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Identification of Deaf Student's Difficulties in Understanding the Circle Concept

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Abstract. Students' difficulties in understanding the circle concept are important issues to be resolved by starting a more in-depth research first about identifying and finding out what difficulties deaf students experience in understanding the circle concept. The identification results can be used by the teacher to help students overcome their difficulties and as material for consideration in carrying out remedial teaching. The aim of this study was to identify how the difficulties experienced by deaf students in understanding the circle concept. The research used was a mixed- method with a sequential explanatory design. The data to be collected first was quantitative data from understanding test then analyzed. Based on these results the researcher collected qualitative data by observed the results of students' written answers and other external representations, then interviewed students to help explain in more detail the results of the initial quantitative data. The subjects in this study were nine deaf students at SLB Negeri 2 Bantul. Data analysis was carried out quantitatively and qualitatively. Based on the research results, knew that the mean score of understanding the concept of circles in deaf students is less than 60 or it hasn't reach the minimum completeness criteria. Most of the students' test answers were represented visually by drawing. From the research results, also knew that the difficulty of understanding students is related to the background of total communication barriers due to their hearing loss. The results of the identification of the difficulty in understanding the deaf students are difficulties in processing information, language difficulties, organizational difficulties, attention difficulties, output difficulties, difficulties with multiple tasks and mathematics anxiety.

INTRODUCTION

Geometry is one of the mathematics subjects studied by students at school [1]. The concepts contained in geometry underlie all mathematical thinking [2], even more broadly, the core of geometric knowledge is said to be the universal ability of the human mind [3]. According to The National Mathematics Advisory Panel [4], geometry has an important role as a basic foundation of mathematics that supports the mastery of concepts both algebra, numbers, arithmetic, and advanced mathematical concepts. Moreover, geometry contributes to the development of mathematics competencies and other cognitive abilities such as IQ [5,6]. For this reason, geometry is an important aspect of learning mathematics and solving problems of daily life. According to Andriyani & Juniati [7], geometry is a branch of mathematics that is better known to students than other branches of mathematics, because students have gained an introduction to the basic concepts of geometry in the form of indirect knowledge through their informal educational environment.

In the research of Gal & Linchevski [8] and Adolphus [9], it is known that students have difficulties understanding geometry topics. According to Andriyani & Juniati [10], a person's conception of understanding is usually constructed based on common sense or intuition. Whereas, the conception itself is influenced by cognition in interpreting a concept [11]. Because each person's cognition is different, the difficulties experienced by each student in understanding the concept of geometry are also different. This difference of the level of difficulty also has

implications for variation in students' failure to understand geometric concepts. The failure to understand geometry is one proof of the mistakes made in studying geometry [12]. Regarding geometric difficulties, circle material is one of the materials that is difficult for students to understand [13]. Supporting this, the results of research by Timutius et al. [14] on high school students also showed that there were still many difficulties and mistakes of students in solving circle problems. Not much different, high school students also experience some difficulties and mistakes when solving problems related to circle elements because some students can't use mathematical concepts and do not know the problem solving procedures correctly [15].

The difficulties of junior high school students in understanding the circle concept can affect their understanding and problem solving in other materials related to the concept of circles, such as transformation material. In addition, not all students can optimize their abilities in learning, including deaf students who have hearing and verbal communication limitations [16]. According to Article 8 to 10 Regulation of the Minister of Education and Culture Number 157 of 2014, said that the content of the special education curriculum for deaf students is equivalent to the content of the regular education curriculum tailored to their specific needs so that student barriers can be minimized and the achievement of student competencies can be more optimal. This means that the circle material taught to hearing children must also be taught to the deaf [17].

Deaf physiological structure abnormalities, causing several obstacles in obtaining information during the learning process, namely students' verbalism in expressing their ideas but not knowing their meaning, tends to only imitate what the teacher says, misperception of the same term but interpreted differently because of limitation knowledge and vocabulary [18]. Obstacles in obtaining information and limited knowledge are due to the lack of interpersonal skills for the deaf with the surrounding environment, most of whom experience total communication barriers with deaf people.

In learning mathematics for the deaf, sometimes the teacher has to sort certain material not to teach and even though the teacher is still the learning tool used by normal children. This is because it is not easy for teachers to develop learning tools according to the needs and needs of students [19]. This also happened at SLB Negeri 2 Bantul, Yogyakarta, where teachers still use learning tools that are commonly used by hearing children because the teachers who teach mathematics there aren't subject teachers who have competence in mathematics but classroom teachers who teach all subjects. The implication that more students memorize the concept and agree to understand it. The students' difficulties in understanding the concepts have an impact on the mastery of other concepts in geometry (for example, the concept of transformation such as rotation). This is indicated by the low students score on each test where around 90% of students haven't reach the minimum completeness criteria in geometry containing a circle context. Whereas, understanding is one of the math skills that students must achieve in school mathematics learning at all levels. Students who understand the concept will be able to interpreting, exemplifying, classifying, summarizing, comparing, explaining, and inferring well [20].

Students difficulties in understanding the circle concept is an important problem to solve by starting a more in-depth study or research first, identifying and finding out what difficulties deaf students experience in understanding the circle concept. The results of the identification of understanding difficulties can later be used by the teacher to help students overcome their difficulties and as material for consideration in carrying out Remedial Teaching seen from the inability of students to understand and the mistakes usually happened in their learning tasks. This is in line with what was stated by the Ministry of Education and Culture [21], that mistakes made by students indicate the difficulties they are experiencing.

According to Supartini in Suwanto [22], difficulties is defined as the failure of students to achieve learning goals characterized by minimal levels of mastery, not achieving proper achievement, failure to achieve developmental tasks, and not achieving prerequisites that required at the next level. In line with this, Dalyono [23] defines learning difficulties as conditions that make students unable to learn well so that students find it difficult to accept or absorb lessons at school. According to Lerner [24], students who experience difficulties in mathematics have certain characteristics, namely difficulties in processing information, difficulties related to language and reading skills, and mathematics anxiety. Furthermore, the WGHB Educational Foundation [25] classifies signs of difficulties that can be seen in students namely output difficulties, organizational difficulties, language difficulties, attention difficulties, visual-spatial or ordering difficulties, and difficulties with multiple tasks. So, if students show one of these characteristics or signs in the learning process, it can be believed that students have difficulties math learning.

The meaning of learning difficulties in this study is condition of the deaf student inability to understand the circle concept with a difficulties indicator which refer to a characteristic of student difficulties as stated by Lerner and the WGHB Educational Foundation. Based on the problem of learning the circle concept, namely the difficulties understanding by deaf students at SLB Negeri 2 Bantul, it is deemed necessary and important to conduct an in depth study of these difficulties to help teachers overcome student difficulties and carry out remedial teaching. So that the

formulation of the problem studied in this study is how the difficulties experienced by deaf students at SLB Negeri 2 Bantul in understanding the circle concept.

METHOD

The research used was a mixed method with a sequential explanatory design. The data to be collected first was quantitative data then analyzed, based on the results of the data analysis, the researcher collected qualitative data to help explain in more detail the results of the initial quantitative data [26]. The subjects in this study were nine deaf students at SLB Negeri 2 Bantul. In addition, input from the teacher was also considered. The circle material understanding test containing the achievement of the seven indicators of understanding according to Krathwohl, namely interpreting, exemplifying, classifying, summarizing, explaining, comparing, and inferring, has been given first. The understanding test consists of seven essay questions that students have to complete in ninety minutes. The test questions that must be done also contain observations of events or problems related to the circle that are presented in a video in front of the class. In answering test questions, students are given independent to represent the answers in own way and language.

Next, researchers interviewed and observed students' behaviour during and after the test to confirm students' answers which were considered still need to be further explored by the researcher. The research instruments were in the form of circle concept understanding test questions, observation guidelines, and semi-structured interview guidelines. The data on the results of understanding in the cognitive realm of students and student errors, were taken using test questions, then the results were used to retrieve data that directly described the students' difficulties in understanding the concept using the observation guideline instruments and interview guidelines. Data from observations and interviews were collected and their validity was seen through technical triangulation by comparing the results of interviews and observations.

Analysis of research data were providing during and after data collection so that the data obtained is systematically structured and easily interpreted according to the problem formulation. The stages used to analyze and interpret the data are as follows: (1) calculating and analysing test scores on each indicator of understanding, (2) analysing qualitative data that has been reduced and its validity seen, in order to obtain a description of student difficulties in each indicator of understanding through data difficulties that have been coded according to type, (3) presenting data, (4) drawing conclusions.

RESULTS AND DISCUSSION

Based on the results of the students' understanding test at SLB Negeri 2 Bantul, it was found that the mean understanding of the students towards each indicator / aspect of understanding was still less than 60 as the criterion for the minimum learning completeness. Illustration of the achievement of student understanding on each of these indicators, can be seen in Figure 1 below.

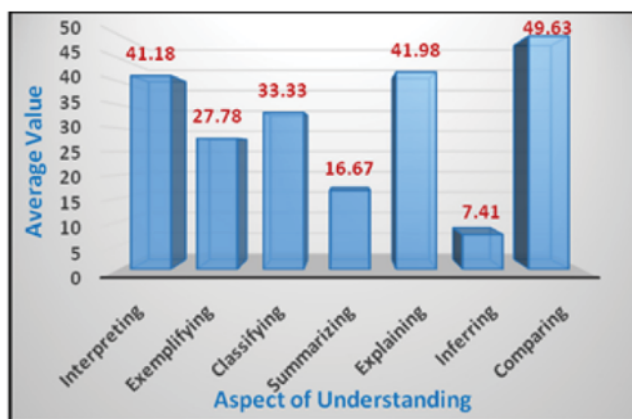


FIGURE 1. The Results of Understanding of Deaf Students at SLB Negeri 2 Bantul

From the bar chart in Figure 1 above, it is known that the average score of the comparing aspect is the student's highest understanding achievement, while the average score of the inferring aspect is the student's lowest understanding achievement. This shows that students are better able to detect the relationship between two objects based on similarities or differences rather than abstracting existing concepts based on certain patterns from a series of examples given. From the diagram above it is also known that the average score of understanding in each aspect is less than 50. This shows that the students' understanding in every aspect has not yet reached the Minimum Completeness Criteria that students must obtain, namely 60. Description of the overall understanding of the nine students can be seen from table 1 below.

TABLE 1. Average Score, Standard Deviation, Highest Score, Lowest Score of Nine Deaf Students

No	Statistic	Score
1	Respondent (N)	9
2	Test Ideal Score	100
3	Highest Score	39
4	Lowest Score	18
5	Mean	29.3
6	Standard Deviation	7.38

Table 1 above shows that the results of the nine students' understanding tests varied. With the achievement of the lowest score, the highest score and the average which is far below the ideal score, it can be said that the understanding of deaf students is still very low. From the Table 1, it is also known that the standard deviation value is 7.38, which means that the mean difference in the score of each student with the mean of all students (their group) is low. After knowing the low level of understanding achievement from students' written answers, then explored through semi-structured observation and interviews to find out students' difficulties based on students' answers. From the results of observations and interviews with students, the identification of student difficulties in each indicator of circle concept understanding is described as follows.

Difficulties of Interpreting

In the first question, students are asked to explain what is meant by a circle. Then seven students wrote down their answers by simply drawing a circle like figure 2 (a), while the other two students drew a circle and wrote an 'empty' description like picture 2 (b) below.

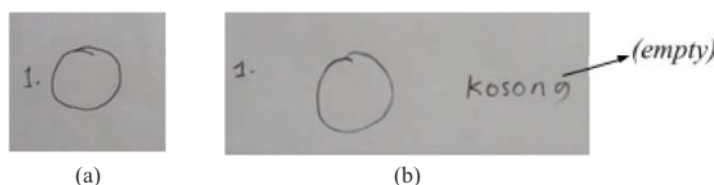


FIGURE 2. (a) – (b) Student' interpreting about Circles

On Figure 2 (a) it is known that students are able to interpret information from one form of written representation about a circle into another form, namely drawing a circle shape correctly. After being asked to confirm, they could not explain and still pointed to the circle he made. In addition, students also interpreted a circle as a shape that has the same value as 'zero' which means empty as shown in Figure 2 (b). After being asked to confirm again, they said that the circle has a shape like a number that means is empty. It means the student' circle interpretation using meaningless attributes that couldn't be used to construct a circle formal definition. From this, we know that students experience output difficulties and language difficulties such as signs of math learning difficulties conveyed by the WGH Educational Foundation.

Difficulties of Exemplifying

In the next question, students are asked to give three object examples of circle and not a circle also their reason. There were only three students who gave one example circle and one example was not a circle because they looked confused, while the other six students chose to answer only one example circle. Example of student answers who answer only one example and not an example of a circle as shown in Figure 3 below.

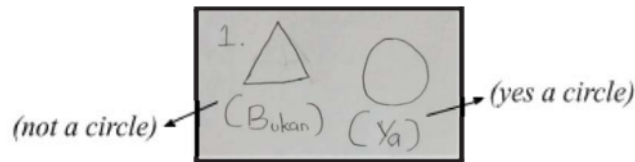


FIGURE 3. Student' exemplifying of circle and not circle

After being confirmed through interviews, it was found that they had difficulties to example of circle shape and not, if they must relate to objects around them. Their mind only focus on the formal shape circle, because so far the teacher has only taught circles with their formal shape and formulas without going into detail on the circle characteristics. This shows that students haven't able to provide specific examples of a concept based on the identification of concept characteristics to select or construct a specific example. From this it is also known that students have attention difficulties and difficulties with multiple tasks such as signs of math learning difficulties conveyed by the WGH Educational Foundation.

Difficulties of Classifying

In the third question, students are asked to group several objects which include a circle as shown in Figure 4 below.

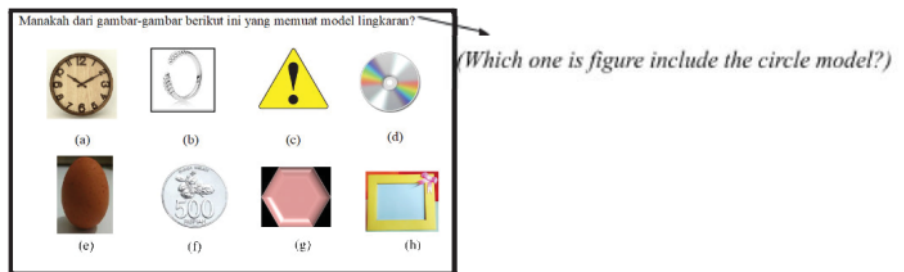


FIGURE 4. A problem of classifying objects in a circle

Most of the students didn't group all objects classified as circles correctly through the pictures. They group only one or two objects that are included in the circle by drawing. Example of student answers that draw two objects including a circle are as shown in Figure 5 below.

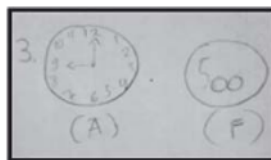


FIGURE 5. Student' classifying of circle by drawing

After being confirmed through interviews, it was found that they still had difficulties selecting items into certain categories or concept. This also shows that students have organizational difficulties and attention difficulties to things together, such as signs of math learning difficulties conveyed by the WGHB Educational Foundation.

Difficulties of Summarizing

In the fourth question, students are asked to make a summary of the description of the circle material presented in a textbook given by the researcher. Only two students wrote their answers about the reading summary, while the others did not write down their answers. An example of a student summary is shown in Figure 6 below.

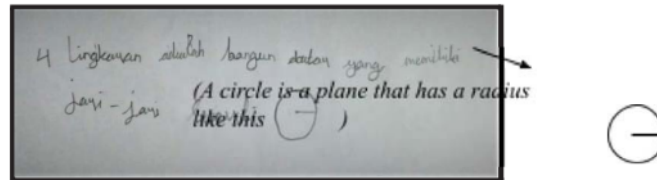


FIGURE 6. Student' summarizing of the description of the circle material

On Figure 6 it is known that students can compose single sentences to present the information presented in the reading which contains formal definitions, circle elements and the application of the concept of circle in daily life. However, this single sentence still doesn't represent an overview of the reading because it contains only one element of the circle. When interviewed more deeply, almost all students said that they did not know how to summarize and had difficulty meaning the reading. Even some students looked anxious and avoided when asked to convey the reason. This shows that students have difficulties in processing information when reading something and mathematics anxiety such as the characteristic of Lerner's mathematical difficulties. Students also identified to have language difficulties such as signs of math learning difficulties conveyed by the WGHB Educational Foundation.

Difficulties of Inferring

The fifth question given to students is related to making conclusion from several videos that provide an explanation of the five properties of the circle illustrated on several objects. Among the nine students, there was only one student who wrote down the answer as shown in Figure 7 below.

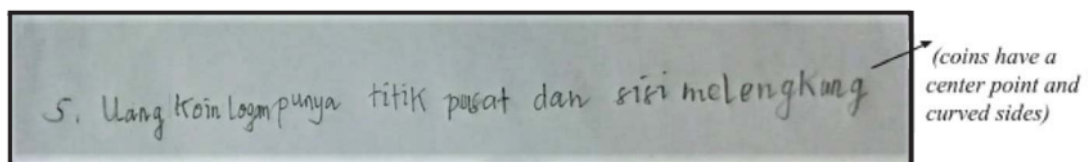


FIGURE 7. Student' inferring of an explanation the circle illustrated on several objects

On Figure 7 it is known that students only write down two circular properties that are contained in one of the circle object, even though these two properties also contained in other objects which are also presented in the video. After being confirmed through interviews, it was found that the student gave the exact same answer as his written answer. This shows that students have not able to abstract existing concept or principle through finding patterns from a series of examples given. Students were identified as having attention difficulties to things together, language difficulties and output difficulties such as signs of math learning difficulties conveyed by the WGHB Educational Foundation.

Difficulties of Comparing

The sixth question given to students relates to compare the similarities and differences that exist in five circle objects that have different sizes and are presented on the video, along with their reasons. Some students can detect the relationship between several circle objects presented in the video, both in terms of similarities and differences. Some other students only answered in terms of the similarities. Example of student answer that can answer the similarities and differences are presented as shown in Figure 8 below.

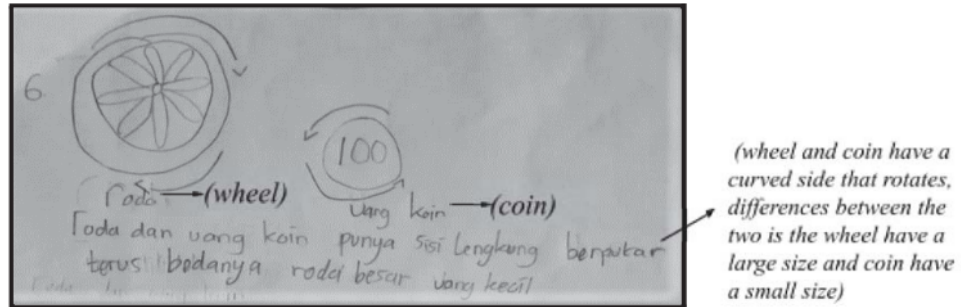


FIGURE 8. Student' comparing two objects

On Figure 8 it is known that students only write two similarities of circle properties that are contained in two circle objects, even though these properties are also contained in the other three objects which are also presented in the video. After being confirmed through interviews, it was found that they only attention to these characteristics in the two objects they wrote, not other properties in three other objects. This shows that students have not able to detect some relationship between more than two objects, both similarities and differences. Students were identified as having attention difficulties to things together and language difficulties such as signs of math learning difficulties conveyed by the WGH Educational Foundation.

Difficulty Explaining

In the last question, students were asked to explain why a coin that was thrown and rolled on the floor could rotate many times. There were only three students who could explain the event by making a causal relationship related to the properties of the circle, while the other six students didn't use their knowledge about concept of circle to make a cause-effect relationship. Example of student answer that don't relate to the circle concept are presented as shown in Figure 9 below.

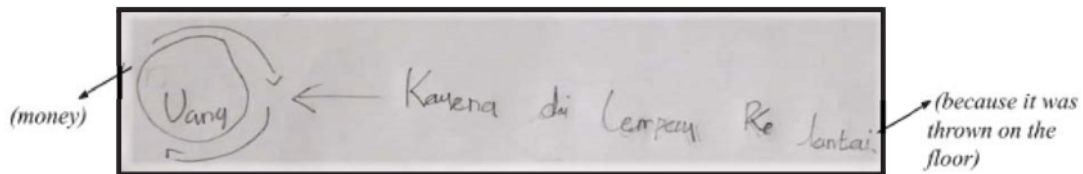


FIGURE 9. Student' explaining the event of coin could rotate many times

After being confirmed through interviews, it was found that they still have difficulties processing the information that their received to build a cause-effect relationship. This is because during this time, their learning still not used to relate newly received knowledge with their environmental problems that are obstructed in terms of total communication. Moreover, the expository learning model carried out by the teacher and verbal communication barriers for deaf that causes limitation vocabulary, often making students experience misperceptions and lack of communicating ideas.

Based on the analysis results of understanding test, observation and interview above, information was obtained regarding the student difficulties in understanding the concept of circle. Even though the students' understanding

achievement is low, some students have good abilities in the aspects of comparing, interpreting and explaining. The achievement of these three aspects of understanding is inversely proportional to the achievement of the other four aspects of understanding. Noticed, based on the student' results written tests that deaf students mostly represent their ideas visually (drawing). These results can be used as material for consideration of learning carried out by the teacher considering the hearing limitations of deaf which according to Vicentis [27] are very different from normal and deaf students, especially relying on visual cues.

In fact, deafness experienced by someone, not only causes hearing loss, but also disabilities language or communicating orally in the usual way hearing people. It need effective of teaching method that can accommodate the communication problems arises. The teaching effectiveness can be seen in terms of the quality of learning which provides positive expectations for student success, the reliability of classroom management, and the suitability of learning designs [19]. So a teacher must hold the well ability of planning and implementation learning, student activation, stimulation of problem solving, discovery, and collaboration between students to create learning that isn't monotonous and boring [28].

CONCLUSION

The deaf students' answer in understanding test were mostly represented visually or with drawing. From the results of observations and in-depth interviews with students, it was also obtained describing of students' difficulties in understanding the circle concept in every understanding aspect, namely difficulties in processing information, language difficulties, organizational difficulties, attention difficulties, output difficulties, difficulties with multiple tasks and mathematics anxiety. All research results have a relationship with the background of deaf' total communication barriers during information acquisition with the surrounding environment, so development of their knowledge is limited. Imply of expository learning that carried out by teacher because difficulties development of learning tools accordance with the characteristics of deafness, is also one of the causes difficulties experienced by deaf students in understanding the circle concept.

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