (ABK) are also entitled to the same education as other normal children.

Children with special needs have physical, psychological, and cognitive conditions with unique characteristics requiring special treatment. Children with special needs are divided into tunanetra (visual impairments), tunarungu (hearing disorders), tunawicara (speech disorders), tunagrahita (intelligence below average), tunalaras (behavioral and emotional disorders), gifted/talented (gifted children), dysgraphia, dyscalculia, dyslexia, slow learner (academic learning disorder) (Lysine & Sembiring, 2020).

One of the children with special needs is an autistic child. Autism or commonly called ASD (Autism Spectrum Disorder), is a complex and highly variable (spectrum) developmental disorder of brain function. Usually, this disorder includes communication, social interaction and the ability to imagine. (Pangestu & Fibriana, 2017). Autism spectrum disorder is a severe developmental disorder that impairs the ability to communicate and interact (Hartati & Hardiansyah, 2019). Although children with autism have disorders that distinguish them from typical children, they can also learn at school. The learning abilities consist of cognitive, affective, and psychomotor abilities. In cognitive abilities, there are various types of abilities, one of which is the ability to number sense.

Number sense is an essential topic in the mathematics curriculum (Cheung & Yang, 2020). Number sense is an essential primary math material in elementary school that students must master (Hermita et al., 2021). Number sense is a person's ability to estimate numbers, predict errors and correct calculation results, and make accurate and efficient calculations. (McIntosh et al., 1992). According to Dehaene (2001), number sense is the ability to understand quickly, estimate, and manipulate numeric numbers. With good number sense, a person can use knowledge about numbers in various situations, especially in mathematical problems. (Safitri et al., 2017). Number sense ability is one of the cognitive aspects that must be developed (Franzon et al., 2020; Maldonado Moscoso et al., 2020; many studies have suggested that subjects with high sensory precision in the processing of non-symbolic numerical quantities (approximate number system; ANS Tomlinson et al., 2020).

How many research results reveal that autistic children find it difficult to develop early number sense abilities? (Oswald et al., 2016; Titeca et al., 2014; Hojniski et al, 2018). According to several studies, the number of sense abilities in autistic children is low. Nevertheless, number sense ability must be developed because it significantly influences students' mathematics learning.

Facts in the field that researchers found during observations at SLB Sri Soedewi, it was obtained information that the teacher only taught his students with the standard algorithm, and the teacher also did not know what number sense was. This is in line with

research conducted by Faulkner & Ten (2007) that the low number sense ability of students is due to the absence of a specific definition of number sense which causes teachers to be unable to determine a learning design to develop this ability. Autistic students have difficulty presenting solutions in detail and still follow the way the teacher solves math problems following what the teacher teaches in class. To see the number sense ability in children with autism, it is necessary to research to analyze the number sense ability in autistic children.

METHOD

This research belongs to the type of qualitative research that uses a descriptive approach. According to Sugiyono (2019), qualitative research is research that is used in natural places, and research does not make treatment because research collects data based on the views of data sources. On the other hand, the descriptive approach produces data in the form of written or spoken words and not in the form of numbers.

This research was conducted at Sri Soedewi Masjchun Sofwan Special School, Jambi City. The subjects in this study were students with unique abilities, namely autism in class V. Researchers chose this school as the research location because the school had autistic students.

The main instrument and auxiliary instrument were used to obtain number sense data for autistic students. The main instrument is the researcher, who interacts directly with the research subject. As the main instrument, the research position is as a planner, implementer of data collection, analysis, data interpreter, and in the end, becomes a reporter for the results of his research. Other research instruments are: (1) Written test questions and (2) an Interview guide.

RESULT AND DISCUSSION

Result

In this study, the subject needed is autistic students. After consulting with the autistic teacher, the researcher is advised to conduct research in the VF class because the teacher is the class teacher in that class and in that class, some students have mathematical abilities and are easier to interact with. So that obtained two students who allow being used as research subjects. Subjects were labelled SA1 and SA2, where the student was an autistic child.

In order to carry out the researcher's goals in analyzing the number sense abilities of autistic students, the subjects needed in this study were autistic students. Based on the recommendation from the teacher, two students were found as research subjects, the reason being that only these two subjects had mathematical

abilities and were easier to interact with. This subject is in labels SA1 and SA2, where the student has characteristics such as parroting and a little difficulty in communicating. This is in line with the statement Mujahideen (2012) that one of the characteristics experienced by autistic children is parroting and difficulty communicating.

In this study, the researchers will use two sessions on both research subjects. SA1 is carried out before the start of the learning process, while SA2 is carried out after the learning process. This is due to conditions in the field that allow researchers to meet students more quickly and take advantage of the time.

The research process begins with introductions with students to build good communication. In this study, the researcher carried out two ways, namely tests and interviews. The first way is by giving a number sense ability test in the form of a test sheet of 4 questions. At first, the researcher asked the students to write down their data on the test sheet and answer the questions on the questions. Then, the researcher sat next to the student to accompany the student while paying attention to how the student answered the test. The time needed to work on the questions is 6 minutes, and the number sense ability test runs smoothly. After the test ended, the researcher informed the students that later, the students would be asked for help to carry out interviews related to the tests that had just been carried out. For the second method, namely, interviews, where the questions asked are by the interview guidelines that have been made. The interview activity takes 7 minutes. To facilitate the compilation of the interview results, the researcher used a recording device from a cellphone. The researchers used the same treatment and process for SA2 after the classroom learning process occurred because time did not allow it to be carried out before the learning process. The research was carried out in the VF.

The Description of Each Indicator

Assessing Numbers

The indicator for assessing the number's magnitude is in question 1. In the question, students are asked to write down the order of the number of balls and write it down in the column provided. The number of balls in each column is different and not sequential. This will fool students, as students can just write a number sequence from 1-20 if students are not carefully working on the problem. This can be seen from the ability of number sense in the indicator to assess the size of the number.

Mental Computing

Mental computing indicators are found in question number 2. In the questions, students are asked to complete the addition of tens. Many ways can be used to do this problem.

Figure 1. Subject SA1's Answer to the First Indicator of Question Number 1

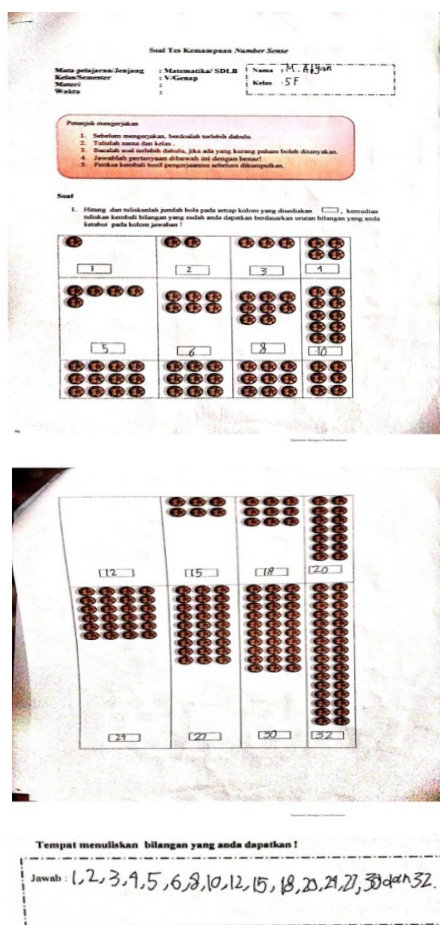
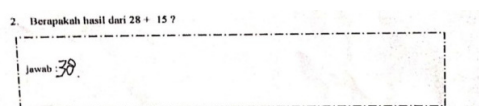


Figure 2. Subject SA1's Answer to the Second Indicator of Question Number 2



It is just that students' cognitive computing should not use any tools. Cognitive computing refers to the ability to do calculations "in the head" to produce exact answers (McIntosh, Reys & Reys, 1997). So, students in doing calculations do not use counting tools, such as calculators, pencils and paper. Students can only think about the answers in their heads.

The Significance of Symbols in Numbers and Quantities

Indicators of the significance of the symbols for numbers and quantities are found in question no. 3. In the question, students are asked to determine which addition of the two groups of apples. If you look at the sum of the questions: 5+3 with 12+3, it can be seen that the two additions are both added to 5. Students can quickly answer the question by understanding the quantity of a number.

Estimate

The estimation indicator is found in question no 4, in which students are asked to calculate the estimated time needed. Again, students can use knowledge in estimating time. As in the question, 15.00 is the same as 3 pm, and 17.00 is the same as 5 pm. Then students can determine the estimated time needed for students to answer the question.

Description and Data Analysis of Test Completion Results by SA1

Analyzing the number sense ability of autistic students in solving problems requires questions that are made based on indicators of number sense ability. The questions used in this study were four that had been validated by mathematicians and classroom teachers and declared valid. For more details, the following is an explanation of the data on the results of the test completion tests by research subjects.

Judging Large Numbers

Regarding the first indicator of the ability of number sense, namely assessing the size of numbers. The subject is said to have met the indicators of assessing the size of the number if the subject can assess the size of a number so that he can sort the numbers entirely and correctly. The following are the results of the SA1 subject's answer in assessing the number of written numbers in question no. 1, which can be seen in Figure 1.

From Figure 1, SA1's answer to question no. 1, the answer sheet shows that SA1 can assess the magnitude of numbers. Because students can assess the magnitude of numbers from the number of objects and then be able to sort numbers entirely and correctly, this is also reinforced by the results of the interview with SA1, where SA1 understands the question of the question that asks to mention the number of balls and SA1 can answer the question correctly, so based on the results of the SA1 test and interview, it is found that SA1 meets the indicators of assessing the number of numbers.

Mental Computing

Regarding the second indicator, the ability of number sense is cognitive computing. Subjects are said to meet the indicators if they can count without always based on existing algorithms. For example, the following results from SA1's answer to question no. 2 can be seen in Figure 2.

Based on figure 2 the answer sheet for the test, SA1 has not been able to answer the question about the second indicator in writing. The subject experienced an error while writing the answer. It can be seen that SA1 wrote the wrong answer.

Figure 3. Subject SA1's Answer to the Third Indicator Question Number 3

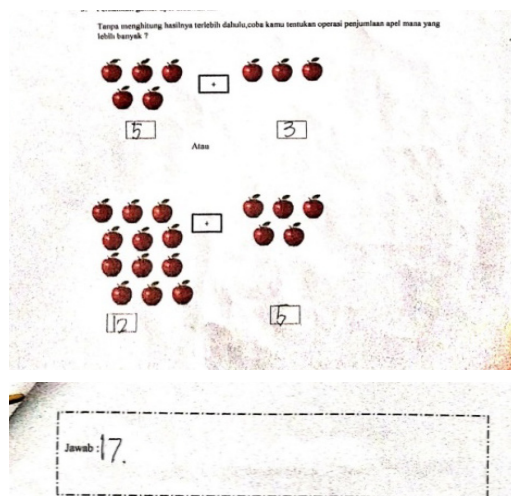
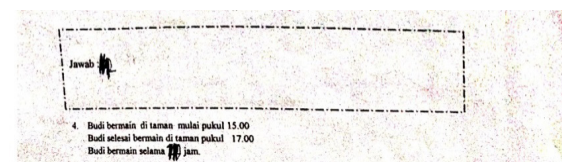


Figure 4. Subject SA1's Answer to the Fourth Indicator Question Number 4



This is reinforced by an interview with SA1 on the second indicator, where SA1 can understand the meaning of the question that asks the number $28 + 15$. SA1 is also able to answer questions from the question. Based on the tests and interviews, SA1 tries to answer it by counting using his fingers. Students seem to find it challenging to communicate in a language, so the subject uses gestures indicating that the subject counts the answer with his fingers. According to the statement Mujahideen (2012), autistic children have difficulty communicating, so these autistic children often use non-verbal communication language in the form of gestures or gestures. It can be seen that SA1 still uses the usual algorithm in counting, so SA1 does not fulfil the second indicator.

The Significance of Symbols in Numbers and Quantities

Regarding the third indicator, the ability of number sense is the meaning of symbols in numbers and quantities. Subjects are said to meet the indicators if they can understand the nature of a number's operation and the relationship between operations. The following results from the SA1 subject's answer to question no. Three can be seen in Figure 3.

From Figure 3, SA1's answer to question number 3, the answer sheet shows that SA1 students wrote down the number 17, which means the student counted the most apples. It was strengthened when SA1 was interviewed about question number 3 for the third

indicator, where SA1 could understand the questions from the questions and based on the interviews conducted when the researcher asked. For example, "Why is the answer 17?". SA1 replied, "12+5," and immediately pointed at his finger. This indicates that SA1 in the process has calculated the results first. However, it looks like SA1 has been able to understand the nature of the addition operation because the apple in the problem uses the addition operation, and the number will increase. Therefore, students have met the third indicator.

Estimate

Regarding the fourth indicator, the ability of number sense is an estimation. Subjects are said to meet the indicators if they can estimate the number of objects, hold estimate objects that can be measured, and estimate the answer from the calculation of numbers. For example, the following are the results of the SA1 subject's answer in estimating the answer to question no. 4, which can be seen in Figure 4.

From Figure 4, SA1's answer to question no. 4, the answer sheet shows that SA1 students wrote the results in 3 hours. It strengthens the results of interviews with SA1 on the fourth indicator. Based on the interviews, it appears that students understand the concept of a clock where 15.00 is the same as 3 o'clock. Then the subject counts 3,4,5. However, the answer is not entirely correct because students should have answered Budi's length of play by calculating the duration from 3 pm to 5 pm, so the answer should be 2 hours. This happened because while working on the last question, a friend from SA1 came and asked him to talk, so SA1 lost focus when answering it. By the opinion of Sawitri (2020) that one of the disorders experienced by autistic children is difficulty focusing.

The score obtained by SA1 in doing the written test, on question number 1 it can be seen that SA2 on the indicator for assessing the size of numbers gets a score of 3, on the mental computing indicator gets a score of 0, on the indicator of the number of numbers as a result of operations gets a score of 2. On the estimation, the indicator gets a score of 1. This shows that SA1 has fulfilled several number indicators. Sense includes understanding the magnitude of numbers, the meaning of symbols in numbers and quantities and estimation.

Description and Data Analysis of Test Completion Results By SA2

Assessing Numbers

Regarding the first indicator assessing the size of numbers. The subject is said to meet the indicators of assessing the size of the number if the subject can assess the size of a number so that it can sort numbers entirely and correctly. For example, the following are the results of the SA2 subject's answers in assessing the number of written numbers in question 1, which can be seen in Figure 5.

Figure 5. Subject SA2's Answer to the First Indicator of Question Number 1

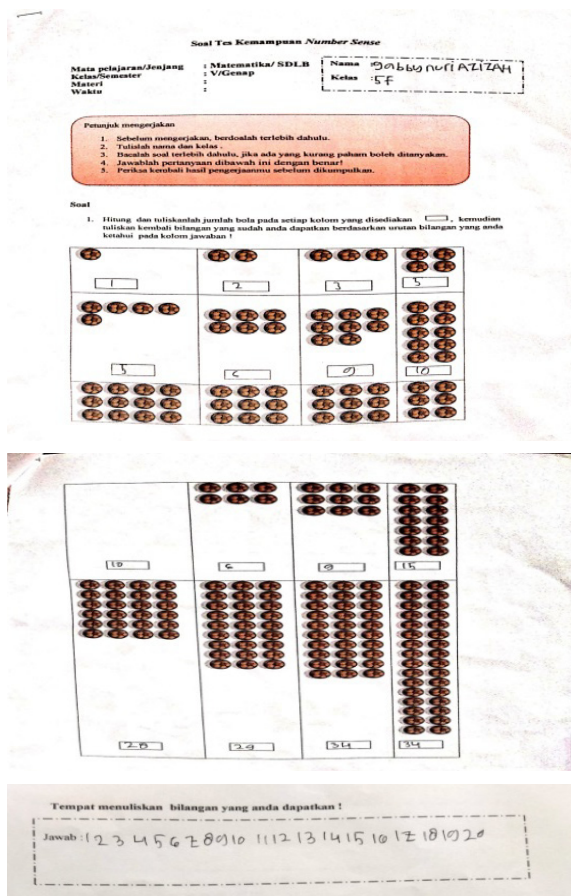


Figure 7. SA2 Subject Answers for the Third Indicator Question Number 3

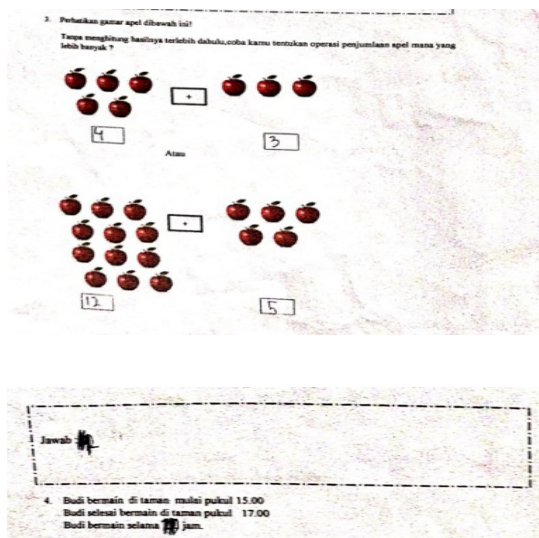
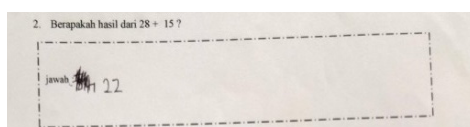


Figure 6. Subject SA2's Answer to the Second Indicator of Question Number 2



From Figure 5, which is SA2's answer to question no. 1, the answer sheet shows that SA2 is not able to assess the magnitude of numbers. It can be seen that the subject can calculate the magnitude of the number of objects, but the subject is still less careful in calculating them. When sorting, the subject only writes down the sequence of numbers from 1-20. This is reinforced by an interview with SA2 on question no. 1, the first indicator. SA2 claimed to understand the question, but when SA2 was only silent when asked to explain, from the test results and interviews, SA2 had not been able to communicate well. SA2 did not fully answer the questions asked. In line with the opinion of Olives (2017), which says that autistic children have disorders of the nerves of the brain, which result in children not being able to communicate effectively. This shows that students do not understand question number 1. So, SA2 has not met the indicators of the number numbers.

Mental Computing

Regarding the second indicator, the ability of number sense is cognitive computing. Subjects are said to meet the indicators if they can count without always based on existing algorithms. The following are the results of SA2's answers to question no 2.

Based on the answer sheet for the test, SA2 has not been able to answer questions about the second indicator in writing. When counting, students use their fingers to count. Because of the subject's lack of accuracy, it is just that the subject experiences errors when writing answers.

When interviewed, the subject also had difficulty calculating the results, and it was seen that the subject deleted the first answer and then changed it by counting again. Therefore, SA2, in answering the question, does not match what was asked and has not been able to answer the question with what was asked. Moreover, similarly to SA1, SA2 also uses the same way to calculate the results using fingers. This shows that SA2 is also in its completion, still using the standard algorithm. Therefore, the subject has not fulfilled the second indicator.

The Significance of Symbols in Numbers and Quantities

Regarding the third indicator, the ability of number sense is the meaning of symbols in numbers and quantities. Subjects are said to meet the indicators if they can understand the nature of a number's operation and the relationship between operations. The following are the results of the SA2 subject's answers to question no. 3, which can be seen in Figure 7.

From picture 7, which is SA2's answer to question number 3, the answer sheet shows that the subject of SA2 crossed out the first answer he answered. At first, the students answered 4, but after being interviewed, the students changed the answer to 12.

Figure 8. Subject SA2's Answers to the Fourth Indicator Question Number 4

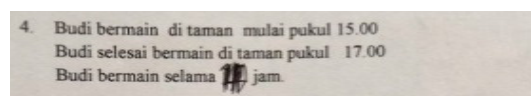


Table 1. Indicators of Number Sense Ability achieved by SA1 and SA2

Subject Name	Number Sense Ability Indicator			
	1	2	3	4
SA1	√	-	√	-
SA2	-	-	-	-

Table Description:

- 1: Assess the magnitude of the number
- 2: Mental Computing
- 3: Significance of symbols in numbers and quantities
- 4: Estimate

Based on the interviews conducted, the researcher asked, "why the answer 4?". SA2 answered, "We try to count the same as 1,2,3,4,5,6,7,8,9,10,11,12,13 (counting while pointing to the apple on the question). 13 more than apples, which is asked at most 12". Students can understand the nature of the addition operation because the apple in question uses the addition operation. It is just that students do not understand the question well, so the answers given are less precise. Therefore, the subject has not met the third indicator.

Estimate

Regarding the fourth indicator, the ability of number sense is an estimation. Subjects are said to meet the indicators if they can estimate the number of objects, estimate objects that can be measured or predict answers from calculating numbers. For example, the following are the results of the SA2 subject's answers in estimating the answer to question number 4.

From Figure 8, which is SA2's answer to question no 4, The answer sheet shows that at first, the SA2 students wrote the results in 22 hours, but after being interviewed, the students changed their answers to 29. Based on the interviews conducted, the researcher asked, "What do you ask for?". SA2 answered, "15 + 17, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 (subject counts using fingers) so the answer is 29". This shows that the subject of SA2 has not understood question no 4, and wrote the wrong answer. Therefore, the subject has not met the fourth indicator.

As for the score obtained by SA2 in doing the written test, in question number 1, it can be seen that SA2 on the indicator assessing the size of the number gets a score of 0, and on the mental computing indicator gets a score of 0, on the indicator of the number of

numbers as a result of operations gets a score of 0. On the indicator, the estimate scored 0. This indicates that SA2 has not met the number sense indicator.

Discussion

After doing research and data processing, it was found how the number sense ability of autistic students in doing math problems was found. This study uses instruments such as test sheets and interviews in which each question contains indicators of number sense ability, namely assessing the magnitude of numbers, cognitive computing, the meaning of symbols in numbers and estimation. However, the number sense ability test questions have a weakness for the data collection instrument. Weaknesses are found in questions no. 1 and no. 3, where question no. 1 cannot describe the indicators of assessing the amount as desired. For question no. 3, the question given is not quite right because it cannot be determined that the operation of adding apples should be the result of the sum of the two groups of apples which has more. This question can confuse students. So this number sense ability test has a weakness. To analyze the number sense ability of autistic children can be seen from the results of the answers to each instrument given. The number sense ability of SA1 is different from that of SA2, which can be seen in Table 1.

From the results of the SA1 research, it has been found that it fulfils several indicators: determining the size of numbers, the meaning of numbers and symbols in the set, and estimates. On the other hand, SA2 does not meet the index of number sense ability at all. In detail, each indicator is described as follows:

In the first indicator, namely assessing the size of a number, SA1 meets the first indicator for estimating a number. In contrast, SA2 does not meet the first indicator for estimating the size of a number. When solving question number 1, SA1 answers correctly. SA1 can estimate the size of the numbers and sort them from smallest to largest. Unlike the case of SA2, the subject could not answer correctly. This is because SA2 has not been able to communicate appropriately. In line with Zaitun (2017), autistic children have neurobiological disorders that interfere with brain function, so they cannot communicate effectively. According to Hadi (2015), so that students can understand the magnitude of a number, students must be able to compare numbers, sort numbers,

Then the mental computation indicator in question number 2 is a simple task. However, SA1 and SA2 had problems, as seen by how students handled the questions. SA1 and SA2 solve the problem with the help of a finger, but the results obtained are both wrong. According to the statement Mujahideen (2012), autistic children have difficulty communicating, so these autistic children often use non-verbal communication language in the form of gestures or gestures.

Hadi (2015) revealed that in order for students to be said to be doing cognitive computing, students could load algorithms, but alternatives should also be supported. Furthermore, when students solve problems, they only focus on solving them using their fingers. So it can be concluded that SA1 and SA2 have not met the mental computing indicators.

Then, indicators of the meaning of symbols in numbers and quantities in question number 3. When completing the question, SA1 answered the question correctly. SA1 can determine the most number of apples. This shows that SA1 can understand the nature of numerical manipulation and can compare numbers. This is different from SA2, where the subject cannot correctly answer question number 3. Students only focus on the most apples without considering the results of the two groups of apples. According to De Lange (1996), the meaning of symbols in numbers and quantities is one indicator of number sense. For students to carry out this indicator students must understand several things, including the effect of operations on a number and the relationship between operations. From the subject's answer, it can be seen that SA1 meets the third indicator while SA2 does not meet the third indicator.

Finally, the estimation indicator in question number 4. SA1 answered with an incorrect answer. Subjects found that 15.00 pm is the same as 3 pm and 17.00 pm is 5 pm, so SA1 counts 3, 4 and 5. It is not like SA2 cannot answer correctly, and SA2 adds known numbers to questions during the interview, so SA2 gives unexpected answers.

According to Hadi (2015), estimates are divided into three categories, one of which is measurement. It refers to a person's ability to estimate an object's weight, length, or volume and its time. Therefore, respondents' responses indicate that SA1 and SA2 do not meet the estimation indicators.

According to Hadi (2015), estimates are classified into three, and one of them is the measurement. This refers to a person's ability to estimate an object's weight, length or volume and time. So from the subject's answer, it can be seen that SA1 and SA2 have not met the estimated indicators.

CONCLUSION

Although children with autism have disorders that distinguish them from other normal children, they also can learn at school. The learning abilities consist of cognitive, affective, and psychomotor abilities. In cognitive abilities, there are various types of abilities, one of which is the ability to number sense.

Number sense is an essential primary math material in elementary school that students must master. Number sense is the ability to understand quickly, estimate, and manipulate numeric numbers.

With good number sense, one can utilize knowledge of numbers in various situations, especially in solving mathematical problems.

The study results concluded that the number of sense abilities in autistic children was still low and different for each autistic student, depending on their communication and concentration skills. SA1 satisfies several indicators: it determines the size of the numbers, the meaning of numbers and symbols in the set, and estimates. On the other hand, SA2 does not meet the index of number sense ability at all. For this reason, the number sense ability in autistic children must continue to be developed.

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