Research Article https://doi.org/10.12973/ijem.9.1.1

International Journal of Educational Methodology
Volume 9, Issue 1, 1 - 11.
ISSN: 2469-9632
http://www.ijem.com/

Gesture Analysis of Children with Special Needs in Solving Mathematics Problems

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*Received: July 31, 2022 ▪ Revised: S*eptember *18, 2022 ▪ Accepted: December 13, 2022*

Abstract: Mathematics learning is essential for children with special needs (CSN). The process of learning mathematics at the CSN can be started from concrete to abstract. During the math learning process, many gestures are produced by CSN. Gestures can direct the individual to take and understand the implied meaning of any movement or facial expression. The problem formulated in this study is how the CSN gesture in learning mathematics and aims to describe the gesture produced by CSN during the mathematics study. The subject in this study was the CSN with an autistic category. Research is conducted by observing the mathematical learning process. This research uses a qualitative approach. Data is collected with an observation technique using an audio-visual camera and is subsequently analyzed qualitatively. The results showed that the fundamental characteristics of CSN in math learning could be seen from the gesture. Each gesture contains verbal meaning and can represent how they think they are in understanding mathematical problems. Another characteristic is indicated by repeated actions (gesture pointing repeatedly). This condition indicates the special attention and confidence of CSN toward the object being observed.

Keywords: *Autistic gesture, children with special needs, mathematics learning.*

To cite this article: Mustafa, S., Baharullah, & Sari, V. (2023). Gesture analysis of children with special needs in solving mathematics problems. *International Journal of Educational Methodology*, *9*(1), 1-11. https://doi.org/10.12973/ijem.9.1.1

Introduction

Children with special needs need special (CSN) treatment due to developmental and children's disorders. CSN is another term to indicate the existence of special disorders in children. The term CSN does not replace the term children with disabilities or extraordinary children, but the term CSN is used in a broader context of children with diverse needs (Santoso, 2012). Koswara (2013) outlines the process of learning mathematics in CSN, which can be started from the concrete to the abstract; for example, in geometric shapes, the teacher can do learning by introducing geometric shapes using various concrete objects. Students can take actions such as observing/seeing, touching and revealing/mentioning geometric shapes on tangible things they keep. Students can be taught to identify or group objects according to their similarities (Mustafa, 2015). Each CSN has its view of learning mathematics, and the difficulties experienced are also different. For example, a complex understanding of mathematical concepts is due to the changing mood of children, so it is easy to lose interest and refuse when given or continue to complete assignments. The usefulness of learning mathematics for students with special needs is a basis for problem-solving in everyday life. The use of problem-solving field is mainly for use in everyday life. The usefulness of learning mathematics for students with special needs is a basis for problem-solving in everyday life. The use of problem-solving field is mainly for use in everyday life.

Ulva and Amalia (2020) explain that there are several reasons for the need for special needs to learn mathematics, namely because (a) Mathematics teaches problem-solving skills, (b) Learning to live smartly, (c) Mathematics opens up insights about other academic subjects, (d) Mathematics provides broad and promising employment opportunities, (e) Mathematics makes us bright at work, and (f) Mathematics makes us wise parents in the future. CSN to learn mathematics because it can help them in their daily lives. Learning mathematics can train the work of the brain so that it can think logically and develop student creativity so that it can be well received by the community (Ulva & Amalia, 2020). Children with special needs need to learn mathematics because it can help them in everyday life (Mustafa et al., 2021).

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According to Yoon et al. (2011), gestures that appear accompanied by speech are often considered derived products of the mind. Therefore, Thomas Jha et al. (2021) state that gestures produced during conversation can provide scientific thinking insights and aid scientific communication in adults and school-aged children. Regarding the mathematics learning process, Goldin-Meadow et al. (2009) argue that teacher gestures can help students in learning activities. When the teacher communicates with CSN, there is CSN gestures production, by what is said, and gestures that do not follow what is displayed. It is reinforced by Walkington et al. (2019) that when delivering learning materials, teachers use gestures to communicate ideas to students. Standing, sitting, and class mobility slightly affect the acceptance of information submitted to students. Gestures and speech are tightly linked (Sweller et al., 2021). One of the strategies that teachers can use is to apply the teacher's movements (body language) in managing the class. Applying gesture (body language) to the teacher in managing the class is relevant to be implemented because gesture or often called gestures, is a "form of non-verbal behavior in hand, shoulder, and finger movements (Desy et al., 2018). Non-verbal communication includes all stimuli (except verbal stimuli) in the communication setting generated by students and environmental users that have potential message value for students or teachers. Non-verbal communication can also be interpreted, namely, communication using gestures, attitudes, facial expressions, symbolic clothing, signs, and the same symptoms that do not use spoken and written language (Rochmah et al., 2022). In other words, the gesture is a sign of physical behavior or an expression of feelings. It involves the movement of the body and the hand (Suresh et al., 2019).

There are several reasons why mathematics should be taught to students, both ordinary students and students with special needs, namely (a) mathematics teaches problem-solving skills, (b) mathematics develops students' ability to think logically, critically, and systematically, (c) mathematics teaches children discipline and responsibility, and (d) mathematics teaches students to make decisions. Learning mathematics can help train children with special needs to communicate and interact with the community.

The study of CSN gestures in mathematics learning is still rare, even though it is interesting to study because every motoric movement performed by CSN during the learning process describes cognitive that are compensated through nonverbal communication. Some previous studies by Cermak et al., (1980), McNeill (1985), Radford (2008), Goldin-Meadow et al. (2009), Healy (2015), Mustafa (2015), and Mustafa et al. (2016) explain the role and function of gesture in the learning. Every gesture produced by the teacher during the learning process will be imitated by the students and help them to understand every meaning and concept of the material.

Gestures with speech significantly contribute to children with special needs. In addition, gestures help to understand abstract mathematical concepts (Mustafa et al., 2021). Unfortunately, the limitations of previous research are still in general and need to highlight how CSN gestures are produced in solving mathematical problems. However, the previous study is a reference frame in this research because it provides specifications for aspects of the problem that need to be developed in the study. Furthermore, it describes the CSN gesture in solving mathematical problems and highlights the level of cognitive abilities.

This research is a follow-up of the previous research, and it is continuously developed by the researcher in order to contribute to mathematics education. Therefore, the problem formulated in this study is how the CSN gesture solves the mathematical problem. Does cognitive level affect CSN gesture production? The mathematical problems solved by CSN in this study focused on arithmetic operations and geometric shapes. The extension of the material will be followed up in the subsequent research.

Literature Review

CSN is in the process of growth/development and significantly experiencing abnormalities/deviations (physical, mental, intellectual, social, emotional, emotional) compared to other children of their age, so they require special education services (Komala Dewi & Mutmainnah, 2016). CSN has various categories. Farrell (2008) notes that there are 14 categories of CSN, but in this study, the CSN gesture is specific to the autistic category. CSN (autistic) occurs because of various factors, including genetic factors triggered by environmental factors (Mustafa, 2015). The following table outlines some of the characteristics of autistic.

Table 1. Characteristics of Children with Disabilities (Autistic)

Characteristic	**Explanations**
Social Interaction	1. There is an abnormal view movement. 2. Failed to show an object to others 3. Fails to develop the game with peers and prefers to be alone 4. Unable to understand the rules that apply in social interactions 5. Not able to understand the expression on people's faces or to express their feelings either in vocal form or in facial expressions
Communication and playing patterns	1. Approximately 50% are experiencing delays and abnormalities in language 2. Often unable to understand the speech aimed at them 3. When interested in objects/objects, they usually do not point or use body movements to convey their wishes, but by taking the hands of others to use to take the object in question
Activities and Interests	Showing abnormalities in play, such as Stereotypy, repairing, and uncreative.

CSN (autistic) is defined as experiencing developmental disorders of communication, social, and behavior by the criteria established by The Diagnostic and Statistical Manual of Mental Disorders, namely social interaction, communication, and restricted behavior (Posar et al., 2015). All CSN (autistic) can learn; they only need to find the right strategy to receive information well. Some methods can be used to help CSN (autistic) in learning activities: visual/verbal cues, modeling, visual support, prompting, fading, shaping, and chaining (Dodd, 2005), (a) Visual/verbal cues are non-verbal or verbal, using manual signs or visual strategies (Dodd, 2005). Visual strategy is a learning strategy using concrete or semi-concrete objects or symbols to convey learning, (b) Modeling is a learning strategy that uses parents or peers to be a model, especially when teaching new skills, (c) Visual support improves communication, transfers information and behavior, and develops independence (facial expressions, gestures, and body language), (d) Individuals need physical guidance to do the work. Prompting is an additional signal to help facilitate the correct response. Providing physical encouragement often guarantees individual success. Reinforcement must be given immediately after completing the mandatory work, (e) Fading is a systematic reduction of aid. Reduction of physical assistance gradually is a successful technique in teaching new skills. This reduction is significant, so they do not depend on help and cues. (f) Shaping is a procedure used to develop skills or behaviors that are not present in a person. Shaping is usually used to teach complex skills such as wearing clothes, eating, and socializing with others (Dodd, 2005), and (g) Channing is creating complex behaviors by combining simple behaviors that have become a part of a person. For example, in brushing teeth: first, save toothpaste in a toothbrush, then put a toothbrush in your mouth and then start brushing your teeth up and down, sideways, left and right, and so on.

In mathematics, CSN (autistic) can learn using the Visual Support strategy, especially in gesture production. The gesture is a form of non-verbal communication with bodily actions that are seen communicating specific messages. In communication studies, the gesture is a type of nonverbal communication that is unspoken. Naturally, the gesture is a nonverbal communication medium used to express themselves through movements that appear consciously or unconsciously (reflexes); gestures can be a substitute for speech (Mustafa et al., 2016). However, communicative cues should be studied with emotional displays to draw an ecologically valid picture of communicative development (Kachel et al., 2021). According to Freedman (Shein, 2012), the gesture is a facilitator of verbal expression. Proponents of this view argue that gestures are intended to achieve adequate verbal expression. In addition, Arnheim and McNeill (1994) also say hand and body movements can be considered gestures. Gestures are spontaneous hand movements produced when speaking (Wong & So, 2018).

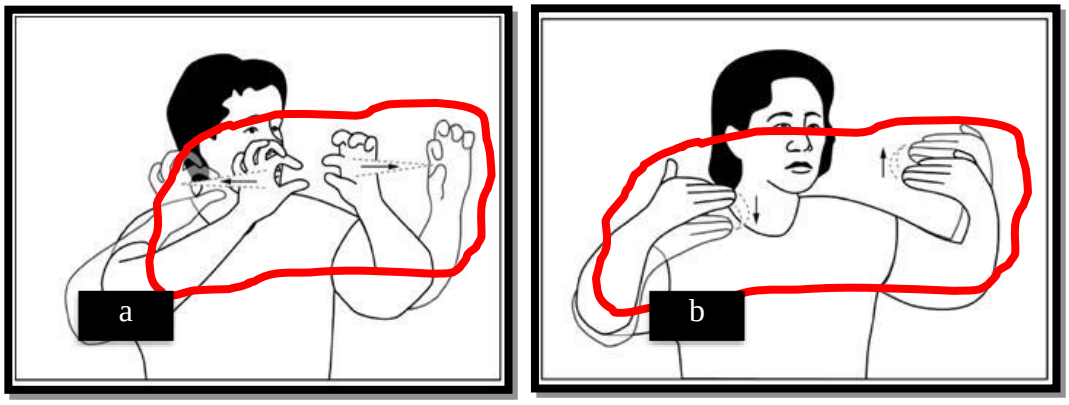

Figure 1. Gestures Describe the Situation Illustration

Figure 1.a emphasizes/reinforces certain aspects/specific aspects of large or small sizes, while Figure 1.b emphasizes/reinforces certain aspects/specific aspects at the top or bottom (Pease & Pease, 2008). Gestures can direct individuals to take and understand the meaning implied by every movement or facial expression. Mood instability that generally belongs to CSN is a unique characteristic that can affect gestures. To maintain stability, CSN can be given a stimulus as a reward/praise (Mustafa et al., 2016).

This study observes CSN gestures during the mathematics learning process and examines students' conceptual understanding while solving math problems. In learning mathematics, problem-solving is an important activity. To become good problem solvers, students need many opportunities to create and solve problems in mathematics and real-life contexts. Many students also experience difficulties in solving problems related to story problems. Gestures act as facilitators in solving mathematical problems (Mustafa et al., 2022). In learning mathematics, problem-solving is an important activity. To become good problem solvers, students need many opportunities to create and solve problems in mathematics and real-life contexts. Many students also experience difficulties in solving problems related to story problems. As facilitators in mathematical problems, gestures can reduce students' cognitive effort when facing mathematical problems. They are very helpful in communicating and interacting between teachers and students, and teachers can lay the foundation of new knowledge just by telling students by moving their hands. Gestures have different characteristics but effectively support meaning in communication. So, gesture can mediate (intermediary)

between gesture users and observers, subjective images, explaining things, and conventional conversations. Sweller et al. (2021) have explained that gesture seems to activate semantic meanings that are useful for comprehension and learning. Gestures activate semantic meaning that helps listeners infer what is meant when speech is unclear.

The literature review used in this research revealed that gestures contributed to learning. However, it must highlight CSN gesture production in solving the mathematical problem, the distraction experienced, how the cognitive level affects it, and the appropriate learning design for CSN in mathematics learning. Goldin-Meadow et al. (2009) studied mathematics learning, explaining that gestures are involved in ancient ideas and creating new ideas. We can lay the foundations for new knowledge simply by telling learners how to move their hands. However, it needs to be strengthened by understanding that gestures accompanied by speech will help us better understand their mathematical thinking process. In mathematics learning, understanding the mathematical thinking process of students is the involvement of bringing the students to gain the advantage of meaningful learning in mathematics (Mustafa et al., 2021). In this context, the teacher's role is essential in helping students during the learning process. Goldin-Meadow et al. (2009) revealed that teachers' gestures could support students in their learning activities. The other advantages revealed that gestures could guide individuals in having and understanding the implied meaning of every movement or expression. However, in another aspect, distraction problems need attention; Mustafa (2015) explained that unstable moods generally experienced by autistic students are one of the unique characteristics that can affect gestures.

Methodology

Research Design

This study uses a qualitative approach. Creswell (2012) describes several characteristics of research with a qualitative approach. First, the research process is constantly developing dynamically, meaning that all stages in the research process can change after the researcher enters the research location and begins to collect data. This research is interpretive and holistic (comprehensive), meaning that the researcher interprets what is seen, heard, and understood and tries to make a general picture of the problem under study so that this research offers diverse views on a particular problem related to the problems in this study (Mustafa, 2015).

Sample and Data Collection

Sample

The data sources in this study were children with special needs in the autistic category. Data collection was carried out during the mathematics learning process by recording audio-visual activities. Therefore, this study's data sources are primary and secondary. The data sources of this research are primary and secondary. Primary data is obtained by researchers directly from the activities of teachers and students during the learning process in the classroom. In contrast, secondary data comes from essential documents related to gestures. The students in this research are in elementary school, grades 5 to 6, in ages ranging from 10-12 years, and did not consider socioeconomic aspects or other status. There were 3 students involved in this study. However, in the discussion, only 1 student was designated as the subject, due to consideration of time efficiency, and the student was dominantly indicated fulfilling the specified characteristics, while 2 other students would be used in further studies.

Data Collection

In strengthening research data, supporting tools (instruments) are needed to collect data about gestures, namely observation sheets, worksheets, and audio-visual cameras used to record gestures that appear during the learning process (documentation). The data were collected into 3 techniques; (1) observation technique, observing students and teacher activities during the mathematics learning process. It aims to see the gestures produced by students during their activities. Observations were conducted by 3 observers who are the researcher’s colleagues. The observer observed every gesture of the students, especially in hand movements and their ability to complete math tasks. The observation was conducted during the learning process. The observer used observation sheets that informed about the characteristics of autistic students in completing math tasks. Each criterion consisted of one item; (a) the accuracy of the gesture (whether the gesture that appears when doing the task is produced correctly, for example, counting using the fingers is done correctly), (b) distraction (does the students have distractions/unfocused while doing the task, for example distracting to other objects), (c) communication (whether students can communicate their tasks, for example when the teacher asks students can answer correctly). (2) assignment technique, the students finish the assignment using the worksheet provided by the teacher. This aimed to identify the student's understanding of the material learned. While working on assignments, students are guided by teachers so that they can understand the tasks given. The assignment contains 10 math questions in multiple-choice form. (3) documentation technique, which is recording the learning process through a camera (video recorder). It aims to get information deeply related to the activities during the learning process. The results of the recording are used as material to improve the results of observations. The procedure of data collection was conducted in 3 meetings (3 weeks of learning).

Analyzing of Data

The data that were collected were analyzed using qualitative analysis techniques. Qualitative data analysis is carried out in an exploratory manner and continues until it is complete so that the data is saturated. The size of the data saturation is indicated by the absence of new data or information. The data analysis was conducted by the research team based on the steps: (1) data reduction, it focused on the process of reduction, focused on the process of selecting, simplifying, abstracting, and transforming the raw data resulting from the data collection process to be adapted to the needs and focus of research. (2) data presentation was conducted in a brief description followed by pictures. It was intended for the researcher to understand what happened and plan for further action. (3) verification and conclusion. This step aimed to find the significance of data collected by identifying relationships, similarities, or differentiation to draw conclusions as answers to existing problems. Verification intended for the assessment of the data congruence with the meaning contained in the basic concept of convenient and objective analysis is more precise and objective. After analyzing the data, the researcher ascertained whether the interpretation of the data was accurate. According to Creswell (2012), triangulation can determine accuracy. The validation involved 2 experts and using a validation sheet, and it had been examined. Qualitative validity in this study used triangulation of different data sources by examining the evidence from these sources, namely observation data, learning achievement data, and documentation. This strategy is suitable for researchers to use. Practically, this method is easier to practice to validate this data. Furthermore, qualitative reliability indicates that the approach used by the researcher is consistent if applied by other researchers. Creswell (2012) details a number of reliability procedures used in this study as follows: (1). Checking the results of data triangulation to ensure that no errors were made during the triangulation process. (2). Ensuring that there is no ambiguity of the definitions and meanings regarding terms/symbols/codes during the analysis process. (3). Discussion of results through regular analysis sharing meetings. (4). Conducting cross-checks and evaluating results.

Findings / Results

The study was conducted by observing/observing CSN (autistic) gestures during the mathematics learning process in class. The gesture is observed using two audio-visual cameras. Students are given a task sheet that contains several math problems (counting and recognizing geometric shapes). The following figure shows the student's activity by counting the number of figures given by the teacher.

Figure 2. Calculating Gestures $2 + 1$

Gesture raises both hands while observing the teacher, and then the right-hand sets 2 fingers while the left hand 1 finger. While saying the students call $2 + 1 = 3$, the gesture produced by SCN, according to their words, is categorized right as not experiencing distraction. Students count numbers $2 + 1$. Next, solve the problem $98 - 53 = \ldots ?$

Figure 3. Calculating Gestures $8 - 3$

The student can follow correctly in writing according to the teacher's direction. For example, in figure 3, in the first step, the teacher asks students to mention the numbers 98 − 53 repeatedly and then directs the writing in order of 98 − 53 to calculate the direction of the results. Then the teacher asks questions, pointing at the number" 8 − 3?". Spontaneously, the students raised their hands, the right hand with as many as 3 fingers and the left hand with 5 fingers, but could not determine the results correctly. Hence, the teacher directed by saying "*minus* 3" while pointing the three fingers on the right hand, and the student clenched his three fingers to mark "*was minus* 3 "then the points teacher said again," how much is left?" while pointing the five fingers of his right hand. Spontaneously students count one by five their fingers correctly, then say "5" while staring at the teacher. After being declared correct, students write numbers 5 but do not match their location, so the teacher directs them to write straight below 8 − 3.

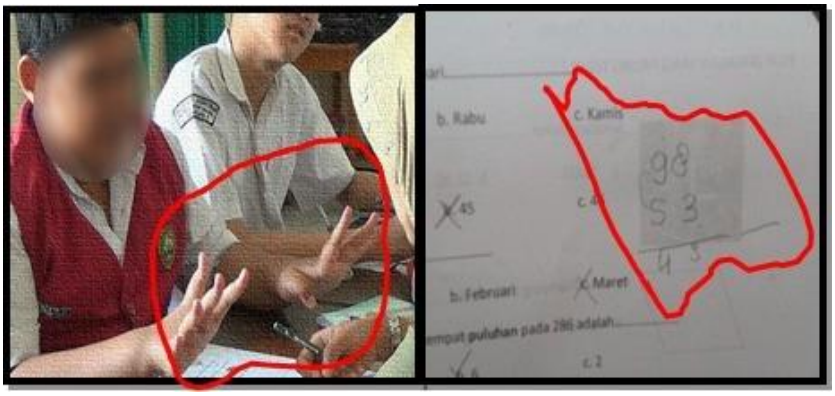

Figure 4. Calculating Gestures 9 − 5

Next, Figure 4 counts 9 − 3. Students raise their left hand with 4 fingers, followed by their right hand with 5 fingers, while showing it to the teacher, but the student cannot determine the result. The teacher said, "which one, *minus* 5?" students clenched their right hand with 5 fingers as a sign of minus 5 "while counting the remaining 4 fingers on the left hand, and the student experienced distraction counting from the thumb to the little finger so that the amount 5. The teacher redirects by setting as many 9 fingers. Students show their left hand as many 5 fingers, and right hand as many 4 fingers, without realizing the condition is different from before even though the results are the same, namely the left hand 4 fingers and right hand 5 fingers. The teacher said, "*minus* 5," while clenching his left hand and saying again," how much is left?" while pointing to the remaining 4 fingers in the right hand. Students start counting one by one, starting from the index finger to the little finger, and the results are exactly as many 4.

When it comes to determining geometric shapes, CSN, in general, can follow well. Students can process the information the teacher conveys because the questions are presented through colorful pictures that attract attention. The picture below shows the CSN hand gestures repeatedly pointing to images that look like conical geometries and tubes.

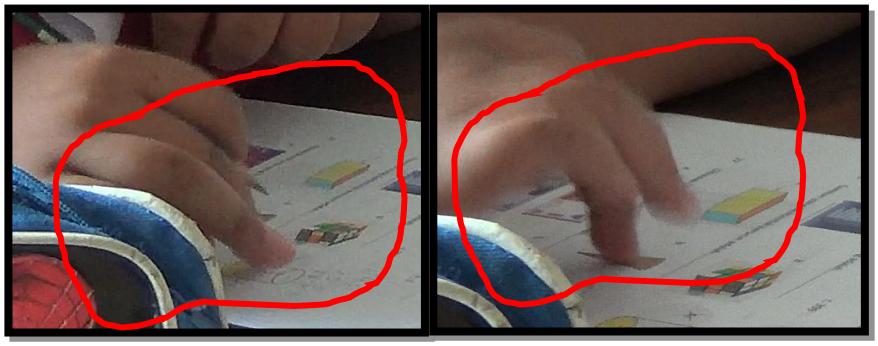

Figure 5. Geometric Pointing Gesture Designation

In the previous learning, the teacher has shown several examples of concrete objects that look like geometrical shapes so that CSN can repeatedly point to the appropriate picture when the teacher gives an assignment.

Based on the study's results, it can be described that to help CSN complete the desired learning tasks, one of the learning strategies is done with visual support. It was confirmed by The National Autistic Society (2020), which revealed that visual supports could be used to help CSN (autistic) learn mathematics. CSN (autistic) characteristics in learning mathematics tend to have difficulty processing sensory information, namely connecting knowledge based on procedures, language, and formal mathematical symbol notation. It can be understood because the "Neurology Record" possessed causes individuals to be very easily distracted from visual perception (disturbances when observing/seeing various objects/objects about sets or groups, resulting in discrimination of shapes and symbols). Baker's (2007)

research has revealed that CSN (autistic) needs intervention support in making abstractions because their brains function differently so the process of making the abstraction, they do is different from that of other normal children.

Discussion

The power of CSN thinking (autistic) is focusing on visual information that attracts attention. Mustafa (2015) revealed in their research that the process of learning mathematics could be meaningful by using concrete objects around. CSN's ability to follow the process of learning mathematics is also strongly influenced by cognitive levels. In this study, CSN is in a high-functioning autistic condition, which is a condition that shows high cognitive and intelligence functions, is the ability to use language and speech effectively, and offers the ability to follow routines even though it sometimes experiences distraction. Therefore, the essential thing that can be done in learning mathematics is knowing how to think CSN about the given mathematical material. This method will help the teacher see each individual's different mathematical abilities.

The primary characteristics of CSN in learning mathematics can be seen from gestures. It is reinforced by Healy's research (2015) which explores the role of the senses in learning mathematics (testing the mathematical activities of children with disabilities). In addition, research findings by Wong and So (2018) suggest that children with ASD may be in gestural production when they engage in spoken narratives, which gives them spontaneity in producing gestures.

Verbal gestures are a core part of the communicative system of the language (Pillion et al., 2019). Each gesture contains a verbal meaning and can represent how students think (what is believed to) in understanding mathematical problems. Another characteristic can be the presence of repetitive actions (gestures pointing repeatedly). This condition shows the special attention and confidence of CSN toward the object being observed. This condition can also be accompanied by "consistent speech," which is a sound/speech sound that is consistently used to refer to a particular object and can be confirmed by accents, for example, staring as a form of affirmation of nonverbal information carried out.

Other communicative functions of gestures (e.g., how gesture adds content to speech) have been studied in verbally fluent children and adolescents on the autistic spectrum. The functions of gestures are analyzed by categorizing gestures based on their meanings or semantic contribution, often denoted as gesture types (De Marchena et al., 2019). Understanding CSN in mathematics learning is very important to determine the barriers and needs and see their type of learning. Therefore, we need an appropriate learning method for them according to the abilities or barriers they have while learning. In particular, children with special needs and their spectrum are very diverse in communication skills, intelligence (cognitive) levels, and even social interactions. For example, autistic with high language skills generally use limited themes and have difficulty understanding abstract concepts. The learning video recordings of teachers and autistic students obtained from this study contained specific observations on CSN activities during the learning process of mathematics in the classroom. There are two essential components found. They are (a) students with high cognitive and intelligence who can use the language, speak up effectively, and show the ability to follow routines; (b) students with low intelligence and cognitive ability who cannot speak (nonverbally), who show limited interests and routines conducted. Autistic students have various spectrums, such as communication skills, cognitive level, and social interaction. Autistic students with high ability generally use limited themes, making it difficult to understand abstract concepts.

Mathematics learning problems for CSN cannot be solved only from within mathematics itself but are related to other aspects such as (a) spatial relationship skills (space), (b) motor skills and visual perception, (c) language and reading skills, and (d) children's ability to remember, and others. Therefore, it is essential to manage to learn well, ensure that the material is according to the student's abilities, and prevent negative attitudes or withdrawn behavior. One of the factors that cause withdrawal behavior is the psychological dynamics of the subject regarding changes in behavior and emotional stability, as well as poor motivational problems. Psychologically, students who withdraw tend to feel anxious, restless, afraid, and confused, which will cause insecurity and tend to separate themselves from others. Understanding student gestures during the learning process is quite helpful for teachers in overcoming anxiety and distractions that students may experience (Mustafa et al., 2021). Mathematics learning procedures that are suitable for the conditions of students with special needs include: describing the condition of the ability of students with special needs in mathematical substance, instilling key concepts, describing key concepts by manipulating concrete objects, switching to symbols, communicating and practicing in everyday life. Students who receive mathematics learning will be accustomed to understanding the properties owned and not owned by a set of objects (abstraction). However, all of that must be adjusted to the development of students' abilities so that, in the end, it will significantly help the smooth process of learning mathematics (Setiawani et al., 2017).

Mathematics is a subject that tends to be challenging to give to autistic students because these children experience obstacles or difficulties in terms of communication and social interaction. However, teachers can overcome this by using appropriate learning strategies so that autistic students can follow the learning process well, for example using gestures and concrete objects in presenting material and understanding every gesture produced by students while solving math problems. Abstract mathematical concepts cannot be simply transferred in the form of a collection of information to students. For example, an autistic child who has not or is the first time knows the concept of numbers.

So, to get to know the concept of numbers, you cannot just say numbers verbally but need concrete visualization, for example, 7 books to recognize numbers 7. The maximum assistance for autistic students is needed in learning mathematics. Thus, children with autistic need a companion teacher to help and direct autistic students when

they have difficulty learning mathematics. The ability of students to solve a mathematical problem has different levels. In particular, in autistic students, the learning styles mainly used are visual learners and hands-on learners. Teachers should use experience and visualization to explain complicated things for children to understand, such as using media or other concrete teaching aids.

Each CSN, especially the autistic category, has advantages and disadvantages that can be directed to learning mathematics. Some of the standard mathematics teaching techniques can be modified to teach the autistic category. Because mathematics is traditionally taught using language, while autistic students have deficiencies in language, it is advisable to use visuals and demonstrations in learning mathematics. It is intended that children immediately see the concept visually and understand its meaning. Some special strategies in teaching mathematics to autistic children are: (a) Teach numbers and shapes. Numbers can naturally be taught while playing, for example using concrete objects in everyday life. For example, teach $1-5$, then $5-10, 11-15, and\ 15-20$ (depending on the child's ability, the target can be more or less in one teaching). In the same way, teach the shapes of circles, stars, rectangles, Etc. It can be in writing or not, depending on the child's condition, (b) Teach the sequence of numbers. For example, fill in the blank numbers in the sequence. Example $3, 4, 5. \ldots .7, 8$. Students will fill in the number 6 in the dots, (c) Teach addition. It can be started from something concrete and then abstracted. If you want to teach, for example, $4 + 5 = 9$. Teach using objects. 4 coins plus 5 coins equal 9. It can also be assisted by other calculating tools to help make other things concrete. After students begin understanding, it can be introduced in groups, such as learning addition. For example: $1 + 1 = 2, 1 + 2 = 3, 1 + 3 = 4, 1 + 4 = 5$ and so on. Teaching in this sequence helps the thinking of autistic students because of their structured and systematic way of thinking. Understanding every gesture produced by CSN in learning mathematics is interesting because besides being able to help them understand abstract mathematical concepts, the gesture is a limb movement that can reduce cognitive load and be a facilitator in solving problems. It is reinforced by Freedman (Shein, 2012), who revealed that gesture is a facilitator of verbal expression. Gestures deeply explain the meaning of thoughts and strengthen the meaning of speech. The gesture is an additional modality that is spontaneous and can serve as a bridge between personal images that are difficult to pronounce verbally and mathematical ideas that are formally symbolic. Gestures accompanied by speech when solving a mathematical problem can appear spontaneously and simultaneously (Mustafa, 2015), and according to McNeill (2000) gestures accompanied by speech can help shape thoughts. Gestures of autistic students in learning mathematics appear naturally and differ from one student to another. These differences give rise to various characteristics of mathematical thinking processes. In the learning process, CSN with the autistic category is easier to learn (understand learning material) through visual media, so learning that uses aids as learning media is the main choice for teachers. Aids can be pictures, puzzles, posters, balls, toy blocks, and others. Understanding every gesture produced by CSN in learning mathematics is interesting because besides being able to help them understand abstract mathematical concepts, the gesture is a limb movement that can reduce cognitive load and act as a facilitator in solving problems. It is reinforced by Freedman (Shein, 2012), who revealed that gesture is a facilitator of verbal expression. Gestures deeply explain the meaning of thoughts and strengthen the meaning of speech. The gesture is an additional spontaneous, which can serve as a bridge between personal images that are difficult to pronounce verbally and mathematical ideas that are formally symbolic.

Gestures accompanied by speech when solving a mathematical problem can appear spontaneously and simultaneously (Mustafa, 2015), and according to McNeill (2000) gestures accompanied by speech can help shape thoughts. However, the gestures of autistic students in learning mathematics appear naturally and differ from one student to another. These differences give rise to various characteristics of mathematical thinking processes. In the learning process, CSN with an autistic category is easier to learn (understand learning material) through visual media, so learning that uses aids as learning media is the primary choice for teachers. Aids can be in the form of pictures, puzzles, posters, balls, toy blocks, and others.

Conclusion

Based on the result and discussion of the research, it can be concluded that cognitive level can affect the CSN's gesture of learning mathematics. The specific observation of CSN activity reveals it during joining mathematic learning process, (a) Students with high intelligence and cognitive function can use language, speak effectively and show the ability to follow the routines, while (b) students with low intelligence and cognitive level, do not speak (nonverbally), they show limited interests and routines conducted.

Gestures production is varied based on CSN conditions. However, every gesture generally comprises verbal meaning and represents thinking ability. A strategy that can be used to support the CSN movement toward mathematics learning is visual support. So that it can help to process the information sensitively. In the learning mathematics process, the teacher should be creative and innovative in delivering material to students because mathematics is an abstract lesson and full of formulas that are difficult for children to understand, especially for students with special needs.

Teachers should apply an interesting and contextual approach and learning model in teaching students with special needs. The teacher can relate mathematics with a concrete thing that students with special needs can understand. For instance, the teacher explains the concept of multiplication by illustrating a fruit, toy, picture, or other concrete things by demonstrating the number of objects multiplied. Mathematic learning is like children with special needs. It is not only guided at increasing students' ability in counting but also guides them in problem-solving. Students' problem-solving abilities in mathematics have various levels. The learning styles used for autistics are (a) visual learners and (b) hands-on learners, so teachers have to use a lot of experience and visualization to explain things that are difficult for children to understand, such as using concrete media or other teaching aids.

Recommendations

This research was specifically conducted on children with special needs in the autistic category and only explained the gestures produced during the mathematics learning process. It is recommended as reference material for the world of education, especially educators (teachers), to provide special treatment for autistic in learning mathematics. So that abstract mathematical concepts can be easily understood. Other researchers can develop this research into various cognitive and gestures produced by an autistic student in learning Mathematics, including natural distraction and appropriate learning models for autistic students.

Limitations

This research was conducted on students with special needs but was limited to the category of autistic. The mathematical material studied is also limited to certain materials, so the observed gestures can still be easily described. There was a distraction (motor disturbances, unfocused) that did not significantly affect the ongoing learning process.

Ethics Statements

The research involving human participants underwent thorough review and approval by the Human Research Ethics Committee at the Universitas Muhammadiyah Parepare. Prior to participating in the study, all participants provided written informed consent, indicating their voluntary agreement to participate.

Acknowledgements

The authors would like to thank the Malang Autism Laboratory and the Rector of the University of Muhammadiyah Parepare Indonesia for their technical support, and all parties involved in this research.

Authorship Contribution Statement

Mustafa: Idea, concept, generalization, design, analysis, writing. Bahaullah: Data collection, data editing, data reduction. Sari: Data collection, data editing, data reduction.

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