

## **Implementation of Problem Based Learning and Manipulative Teaching Aids to Growth Mathematical Imagination Students with Hearing Impairment**

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### **Abstract:**

**Background:** Imagination not only includes the ability to imagine in drawing, but imagination is the basic ability of a person to think in building knowledge or problem solving in a certain way. Imagination is seen as the basis and power of a person's mind to be able to foster creative and innovative thinking (Lian et al., 2012). Mathematics has five basic abilities which are standard mathematical abilities, namely problem solving, reasoning, communication, connection, connection and representation (NCTM, 2000). Therefore, the ability of mathematical imagination becomes important for every student to have.

**Materials and Methods:** This research is a mixed method research with Pre-Experimental Design and applied one-group pretest-posttest design. This research used observation, documentation, tests, and interviews.

**Results:** Quantitative analysis using mathematical imagination final test show that is more than the initial test results. On the other hand, qualitatively analysis obtained description of mathematical imagination students with hearing impairment for aspects of scientific sensitivity, scientific creativity, and good scientific productivity.

**Conclusion:** Mathematical imagination ability of students with hearing impairment in 11<sup>th</sup> grade of SMALB Negeri Salatiga experienced good growth with a Problem Based Learning and manipulative teaching aids.

**Key Word:** Problem Based Learning, Manipulative Teaching Aids, Mathematical Imagination, Students with Hearing Impairment

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### **I. Introduction**

Education is essentially a conscious and planned effort to realize a learning and learning so that students actively develop the potential to become human beings who believe and devote to God, noble, healthy, knowledgeable, competent, creative, independent, and become citizens who participated responsibly (Depdiknas, 2003). Inclusive education is defined as an education delivery system that provides opportunities for all students who have disabilities and have the potential intelligence and / or special talents to attend education or learning in the educational environment together with students in general (Aziz et al., 2015). UU No. 8 of 2016 concerning Penyandang Disabilitas caluse 1 states that persons with disabilities are any person who experiences physical, intellectual, mental, and / or sensory limitations for a long period of time who interact with the environment may experience obstacles and difficulties to participate fully and effectively with other citizens based on equal rights. Children with disabilities who experience disabilities certainly become a factor in determining an innovation that will be done, children with hearing impairment is one of the disabilities who really need an innovation in the learning activities. Children with hearing impairment can be interpreted as children who experience deficiency or loss of hearing ability that is caused by damage or loss of hearing ability (Wasito & S, 2010). To create an innovative learning atmosphere, teachers are expected to have three attitudes in developing mathematics learning, namely the teacher must at least know the nature of mathematics, the nature of children, and how to teach mathematics based on existing theories (Mariya et al., 2013: 40). In the newest curriculum of Indonesia that is Kurikulum 2013 math that must be given at all levels of education (Aziz et al., 2015). Mathematics subjects need to be provided to all students with the aim of developing students' thinking abilities and providing basic mathematical knowledge (Satoto et al., 2013).

Imagination is an interesting activity that is often done by every human being, this is done to stimulate, grow, and increase the potential of children's intelligence and creativity in their infancy. Imagination is considered as an important ability in solving a problem. According to Vygotsky (2003) identifying that there are four ways that connect imagination with reality, imagination is an important function for human life. First,

imagination comes from a person's experience. Second, the results of one's imagination have a relationship with real life. Third, the function of imagination and reality is related to emotions, so each emotion has the capacity to trigger impressions and thoughts at a particular moment. Fourth, the imagination that has been externally manifested into a tangible form. So, it can be concluded that the ability of imagination is very important for students. From the results of interviews and observations obtained that the mathematical imagination ability of students with hearing impairment in the 11<sup>th</sup>-B grade in SMALB Negeri Salatiga is still low.

Choosing the right learning model must pay attention to the condition of the students, the nature of the teaching material, the media facilities available, and the condition of the teacher itself (Mariya et al., 2013). The learning model influences students in understanding the material including in growing the mathematical imagination ability of the material provided by the teacher. In order to make Problem based Learning easier to understand and attract students' interest, learning will be better when using existing problems in the environment around the local culture specifically where students live, so students do not feel they are bored and tired of participating in learning mathematics (Abdulloh et al., 2015). Therefore, researchers are interested in using problem based learning and manipulative teaching aids for students with hearing impairment.

Problem based learning steps according to Arends (2012) are (1) giving orientation to the problem to students; (2) organizing students to research; (3) assisting independent and group investigations; (4) developing and presenting results; and (5) analyze and evaluate the problem solving process. In implementing problem based learning in schools, teachers can apply the following syntax. (1) The teacher prepares questions that meet the requirements as a matter of expressing students' abilities. (2) The teacher explains the algorithm has not been notified to students. (3) The teacher gives exercises that are routine. (4) The teacher asks students to work on the questions used to reveal the ability of students in problem solving. (5) After the teacher checks the student's work, the teacher answers the problem solving in front of the class (Pujiastuti et al., 2018).

According to Mariya et al. (2013) the effectiveness of a learning is not only determined by the learning model used, but the use of appropriate media will be able to maximize learning outcomes and one of the media is a teaching aid used in learning mathematics. Learning for SLB students who use teaching aids in a pleasant atmosphere and mathematics seems easy. The use of manipulative teaching aids accompanied by the application of an appropriate learning model is expected to help the teacher to foster student imagination so that it can achieve the learning objectives formulated (Sugiman et al., 2018). According to Pujiastuti and Mashuri (2017) suggested that teaching aids can help in embed concepts, understanding concepts, proving formulas, and training skills. In addition, students' motivation to learn increased if learning process use teaching aids. Teaching aids are aids used by teachers in communicating to create effective teaching with students in learning process. Therefore, the researcher uses manipulative teaching aids with indicators (1) introducing, refining, improving understanding of concepts and facts, (2) facilitating abstraction, (3) having a harmless shape, (4) have interesting colors.

Imagination is from imaginary which means to imagine yourself in 'Latin' word. The word imaginary shows that imagination has an individual scope, concerning self-reflection, assessment of feelings, and one's own thoughts (Perdue, 2003) in (Lian et al., 2012). Furthermore, Bland (2012) and Afiff (2013) explain that imagination is a cognitive process which is a series of complex mental activities in which the elements in mental activity are free from sensory sensations. Imagination involves integrating aspects of memory, memories, or experiences into a mental construction that is different from the past and becomes a new reality in the present, or even anticipating reality in the future.

Mathematical imagination ability in this study consists of several aspects and indicators according to Mun (2015: 2104), as follows.

**Table 1.** Indicator of Mathematical Imagination Ability

Aspect	Indikator
Scientific Sensitivity (SS)	<i>Emotional understanding</i>
	<i>The experience of imagination</i>
Scientific Creativity (SC)	<i>Diversity</i>
	<i>Originality</i>
Scientific Productivity (SP)	<i>Creation and reproduction</i>
	<i>Scientific sense of reality</i>

Purpose of this research there are: (1) whether the final test results of the mathematical imagination ability of students with hearing impairment by implementation of the problem based learning and manipulative teaching aids are better than the results of the initial tests; (2) description of the mathematical imagination of students with hearing impairment; (3) the growth of mathematical imagination of students with hearing impairment.

## II. Material And Methods

This research is a mixed method research that uses Pre-Experimental Design with one-group pretest-posttest design.

**Study Design:** Learning activity with implementation of problem based learning and manipulative teaching aids.

**Study Location:** Research held for students with hearing impairment in the 11<sup>th</sup>-B grade in SMALB Negeri Salatiga.

**Study Duration:** July – December 2018

**Sample size:** 8 students.

**Sample size calculation:** The sample in this research was taken by purposive sampling.

**Subjects & selection method:** Population in this research are students with hearing impairment of SMALB Negeri Salatiga. Furthermore, using purposive sampling the selected sample are students with hearing impairment in the 11<sup>th</sup>-B grade in SMALB Negeri Salatiga.

**Inclusion criteria:** students with hearing impairment in the 11<sup>th</sup>-B grade in SMALB Negeri Salatiga.

### Procedure methodology

This research used observation, documentation, tests, and interviews. Quantitative data analysis began with a normality test and then continued with a t-test that aims to find out whether the final test results in the mathematical ability of deaf students with the implementation of problem based learning models and manipulative teaching aids are better than the initial tests of mathematical imagination. The study began with observations and interviews to find out the learning activities used in SLB Negeri Salatiga, the characteristics of SLB Negeri Salatiga students in general and specifically for students with hearing impairment, then the researchers determined the material to be given during the learning process and selected integer operations material. Furthermore, researchers developed a learning implementation plan that is in accordance with the Problem Based Learning model assisted by manipulative teaching aids. In addition, researchers also prepare other research instruments namely, written test instruments and interview guidelines. The next step is to conduct a preliminary test of students' mathematical imagination abilities and interviews to confirm mathematical imagination abilities based on test results. After that, researchers conducted a learning model with problem based learning assisted with manipulative teaching aids with the material used was integer operations. After the material is finished, a final test of mathematical imagination is carried out by interview.

### Statistical analysis

The normality criteria to accept  $H_0$  if  $L_o < L_{tabel}$  with the value of  $\alpha = 0,05$ , continue by t-test with criteria reject  $H_0$  if  $t' \geq \frac{w_1t_1 + w_2t_2}{w_1 + w_2}$ . Description of mathematical imagination and the growth of mathematical imagination ability in problem based learning models assisted by manipulative teaching aids are analyzed qualitatively by the following steps (1) data reduction (2) data presentation (3) make conclusions.

## III. Result

Quantitative and qualitative data analysis after the implementation of Problem Based Learning and manipulative teaching aids for students with hearing impairment in 11th-B grade SMALB Negeri Salaiga showed the following results.

### Quantitative data analysis

#### 1. Normality test

Using the results of the final mathematical imagination ability by Liliefors test. Normality test results can be seen in table 2.

**Table 2.** Result of Normality Test

Data	$L_o$	$L_{tabel}$
Final test results of mathematical imagination ability	0,2968	0,319

From the result it is clear that  $L_o = 0,2968 \leq L_{tabel} = 0,319$ , then  $H_0$  is accepted, which means that the data comes from a normally distributed population.

2. Hypothesis test

Hypothesis testing is done by comparing of initial test and final tests of mathematical imagination abilities using t-test the results can be seen in table 2.

**Table 3.** Result of Hypothesis Test

Data	$t'$	$\frac{w_1 t_1 + w_2 t_2}{w_1 + w_2}$
Initial test results and final tests of mathematical imagination ability	4.73	2.23

From the result it is clear that  $t' \geq \frac{w_1 t_1 + w_2 t_2}{w_1 + w_2}$ , so we can conclude that  $H_0$  is rejected which means the results of mathematical imagination ability final test more than the initial test.

**Qualitative data analysis**

Comparing the results of the initial test of mathematical imagination with the results of interviews on subjects B-01, B-03, and B-05 shows that the scientific sensitivity aspect is fulfilled quite well. While aspects of scientific creativity and scientific productivity have not yet been fulfilled. On subject B-02 aspects of scientific sensitivity and scientific creativity are fulfilled quite well. While the scientific productivity aspect has not yet been fulfilled. Furthermore, for subject B-04 aspects of scientific sensitivity, scientific creativity, and scientific productivity have not been met. So that on subject B-04 there are no aspects of the imagination that are fulfilled. Thus, subject B-06 has aspects of mathematical imagination ability of scientific sensitivity and scientific creativity quite well.

The final test results of the mathematical imagination ability of subjects B-01, B-03, B-04, B-06 are good aspects of scientific sensitivity and is quite good, in other hand scientific productivity is good. Subject B-02 has aspects of imagination ability, scientific sensitivity, creativity, and productivity is good. Subject B-05 has aspects of mathematical imagination ability of good scientific sensitivity, creativity and productivity is good enough.

**IV. Discussion**

**Description of Mathematical Imagination Ability**

Based on the results of tests and interviews, subjects B-01, B-03, 05 have the mathematical imagination ability of Emotional Understanding (EU) aspects of scientific sensitivity. Thus the subjects B-01, B-03, 05 are students who can explore the difficulties of mathematical problems. Subjects B-01, B-03 have not been able to solve the problem obtained from experience / recall the rules of resolution, find new steps in solving other than what is given by the teacher, find new strategies found can be applied in solving similar problems, find new strategies with basis, and transfer abstract problems into concrete.

Subject B-02 shows that subject B-02 has mathematical imagination ability Emotional Understanding (EU) aspects of scientific sensitivity and Diversity (D) aspects of scientific creativity. Thus the subject B-02 is a student who can explore the difficulties of mathematical problems and solve problems obtained from experience / recall a settlement rule without making new solutions or slightly modifying, on the other hand subject B-02 has not been able to find new strategies found can be applied in solve similar problems, find new strategies on the basis of, and transfer abstract problems into concrete.

Subject B-04 no aspect of mathematical imagination appeared. Thus the subject B-04 does not have the ability of mathematical imagination Emotional Understanding (EU), The Experience of imagination (EI) aspects of scientific sensitivity; Diversity (D), Originality (O) aspects of scientific creativity; Creation and Reproduction (CR), Scientific sense of reality (S) scientific productivity aspects.

Subject B-06 has the mathematical imagination ability Diversity (D) aspects of scientific creativity. Thus the subject B-06 is a student who is able to find new steps in completion apart from what is given by the teacher but the subject B-06 can't to explore the difficulty of the problem, solve the problem obtained from experience/recall the rules of settlement, find new strategies found can be applied in solving similar problems, finding new strategies with a basis, and transferring abstract problems into concrete.

**Growth of Mathematical Imagination Ability**

The mathematical imagination ability of students with hearing impairment based on the aspect of imagination according to JiyeongMun, et al before learning by using a problem based learning model assisted by manipulative teaching aids is Emotional Understanding (EU), The Experience of Imagination (EI) aspects of scientific sensitivity both and Diversity (D) aspects of scientific creativity is quite good. Whereas after learning using the problem based learning model assisted by manipulative teaching aids there was an increase in Emotional Understanding (EU), The Experience of Imagination (EI) aspects of scientific sensitivity were good;

Diversity (D), Originality (O) aspects of good scientific creativity; Creation and Reproduction (CR), Scientific sense of reality (S) good scientific productivity aspects.

## V. Conclusion

The research process shows the application of problem based learning with manipulative teaching aids to foster mathematical imagination of students with hearing impairment in the 11<sup>th</sup>-B grade in SMALB Negeri Salatiga.in academic year 2018/2019, it can be concluded that the final test results of the mathematical imagination ability of students with hearing impairment by implementation problem based learning and manipulative teaching aids are better than initial tests of mathematical imagination abilities. Description of mathematical imagination of 11<sup>th</sup> grade in SMALB Negeri Salatiga.is a scientific sensitivity aspect well indicated by Emotional Understanding (EU), The Experience of Imagination (EI) is achieved; aspects of scientific creativity both shown from Diversity (D), Originality (O) achieved; aspects of scientific productivity both shown from Creation and Reproduction (CR), Scientific sense of reality (S) is achieved. The growth of mathematical imagination in students is when the initial test aspects of scientific sensitivity are good, scientific aspects of creativity are quite good and scientific productivity aspects are not achieved. Whereas after learning there is an increase in aspects of good scientific sensitivity, aspects of scientific creativity are quite good, and aspects of scientific productivity are good.

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