

Mathematic Communication Skills of a 1st Grader with Down Syndrome in Primary School

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Down syndrome (DS) is characterised by weak motor control, and lack of ability to coordinate. However the DS student can still be trained to reach the point of regular ability in terms of mathematic communication skills in learning mathematics. In order to analyse the mathematic communication skills of a student with DS, a descriptive qualitative research approach was carried out, while the data collection was done by observation, interview, and documentation techniques. The research subject was one DS student in the 1st grade of elementary school. This study was conducted at SD Muhammadiyah 9 Malang, East Java, Indonesia. The results of the analysis stated that of the three indicators of mathematic ability in the verbal production aspect, the DS student was able to master the indicators of asking and answering questions. Whereas in the mathematic communication skills of the written aspect, of the three indicators shown, only one indicator had been mastered by the DS student, namely declaring a situation into the form of a mathematical model, although that ability has to be improved.

Key words: *Down syndrome, mathematic communication skills, mathematics learning.*

Introduction

Down syndrome (DS) is a condition of physical and mental development intellectual disability in children (Bruckner, Singh, Lelong, & Khoshnood, 2019; Clarós et al., 2019; Dandashi et al., 2015; Halliday & Mallucci, 2019), due to abnormalities in chromosome development (Ahlfors et al., 2019; Zampini & Zanchi, 2020). As one part of the group of children with special needs, DS children generally have more abnormalities than other disabilities, especially in terms of

their intelligence (Enea-Drapeau, Carlier, & Huguet, 2017; Godfrey & Lee, 2018; McKenzie, Milton, Smith, & Ouellette-Kuntz, 2016). Physically, children with DS show abnormalities that give rise to the typical facial appearance associated with this condition, including increased palpebral clefts with inner epicanthic folds, the flatness of nasal bridges, mid-facial hypoplasia, and the tendency to stick out the tongue, especially when they are very young. Many other minor functional abnormalities that are not too significant in the ears, hands, feet and stature are usually less perfect (Bull et al., 2011; Patil, Rao, & Majumdar, 2014).

DS children are also characterised by weak motor control and a lack of ability to coordinate. However, they can still be trained to reach their ability to the normal point (Alesi & Battaglia, 2019; Ferreira-Vasques & Lamônica, 2015; Pise, Pradhan, & Gharote, 2018; Zeng et al., 2017). In terms of cognitive abilities, DS children experience a slowdown in learning in their ability to overcome problems, so they cannot solve a causal relationship problem (Marchetti, 2018; Miendlarzewska & Trost, 2014; Pauli, 2019). Slow learning in children with DS cannot be cured, but with maximum support and attention, DS children can grow happily and maximise their potential. One of the supports that can be offered is in learning undertaken in schools (DSAWM, 2010; Ferguson, 2014; Mcfadden, 2014).

At the primary school level, there are several subjects that all students need to master, including DS students. One of these subjects is mathematics (Engevik, Næss, & Berntsen, 2018; Faragher & Clarke, 2016; Gil Clemente & Cogolludo-Agustín, 2019; Leonard & Chaidir, 2018; Opoku, Tawiah, Agyei-Okyere, Osman, & Afriyie, 2019). In learning mathematics, when students think about mathematics and communicate thought results verbally or in writing, it means students are learning to explain and influence what is in their minds. This condition also applies to DS students (Hill et al., 2008; Sedova et al., 2019; Zaslavsky & Shir, 2005).

The activity of thinking about mathematics, then communicating verbally and in writing the results of mathematics, becomes the most fundamental point for measuring learning success (Bambaeroo & Shokrpour, 2017; Freeman, Higgins, & Horney, 2016; Yayuk & Husamah, 2020). Mathematical communication is not just exposing ideas but also involving activities to talk, explain, describe, listen, ask, clarify, and share opinions (Bambaeroo & Shokrpour, 2017; Scusa, 2008; Wichelt, 2009; Wood, 2012; Zwiers et al., 2017). With all its limitations, DS students also do the same thing in learning mathematics.

As the results of the initial interview with teachers for children with special needs grade 1 at SD Muhammadiyah 9 Malang of East Java Province, it was known that DS students undertook mathematics learning activities following the material that had been determined. When learning mathematics, for example, the theme of number recognition, students had difficulties in recognising, differentiating, and writing numerical symbols. The implication was that DS students had more challenges in communicating numerical symbols in spoken language. The

results of observation in January-February 2020 indicated that the teachers had been drilling introduction to numbers material, pronunciation, and writing practice that were conducted continuously in class. However, DS students had not been able to meet the learning objectives.

Furthermore, it should be understood that when students get information in the form of mathematical concepts given by the teacher or obtained from various sources (reading material/media/learning methods), there will be a transformation of mathematical information from the source to the students. Students will respond based on their interpretation and understanding of the information. The problem that often arises is the response given by students to the information received is not following what is expected. This might happen because of the mathematical characteristics that are full of terms, symbols, and formula, so it is not uncommon for students to be able to solve mathematical problems well, but they do not understand what they are doing (no concept understanding). Therefore, skills in expressing and communicating mathematical ideas become important both verbally and in writing. According to Astuti and Leonard (2015) and Nuraini and Surya (2017), by communicating mathematically students can improve vocabulary, develop speaking skills, write ideas systematically, and have better learning abilities. Accordingly, Freeman et al (2016) mention, mathematical communication skills are one of the determinants of whether students have understood mathematical concepts that have been learned during the learning process, including for DS students.

Problem of Research

Mathematical communication needs to be the focus of attention in mathematics learning, and it should be the main aspect of education and learning researchers, including in this case children with special needs, especially children with DS. In the Indonesian context based on searches through Google Scholar, there are several studies related to mathematical communication in slow learners (Supriadi & Damayanti, 2016), autistic children (Damiyanti & Hidayat, 2019; Irawan & Febriyanti, 2018), and children with intellectual disability (Sholikhah, 2018), and hearing impairment. On the other hand, there is only one study on communication aspects of DS children, and that only addresses general communication skills (Mujib, 2016), not mathematical communication skills. Search results using the Scopus database found that there are only 12 journal articles related to mathematics for DS students. The emerging themes, for example, are related to teaching mathematics in general (Faragher, 2019; Lemons, Powell, King, & Davidson, 2015; Onnivello, Lanfranchi, & Zorzi, 2019; Opoku et al., 2019; Tangarife Chalarca, 2018), numerical (Abreu-Mendoza & Arias-Trejo, 2015; Lanfranchi, Aventaggiato, Jerman, & Vianello, 2015; Novalia et al., 2020), number (Porter, 2019; Simms, Karmiloff-Smith, Ranzato, & Van Herwegen, 2020), geometry (Gil Clemente & Cogolludo-Agustín, 2019), and Cartesian plane and algebraic formulas (Monari Martinez & Neodo, 2020). Various research themes on the implementation of mathematics are focused on

gifted students (Dada & Akpan, 2019; David, 2019; Hartinah et al., 2019; Huda et al., 2019; Jarrah & Almarashdi, 2019; Novalia et al., 2020; Pardimin, Arcana, & Supriadi, 2019; Sumaji, Sa'dijah, Susiswo, & Sisworo, 2020). There is no research at all related to mathematical communication in DS children. Therefore, it is very important to conduct research with the theme of mathematical communication in children with DS.

This article aimed to explain the results of the analysis of the mathematical communication skills of students with Down syndrome in grade 1 Elementary School. The results of this analysis contribute to providing alternative approaches that can be implemented by class teachers, teachers of children with special needs and "shadow" teachers in assisting DS students to learn mathematics in elementary schools. This study will be a reference for relevant researchers, especially in Indonesia, amidst the scarcity of knowledge relating to mathematical communication skills of DS children. This research will also be the basis for the development of DS children's creativity in mathematics, as according to Cevher, Ertekin, and Koksal (2014) this is also very important to do.

Method

Research Design

This research employed a qualitative approach, and the type of research is descriptive. A qualitative approach is used with the intention of understanding the phenomena about what is experienced by research subjects holistically such as their behaviour, perception, motivation, action. This will be done by utilising descriptions in the form of words and language, and in a special natural context and by utilising various scientific methods. This research describes the mathematical communication skills of elementary school students with DS. The indicators of mathematical communication skills refer to the product by Juhrani, Suyitno, and Khumaedi (2017), as presented in Table 1.

Table 1: Indicators of mathematical communication skills

No.	Mathematical skills	Indicators
1.	Verbal communication	The ability to ask of students with DS The ability to answer students with DS The ability to summarise of students with DS
2.	Written communication	Explaining ideas or situations from a picture or graphic in his/her own words in written formats (writing); Describing a situation from a picture or graphic (drawing); Stating a situation into a mathematical model.

Participants

This study was conducted in grade 1 SD Muhammadiyah 9 Malang, East Java Province, Indonesia. The research was done in the even semester of Academic Year 2019/2020 and was carried out in January-March 2020.

Research subjects can be interpreted as people or anything that is the subject of research. The subjects of this study were 1 DS student grade 1 elementary school, with the initials EM and one teacher for children with special needs grade 1, who has more than 15 years of teaching experience at SD Muhammadiyah 9 Malang.

Data Collection

The data in this study was compiled through several techniques, namely observation, interviews, and documentation. The researchers observed the activities of students and teachers, and environmental conditions (class). Researchers also conducted interviews with a teacher for children with special needs. Various learning materials and products used by the teacher, and the products produced by students, was documented to enrich research data.

Data Analysis

Data analysis in this qualitative research was started when the data collection took place, and after the data collection was completed within a certain period. The data analysis implemented content analysis techniques. Activities in data analysis included data reduction which summarised, chose the main points, focused on the important things, as well as looking for themes and patterns. Moreover, data display organised the data, which is arranged in a relationship pattern, so that it is more easily understood. Finally, the conclusion drawing/verification is to conclude the data originally compiled as temporary and will change if no strong evidence is found that supports the next stage of data collection. If the conclusions expressed at an early stage are supported by valid and consistent evidence by the time the researchers returned to the field to collect data, then the conclusions put forward are assumed as credible conclusions.

Results

SD Muhammadiyah 9 Malang, East Java is one of the inclusive schools under the coordination of Muhammadiyah, the largest modern Islamic organisation in Indonesia. Inclusion schools place special needs children in regular classes, along with other general students. However, in the implementation of DS student learning, the school uses an Individual Learning Program. The Individual Learning Program is significantly needed by every child with special needs.

This is because every child with special needs has their limitations, hence requires different treatment.

In regular classroom learning, thematic learning was carried out with the themes: "Myself", with a "Me and Myself" sub-theme, which consists of several subjects, namely mathematics, cultural arts and crafts, and civic education. Mathematics learning to be specific is taught (1) Basic Competence 3.2, which explains numbers up to two-digits and the value of the place compiler of the number symbol using a collection of concrete objects and how to read them. The next competencies taught are (2) Basic Competence 4.2, which is writing symbols of numbers up to two-digits that identify many members of a collection of objects with the idea of place values. For children with special needs in class 1, especially for DS specifications, the teacher set the Individual Learning Program which contains the achievements or targets that had to be met in one semester. The target is to understand the symbol number from 11-20 and the students are required to be able to write the number symbols.

Based on the learning initiated by the teacher for the student with special needs, data is obtained on the mathematical communication skills of DS students. The mathematical communication skills of DS student with the initials EM can be explained in-depth on the oral and written aspects. The verbal aspect included the ability to ask, answer, and infer. Also, written communication can be grouped into three, namely (1) explaining the idea or situation of a picture or graph in his/her own words in written form (writing), (2) expressing a situation with pictures or graphics (drawing), and (3) stating a situation in the form of a mathematical model.

Observation results showed the mathematical communication skills in the oral aspect with indicators of the ability to ask from EM student. The participant gave more questions to the teacher. The results of observations when students were processing the number symbols, indicate that each teacher conveyed both new and repeated information. EM always asked questions and asked again to be repeated. The teacher responded to EM student's questions by giving answers, but often the teacher also responded back with some questions to EM. However, the answers given by EM are sometimes not right. This is because the student tended to be constrained by limited vocabulary mastery. To overcome the low ability to answer, the teacher asked EM to repeat answers. Although the student could not convey the answers properly through verbal vocabulary production, EM tried to support the answers through body movement. At this stage, it can be seen that questions have encouraged two-way communication between teachers and students, even though the grammar used when asking is not very clear and EM tends to only use body language to indicate the desire to ask. The answers given by EM are not right because the vocabulary mastery is still low.

The results of the interview with the teacher showed that EM had difficulty thinking abstractly. Therefore, EM had to be given concrete media to practice the ability to speak, remember,

understand, arouse, and distinguish numbers. Concrete media can bridge the cognitive abilities of DS students. The concrete media used in the interaction is shown in Figure 1.

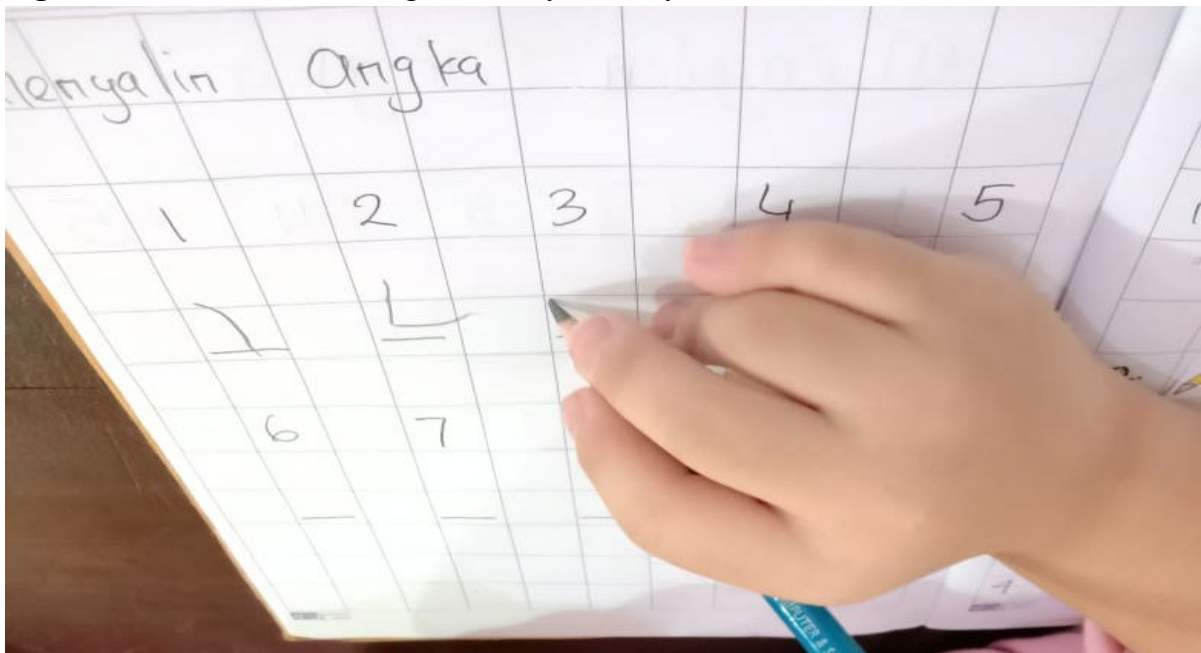
Figure 1. Mathematics learning media for DS student



The media has proven able to stimulate DS students to be more active in bridging what is being learned. However, mathematical communication on the verbal aspect of 'concluding/infering' could not be done perfectly by EM. EM had not been able to generate a conclusion or infer information well on the material being studied and was still limited in the ability to answer the teacher's questions. The results of interviews with the teacher suggested that he is optimistic that learning media plays a major role in assisting EM in stimulating this ability to conclude information, although the learning process might take longer than other regular students.

Based on the described results, it can be concluded that the ability to communicate mathematically in verbal aspects such as the ability to ask and answer questions is well mastered, but the ability to deduce information is still not mastered perfectly. Furthermore, mathematical communication skills in the written aspect were known from the results of fine motor drilling of EM student. During the lesson, EM was given the assignment sheet to bold the number symbols. Observation results projected that the muscles of EM's hands were very weak. When writing activities on symbols that only required a single writing step, EM was able to do it well. For example number symbols 1, 6, 7. However, when having to write the symbols that needed more than one stroke, EM experienced difficulty, for example on numbers 2, 3, 4, 5, 8, and 9. This condition is illustrated in Figure 2.

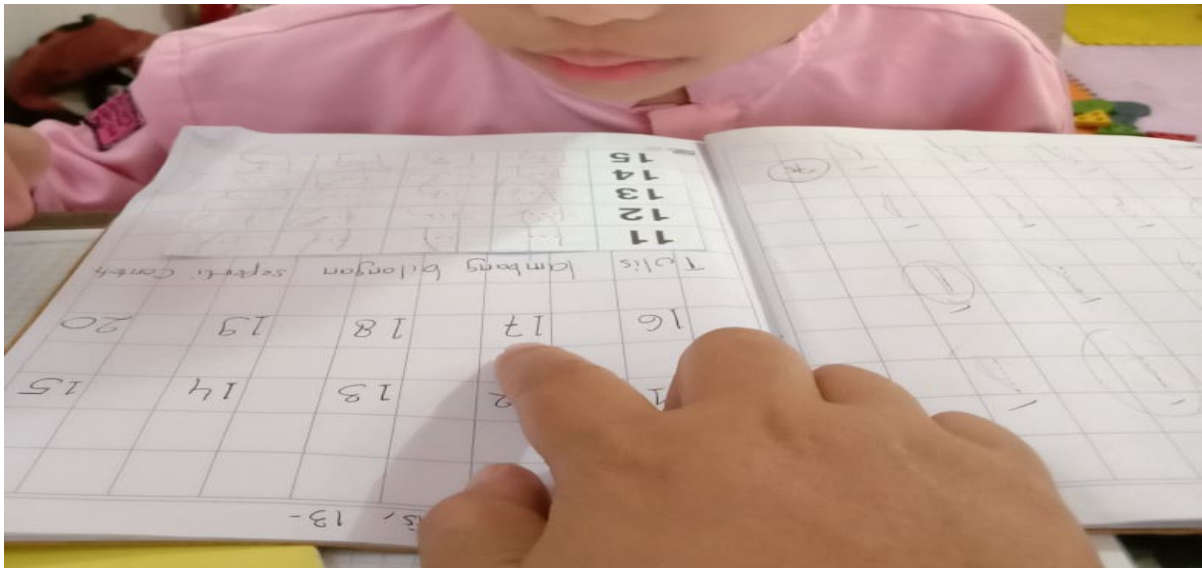
Figure 2. The results of writing number symbols by the DS student



Responding to the results of the student's writing as presented in Figure 2, when drilling was considered as an activity to write numerical symbols to strengthen student mastery, the teacher provided the media repeatedly in the learning process for 4-5 times face to face. In one day, face to face drillings was conducted for 2 x 35 minutes. From this process, it seemed that EM had not been able to explain ideas or situations from a picture or graph in his/her own words in written form (writing). Yet with the help of the teacher and learning media, EM could fulfil the task. In another aspect, namely describing the situation with pictures or graphics (drawing), EM also had not mastered the skill. This was due to very weak hand muscles. Based on the results of interviews with the teacher, the best strategy was to play and provide assistance in the form of drilling.

The ability of mathematical communication in the aspect of writing the form of a mathematical model was seen when EM answered the teacher's question about the numerical symbol. EM wrote the numbers to answer the instruction from the teacher. This situational activity is presented in Figure 3.

Figure 3. Process of the DS student writing down symbols according to the teacher's instructions



Discussion

Many children with DS have difficulty forming questions. Often, they use a one-word construction to make a statement that the listener interprets as a question or request (Bekins, 2011; Kent & Vorperian, 2013). The repeated and intense "asking and answering" activity is very important for the teacher to do for DS children. Questions and answers will encourage children to enrich vocabulary in an atmosphere of two-way communication between teacher and students (Frizelle, Thompson, Duta, & Bishop, 2018; Kabashi & Kaczmarek, 2019). Answering questions encourages children to hear questions, think about meaning, understand the meaning, form answers, and say the answers they make (Chin & Osborne, 2008; DSAWM, 2010; Griffin & Hart, 2018; Scharfenaker & Stackhouse, 2013). Asking questions involves thinking about what you want to ask, forming questions in your mind, and then generating questions that you want to ask (DAAS, 2020; Fortnum et al., 2014; Iannone & Meredith, 2015). According to Mara and Mara (2011), through an intense communication process, DS children will be able to answer correctly for verbal instructions, save visual contact, and work closely with the teacher. Eventually, almost all actions will repeat when asked. However, Watson (2019) gave signs that "the teacher should use appropriate language for student understanding, speak slowly when necessary, and always break tasks into smaller steps and provide instructions for each step. Students with DS usually have good short-term memory".

A child with DS, like any other child, may benefit from interacting with memory stimuli, but needs additional support and help (da Cruz Netto et al., 2020). Until now, there have not been advanced teaching tools that are suitable for DS children to use in their learning process. DS children used simple words and images during the learning session (Yussof, Anuar, Rias,

Abas, & Ariffin, 2016). According to Watson (2019), through a multimodal approach, a teacher may use as many concrete materials and real-world authentic situations as possible to help DS children comprehend better.

The drilling method is an exercise that is done repeatedly on certain parts of the material that are considered not yet under the existing learning guidance (Maryamatussalamah, Milyartini, & Nusantara, 2013). The main teaching strategy in DS is repetition and drilling so that a habit is created by the repetitive production of the language (Polo, 2017). The research results of Adnyani, Suarni, and Jampel (2015) show that the drill method has an effect on learning motivation and towards the abilities of students with special needs. Meanwhile, Halaliah (2019) claims that the implementation of the drilling method encourages students with special needs to memorise.

In general, mathematical communication skills in the aspect of writing consist of the ability: (a) explaining an idea or situation from a picture or graphic in his/her own words in written form (writing), (b) describing a situation with pictures or graphics (drawing), and (c) displaying a situation in the form of a mathematical model. The results of observations and interviews indicated that EM had not been able to explain ideas or situations from a picture or graphic in his/her own words in written form (writing), but EM needed the help of the teacher and the learning media. This finding is in line with da Cruz Netto et al (2020), confirming that "A child with DS may benefit from interacting with memory stimuli, but needs additional support and help. The use of special teaching methods can enhance the memory processes of these children". Teacher's motivation and stimulus become very important, as it is supported with the opinion of Baksi (2005), "many people who have DS are strongly motivated to interact with others, and become skilled and successful communicators using whatever means is effective: actions, facial expressions, gestures and sign languages, or words, phrases, and sentences. "

In other indications, namely stating the situation with pictures or graphics (drawing) EM student had not mastered the skill. This is in line with Clements and Barrett's (1994) assertion, "it was found that all participants performed better on the picture-selection tasks than on the drawing tasks and that the individuals with Down's syndrome performed significantly worse than the children without learning difficulties". While in the indicator of displaying a situation in the form of a mathematical model, the student had demonstrated this ability even though it still needed to be improved. Referring to Leonard and Chaidir (2018), there is hope for DS students to be able to learn and improve their abilities. Therefore, in the future, teachers need to make effective learning designs. The learning designs can be used to improve the quality of education in meeting the learning needs of DS children according to the principle of active and fun cognitive development for elementary school children.



Conclusion

The mathematical communication skills of the verbal aspects of DS students in the ability to ask and answer questions are well mastered, but the ability to infer is still not developed perfectly. The ability to communicate mathematical aspects of writing is still weak. EM had not been able to explain ideas or situations from a picture or graphic with his/her own words in written form (writing), but it was achieved with the help of the teacher and learning media. In another indicator namely stating the situation with pictures or graphs (drawing), EM had not mastered the skill, while in the indicator of displaying a situation in the form of mathematical models, EM had shown an improvement although particular help was still necessary. The indicators that are still weak require further efforts, therefore it is not only a challenge for teachers but researchers who are concerned about DS children learning success. In-depth and comprehensive research with more subjects, classes, and education levels also needs to be done so that various efforts to help children with DS can be maximised.

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