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Learning Assistance for Blind Students to Improve Mathematical Ability

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Abstract: In Indonesia, an education system is implemented where students with special learning needs can get an education in public schools. One type of child with special needs accepted by public schools is blind. Blind children usually have various things during learning, such as difficulty in understanding abstract concepts, low learning motivation, slow to understand the material, and need to understand repetitive material. Therefore, community service is required to provide special assistance to blind students to help students learn mathematics. Partners in this service are two blind students from MAN 2 Sleman. The stages of this service consist of 3 stages, namely the preparation, assistance and evaluation stages of learning. The results of the community service show that there is an increase in mathematical understanding for blind students. In addition, students become easier to understand

Keywords: community service, learning assistance, blind student, mathematics

INTRODUCTION

All individuals have the right to education, including students with special needs, which is guaranteed by various regulations in Indonesia. For example, one of the regulations states that "every citizen has the right to education". Thus, education is guaranteed for every citizen regardless of the circumstances. To implement these regulations, an education system called inclusive education emerged. Therefore, in Indonesia, an inclusive education system has been implemented where students with special needs are allowed to attend education together with students in general (Purnomo, 2016). Students with special needs are students who have special characteristics or are different from students in general, where these students have limitations in terms of mental, physical, emotional, or intelligence (Geniofam, 2010). Usually, students with special needs have learning and developmental barriers. Therefore, special-needs students need educational services following the obstacles experienced (Ariyanti et al., 2021).

In Indonesia, inclusive schools have been developed. Yogyakarta is one of the provinces that has implemented inclusive schools. There are several inclusive elementary schools in Yogyakarta, one of them is MAN 2 Sleman. One of the children accepted into inclusive schools is a blind student. Blindness is a disorder in a person so that a person's vision cannot function optimally (Camalia et al., 2016). Blindness is a type of disturbance in a visual function where a person cannot use his vision completely so that in his daily life, the person is like an alert person (Atmaja, 2014; Ernawati, 2018). A child is said to be blind, that is, if the visual acuity is less than 6/21, meaning that based on the test, he is only able to read letters at a distance of 6 meters, while by alert people, it can be read at a distance of 21 meters (Widjaya, 2013).

Thus, a person who is blind is said to need special tools and media in his learning activities so that a blind person can learn with conditions without vision or with limited vision. In general, the blind are classified into 2, namely low vision and total blindness (Khaeroh et al., 2020). Mild visual impairment is a mild visual impairment that is still able to participate in learning and carry out activities like people in general by using the rest of their visual function (Ernawati, 2018).

People classified as mildly blind have visual acuity between 20/70 feet to 20/200 feet. Low vision blind people still have the residual vision but cannot read in normal size, but their vision function can be improved through optical aids or environmental modification. For example, low vision may be able to read if the writing is enlarged, but it will also be helpful to learn braille or use audio recordings.

Conversely, total blindness is a visual impairment where the visual function cannot work so that it cannot see dark or light. Total blindness is a condition where people cannot receive information using their sense of sight, so they only rely on their sense of touch and hearing in the learning process. People who are classified as blind have visual acuity of 20/200 feet or less or more than 20/200 feet but their visual acuity is not greater than 20 degrees. For example, to read blind people using braille which is read by means of fingertips, or listening to audio recordings through hearing.

Mathematics is a subject that students learn from elementary to college because mathematics is important. After all, almost all branches of science involve mathematics. However, students perceive mathematics as something that is considered difficult and less liked by students in regular schools and inclusive schools (Aziz & Prabowo, 2015; Pramitasari et al., 2019). It is not uncommon to find obstacles in teaching basic mathematics concepts to students, including children with special needs (Fransisca et al., 2021). The Service Implementation Team conducted interviews with mathematics teachers at the school where the service was carried out and obtained information that blind students had difficulty and were slow to accept mathematics lessons, especially in trigonometry material.

The term trigonometry comes from the words trigono and metro, which in Greek can mean "three angles" and "measure", so based on these two words, trigonometry can be defined as a branch of mathematics in terms of angles in triangles and trigonometric functions such as sine (sin), cosine (cos), and tangent (tan) (Kariadinata, 2018). According to Jelatu et al. (2019), trigonometry is important to be taught to students, especially at the high school level. Students need to understand trigonometry because it is a prerequisite for understanding topics in Newtonian physics, architecture, surveying, and other engineering branches. In addition, trigonometry is one of the earliest mathematical materials to connect algebraic reasoning, geometry, and graphs. Trigonometry is also an important starting point before understanding calculus. With these problems, it is necessary to carry out learning by applying fun methods and using learning media. Therefore, the implementing team took the initiative to do service in the form of assistance in learning mathematics in mathematics subjects for blind students at inclusive schools in Yogyakarta.

METHODOLOGY

Community service activities were carried out in 2 schools that held inclusive schools in Yogyakarta Province. Service activities in the form of providing learning assistance. The purpose of this community service is to assist in learning, especially for blind students, in materials that are considered difficult. This assistance was attended by two students with special needs, namely the blind. Students who take part in assistance are determined based on the considerations of the teacher because the teacher better understands the conditions and abilities of students. The implementation of assistance is carried out according to a schedule that has been agreed upon by the team and students.

The stages in its implementation follow the flow presented in Figure 1.

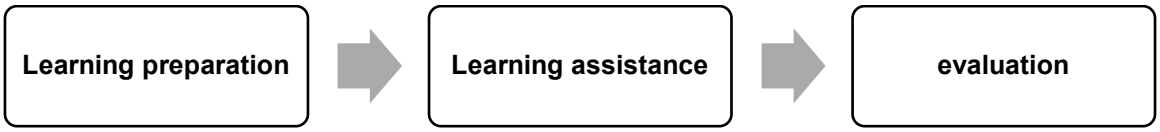


Figure 1. Stages of Community Service Implementation

Learning preparation is the initial stage in the implementation of community service activities. At this stage, observations of the condition of schools and students were carried out. In addition, the team also conducted interviews with teachers and students to find out the problems in implementing learning for blind students. It determines students' needs so that the methods or learning media offered can be applied properly. In addition, it is hoped that this assistance can significantly influence the success of learning. After knowing the needs of the target, the implementing team designed the lesson and made a service instrument in the form of questions to determine the community service's success.

The next stage is learning assistance. In the beginning, students are given an initial test containing math questions to determine the child's mathematical understanding. At this stage, the team will provide individual learning with students using previously designed learning methods. Next, students begin to learn about the concept of mathematical material. At the end of the assistance activity, blind students were given questions to determine student understanding. The last stage is the evaluation stage of the assistance activities that have been carried out. Evaluation of this service is in the form of giving a test. The test is used to determine the ability of students after assistance. In this activity, the indicator of success used is that there is an increase in the ability of blind students to understand mathematics.

RESULTS AND DISCUSSION

The implementation of service activities follows the steps that have been formulated, namely learning preparation, learning assistance, and evaluation. The following are the details of the activities carried out during the service activities.

Learning Preparation

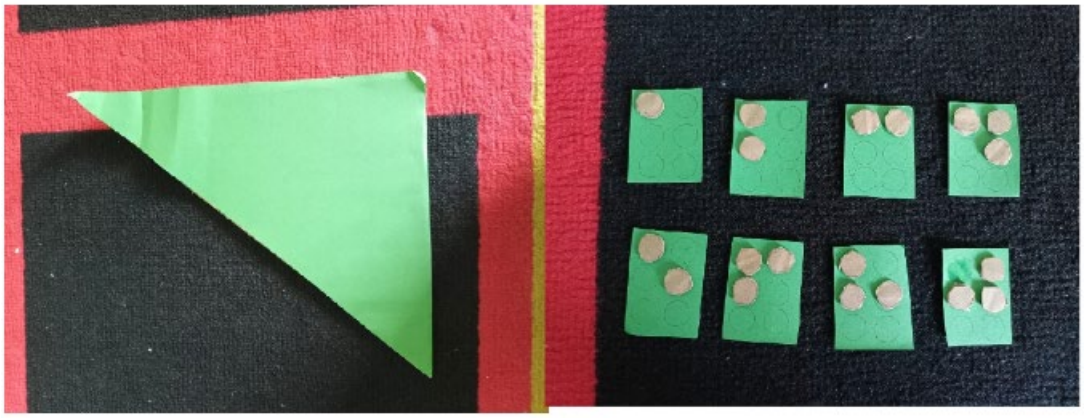
Based on the results of interviews and observations with mathematics teachers, it was found that the slow learner students' mathematics learning outcomes were still lacking. Therefore, assistance schedules and learning methods are prepared with input from teachers and students. The target in this service consists of 2 students with blind disabilities. The materials and strategies used in learning are presented in Table 1.

Table 1. Student Data, Material, and Assistance Strategies

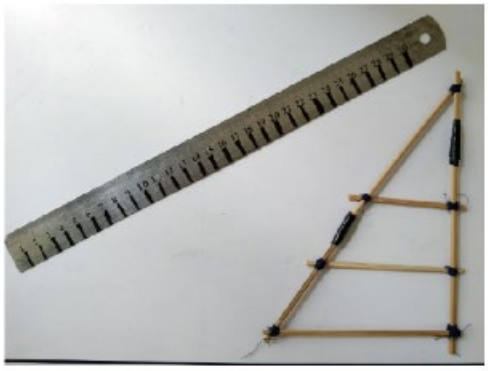
Student	Disability	Material	Assistance Strategy
Student 1	Blind Student	Trigonometric ratio	Drill method and with a props
Student 2	Low Vision		Discovery Learning with a props

Student 1 is a student who has been severely blind (absolutely unable to see) since birth, so he has never seen how students commonly use triangles and numbers with normal vision. That's why we made braille. When we met the student, he was very open and communicated well, telling us some of the difficulties he felt, especially in learning mathematics. They had never even used props. At first, when given the questions we read, students continue to wrongly determine the right angles of the triangle, the front side, the side, and even the hypotenuse of the right triangle, so that in answering questions, they still tend to be wrong. So the initial score obtained is only around 33.75. Student 2 has low vision, so he can barely see. Low vision blind people still have residual vision but cannot read in normal size, but their vision function can be improved through optical aids or environmental modification. For example, if the writing is enlarged, low vision may be able to read. The initial condition of students before the implementation of learning is that students have difficulty in determining the values of sinus, cosines, and tangent when there is one side of a right triangle that is not yet known. As a result, students can less reconstruct the Pythagorean Theorem material with trigonometric comparisons of right triangles.

Meanwhile, the learning props for flat stick sticks were given. Figure 2 shows an example of the props.



(a)



(b)

Figure 2. The Props for learning assistance: (**a**) the props are embossed triangles and embossed braille figures; (**b**) the props in the form of a triangle and a ruler

Learning Assistance

Assistance activities last 1-1.5 hours. For student 1, the learning carried out by the team was by giving a treatment to investigate and determine whether a given treatment could affect a variable to be studied. In this study, researchers provide treatment by using visual props to help students understand the material. In the other 2, for student 2, the model used in this trigonometric comparison study of right triangles uses the discovery learning method with a worksheet. In addition, this learning is also assisted by teaching aids that researchers have made. Discovery learning was chosen so that the mathematical concept can be understood by blind students independently and is expected to make students reconstruct the new material they get with what students have learned. In addition, the discovery learning model is in line with the 2013 curriculum (K13), where the learning process is student centered so that students can construct their understanding of the material being taught with what they have learned (Kartikasari et al., 2018). The community service team emphasized the ability of the student's sense of touch and hearing. Students use triangle props to feel the surface so that students get an idea of what a right triangle looks like. While the way to use a special ruler is the same as a ruler, in general, is to find out the length of an object by counting the number of lines.

(a)

(b)

Figure 3. Learning assistance: (**a**) Learning Assistance for Student 1; (**b**) Learning Assistance for Student 2.

Evaluation

At the evaluation stage, students who have been assisted at the last meeting are given math questions or posttests to determine the results of learning mathematics after the assistance is carried out. Posttest questions are given according to the abilities of children with special needs. The results obtained by students before and after assistance are presented in Table 2.

Table 2. Data on math scores before and after assistance

Siswa	Pre-test Score	Post-test Score
Student 1	33,75	79,5
Student 2	55	82,5

The success of the service activities can be seen from the increase in the pretest and posttest scores for the mathematical abilities of children with special needs for visual impairment who participate in assistance. It shows that the expected success indicators have been achieved.

Using these embossed teaching props, student 1's abilities have rapidly increased. At first, they only imagined and guessed the sides of the triangle, but with this teaching aid, students could feel the shape of the triangle, angle, and side of the triangle directly. In the intervention phase, students can determine the side of the triangle and the length of the side of the triangle so that they can answer questions more precisely than during the pretest. In this phase, the average student score becomes 79.5 on (a scale of 100). This value increased by 45.75, then the pretest value.

On the other hand, the condition of student two after the learning was carried out was that the students experienced an increase in their ability to determine the values of sinus, cosines, and tangent. In addition, students can also reconstruct the Pythagorean Theorem with trigonometric comparisons in right triangles. It can be seen from students' activeness during learning and the increase in evaluation results.

CONCLUSIONS

This service activity, which was carried out involving children with special needs for visual impairments, was very well received by the principal and mathematics teachers. In general, the assistance of children with special needs who are visually impaired in understanding mathematical concepts is going well. In addition, this service activity has met the indicators of success where there is an increase in students' understanding abilities after assistance is provided.

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