Mathematical problem solving in students with disability based on prior mathematics ability

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Abstract. This research aims to understand the ability of deaf students to solve mathematical problem solving based on prior mathematical abilities. This research was conducted by using descriptive qualitative methods. Data collection techniques consists of tests, questionnaires, and interviews. The research subjects were deaf students in one of special schools in Bandung, Indonesia. The result of this study is problem solving abilities of 5 deaf students based on Prior Mathematics Ability. The result indicates one student has problem solving skills in a good category, three students are sufficient and the other one is in the low category. However, it does not mean that students who have Prior Mathematics Ability in a good category indicate that they also have good problem solving skills.

1. Introduction

Discussions of education should always be felt and clearly seen around us. It has become a staple of education as stated in Article 31 paragraph 1 of the 1945 Constitution, which reads "every citizen reserve the right to receive teaching". In the paragraph, it explains that every citizen means that every individual human being in Indonesia has a reason to continue to get proper education for their survival. No exception for a child with special needs. Like other normal children, they also have a stake in getting their rights. Deaf is someone who has a lack or loss of ability to hear well in part or in full due to the malfunction of part or all of the hearing instruments, so that they cannot use his hearing instrument in daily life which has a complex impact on his life [1]. Introduction In supporting 21st Century Education, the Indonesian government established four main skills that must be mastered by students in learning. The four skills are known as 4C skills, namely critical thinking skills and problem-solving, communication skills, creativity and innovation, and collaboration [2], problem-solving is an attempt to find a solution of a problem that cannot immediately be resolved through prior knowledge formulations. Based on the approach, problem solving is divided into routine problems and non-routine problems [3-5].

Hearing loss is divided into two, namely hearing loss and deafness. Deafness is a severe hearing disorder that a person cannot process verbal language even they use hearing aids. While hearing loss is lower than the deaf, but still has an influence on social, cognitive, and individual development [6]. Deaf children are very dependent on their vision in the learning process, while visual strategies are the best strategies in communication and learning for deaf children [7,8]. Mathematical skills in deaf children have no difference with normal children, except that in learning using audio visual students with normal hearing have better potential [9].

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The capabilities that must be owned by the generation in the 21st century, including those that include creativity, critical thinking, innovation, problem solving, decision making, communication, collaboration, literacy, communication and technology, and social responsibility. Besides that based on NCTM which explains that problem solving and critical thinking must be owned by everyone to help in the process of mathematical thinking [10,11]. Mathematical problem solving is a complex cognitive activity accompanied by processes and strategies. The processes and strategies that described by montague are read, paraphrase, visualize, hypothesize, estimate, compute, and check [12].

Learning by using Realistic Mathematics Education Approach (RME), it becomes better and more enjoyable for students. Learning motivation becomes increased and the concentration of students to follow the learning becomes more focused [13]. Deaf students generally lag behind a few years in arithmetic, but little is known about the mechanism behind this [14].

2. Method
The type of research used in this study is qualitative research. Qualitative research is research that aims to understand the phenomenon of what is experienced by research subjects, holistically and in a descriptive way in the form of words and languages in a specific natural context and by utilizing various scientific methods [15]. Qualitative research is much more difficult to do than quantitative research because the data is collected and is the main measurement tool for collecting data is the investigator himself [16]. Which means that qualitative research is more difficult when compared to quantitative research because the collected data is subjective and the instrument as a data collection tool is the researcher himself. qualitative methods are divided into five types, namely phenomenological research, grounded theory, ethnography, case studies, and narrative research [17]. This research is in accordance with the type of case studies because it is in accordance with the purpose of this study who wants to know deeply about solving mathematical problems of deaf students.

The subject of this study was students with special needs who were hearing impaired (deaf) who had studied arithmetic material. The choice of this subject is in accordance with the research background. The place of research is an Extraordinary School (SLB) in the city of Bandung. The researcher uses documentation to get student data. Then to get the research data, students were asked to solve mathematical questions on mathematical reasoning and communication tests, then the researcher interviewed the research subject. Data obtained during interviews were recorded using a voice recorder. Suggest that activities in qualitative data analysis are carried out interactively and take place continuously until complete, so the data is credible. Activities in data analysis, namely data reduction, data presentation, and conclusion drawing / verification.

3. Result and discussion

3.1. Results
This observation was carried out using the Case Study method on 5 heavy deaf students of class VIII SMPLB from SLB B Prima Bhakti Mulia. A number of deaf students who participated in the testing process had AN initials (15 years), MN (16 years), JT (17 years), FH (15 years), and GS (15 years).

3.1.1. Prior mathematical ability of deaf students. This early mathematical ability was taken from 5 students who had hearing impairments. The results of the initial math ability test are as follows.

| Table 1. Deaf students' prior mathematics ability test results score. |
|---|---|---|---|---|---|
| Student | AN | MN | JT | FH | GS |
| Score obtained | 9 | 5 | 12 | 4 | 7 | 20 |
This early mathematical ability test was conducted to measure the level of initial mathematical thinking of deaf students that would affect the level of advanced mathematical thinking which would later be tested with mathematical problem solving questions. The Early Mathematics Ability test consists of 20 multiple choice questions containing integer material, basic arithmetic, algebra, flat geometry and statistics. These basic materials are very related to the advanced material in the problem solving ability test questions.

From the results obtained from the table above, the highest score obtained by JT with 12 numbers is true, AN with 9 numbers is true, GS with 7 numbers is true, MN with 5 numbers is true and FH with 4 numbers is true.

3.1.2. Ability of problem solving deaf students. This problem solving ability is taken from 5 students who have limited hearing. The results of the mathematical problem solving test are as follows.

Table 2. Results score of the problem solving ability test for deaf students.

| Question number | AN | MN | JT | FH | GS | Ideal Score |
|-----------------|----|----|----|----|----|-------------|
| 1               | 15 | 15 | 0  | 15 | 15 | 20          |
| 2               | 10 | 10 | 10 | 10 | 10 | 20          |
| 3               | 5  | 0  | 0  | 5  | 20 |             |
| 4               | 5  | 5  | 5  | 5  | 20 |             |
| 5               | 5  | 0  | 5  | 15 | 20 |             |
| Total score     | 40 | 30 | 20 | 35 | 50 | 100         |

Table 3. Criteria for the value range of the problem solving ability test (As Permendikbud No. 23 of 2016).

| Criteria   | Value Range |
|------------|-------------|
| Very Good  | X ≥ 75      |
| Good       | 50 ≤ X < 75 |
| Enough     | 25 ≤ X < 50 |
| Less       | 25 < X      |

Based on the table of criteria above, X is the true value of the problem solving ability test. The problem solving test consists of 5 items made based on the extraordinary school syllabus that is being used. Each item has 4 problem solving phases which each phase has a point value of 5. If students can pass these four phases perfectly, students will get 20 points of value on each point.

3.1.3. Identification of deaf student test results

a) Question number 1. Indicator question: Understand the relationship of lines and lines, lines and angles, angles and angles, and their measurements and understand the rectangular flat shape in problem solving.

From this question the total number of squares that can be made is 21 square. By way of trying students can create a square by connecting the dots that have been provided.
AN already understands how to create a square from several vertices. AN can find 9 upright small squares and 4 medium squares that are upright, then AN finds 4 squares that are sloping. This means that AN has entered the planning phase and can calculate the number of squares that have been arranged before, from here AN has entered the completion phase. But AN careless in working on the problem, AN does not do the viewing phase again because there is still a square that has not been strung.

b) Question number 2. Indicator Question: Complete operations of algebraic forms and comparisons in problem solving.

The answers to these questions can be made in the form of registering patterns with tables or specifying the number of jumps with variables and being formed into linear equations.

gs can describe the condition of the question in the picture, which means that GS has understood the problem. Entering in the planning phase it turns out that the strategy used is not effective for working on the questions completely. GS tries to sort the conditions to get the pattern, but GS has already concluded before getting the pattern. As a result the GS does not go through the completion phase and the phase of looking back.

c) Question number 3. Indicator: Complete the operation of algebraic forms and comparisons in problem solving.

Questions about simple social arithmetic concepts are combined with one variable linear equations.
According to JT's answer, it can be seen that JT only multiplies the amount of rupiah paid with an additional discount. It seems that JT doesn't understand the meaning of the question in the question.

d) Question number 4. Question indicator: Understanding numbers in problem solving. Use the properties of operations to calculate integers and fractions in solving problems.

A story question that uses the concept of simple fractions in the form of subtraction of reduction of fraction and fraction multiplication.

Based on the picture, GS has entered the phase of understanding the problem, just looking at the numbers that exist and trying to simplify it, but GS is still wrong in the procedure. GS only understands the patterns taught by previous teachers and it is difficult to develop new work patterns.

e) Question number 5. Question indicator: Understanding numbers in problem solving.

This story problem does not have a standard formula, so to do it requires trial or guessing to find the appropriate results.
calculating the number of feet that FH gets. FH does not carry out the phase of looking back.

3.2. Discussion
Results after identifying observation data, the observer analyzed the results of the early mathematical abilities and mathematical problem solving abilities of students in the form of information with Polya's heuristic theory. The following are the results of the analysis of researchers regarding the mathematical early abilities of deaf students.

The analysis of the results of mathematical problem solving abilities based on the early mathematical abilities of deaf students is obtained from the results of tests and observations. The following are the results of the observer's analysis.

Table 4. Analysis of the capability of mathematical problem solving based on early mathematics ability deaf students.

| Question number | Student | Analysis of the Ability of Mathematical Problem Solving Based on Early Mathematics Ability Deaf Students |
|-----------------|---------|--------------------------------------------------------------------------------------------------|
| 1               | AN      | Of the 20 number questions given, AN only works 15 questions. Among the 9 questions that are filled are true and 6 questions are worth wrong. This means that AN is still not working on half of all the questions correctly. This means that AN mathematical problem solving ability is still lacking. |
| 2               | MN      | Of the 20 question numbers, MN only works on 12 number questions. Among them, 5 questions are true and 7 questions are wrong. MN is lacking in mathematical problem solving skills if reviewed based on early mathematical abilities. |
| 3               | JT      | JT does not work on 2 questions from 20 questions given. Of the 18 questions that JT answers, as many as 12 questions the correct answer and 6 questions the wrong answer. JT already has sufficient mathematical problem solving skills. |
| 4               | FH      | FH only works on 6 questions from 20 questions given. Among the 6 questions that were worked out were only 4 questions that were answered correctly by FH. FH mathematical problem solving ability is still lacking. GS works on 19 questions, but GS only answers 7 number questions correctly, 12 numbers about the wrong answer. This means that the GS mathematical problem solving ability is still lacking. |
| 5               | GS      |                                                                                                  |

Based on the table above it can be seen that deaf students answer at least 4 correct questions and answer the most 12 questions correctly. When associated with Early Mathematics Ability, most deaf students do not yet have sufficient ability to work on all problem solving problems correctly.

4. Conclusion
Based on observations obtained from SLB B Prima Bhakti Mulia, it can be concluded: Problem solving skills of 5 deaf students based on Early Mathematics Ability, namely one student has problem solving skills in a good category, three students are sufficient and one student is in the low category. But not necessarily students who have Early Mathematics Ability in good categories will influence good problem solving abilities too.

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