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Development of Braille Module Using Problem Based Learning with the Help of Audio to Enhance Visually Impaired Students' Creative Thinking Skills on Mathematic

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ABSTRACT

The aims of this research are to know: 1) process and product development of Braille module problem based learning with audio as a valid, practical and effective to enhance visually impaired students' creative thinking skills on mathematics; 2) whether learning using Braille module is more effective or not than learning using ordinary module to enhance visually impaired students' creative thinking skills on mathematics. This research and development uses 4D model by Thiagarajan which has modified in Focus Group Discussion. The data of this research are analyzed descriptively and statistically. Analysis of module's quality is based on expert judgments, practically and effectiveness criteria score. Analysis of pretest-posttest of students' creative thinking skills on mathematics used t-test (hypothesis testing). The results of this research are: 1) process of the development of the module was started with an analysis of problems and needs of visually impaired students to obtain the first draft module. The validation process was done by following up suggestions and revisions from the experts to produce a valid second draft. The results of the trial test can be concluded that the module is practical with the classification of the minimal percentage of the implementation in each meeting and effective based on the minimal percentage of the students' response in every meeting of learning; 2) learning using Braille module more effective than learning using ordinary module to enhance students' creative thinking skills on mathematics for visually impaired students.

Keywords: Braille module problem based learning, creative thinking skills, visually impaired students.

INTRODUCTION

According to the laws of UUD 1945 section 31 subsection 1 is written that all citizen of Indonesia have equal opportunity to pursue education, with no exception for visually impaired students. Visually impaired students has limitation due to damage eyesight. Damage eyesight is a general terminology for visualize the loss of eyesight. In damage eyesight terminology is explained the kind of blindness that consist of blind and low vision [13]. The damage eyesight will caused in the process of information reception, especially happened for blind students. It is happened because the sight sense is the highest sense for accepting information which is 83% of information can be accepted [8]. It caused the different learning method for blind students and normal students. Visually impaired students use touch sense, especially the blind students. Low vision students are still able to

use sight sense, but some of them are able to read use touch sense.

The existing of visually impaired students cannot be argued, but then we need to think about kind of help that can be given to help students with visually impaired [10]. A helping hand can be given through supported facilities in learning such as book, visual aids, audio media, and others resources which help visually impaired students learn well. Based on the interview and documentation at schools at Yogyakarta, it is collected information that the facilities for visually impatient students is insufficient. Based on interview with teacher at MTs Yayasan Kesejahteraan Tunanetra Islam (Yaketunis) Yogyakarta on December 11, 2015 and January 10, 2016, it is collected information that the existing of Braille book is insufficient, especially mathematics Braille book. Usually, teacher use a general

learning book and then s/he speak it out loud for visually impatient students. Sometime, it is difficult to teach mathematics without Braille book, especially in teaching geometry. It is happened because geometry usually learned by visual; drawing, graft, lines, curves, and others. Irony, visually impatient students are not able to do those ability without helping tools [16]. It becomes an obstacles for visually impatient students to learn the concept of geometry. Based on research [5] showed that visually impaired students has difficulties to describe cuboid. Sometimes, they describe it as rectangle. A research done by [18] give information that visually impaired students are not sure in differentiating two different sides. Those students are also not sure in solving a complex problem of two dimension shape. According to the observation at Grade VII (March 13, 2016) and Grade VIII (January 30, 2016), teacher dictate the material of lesson and then students take notes of it. Visually impaired students sometimes did mistakes on taking notes of material of learning and problem. Those things effect to their understanding when the re-read their notes. Sometimes, misunderstanding occurs. The quantity of material of learning becomes limited because the insufficient Braille Book for learning.

Heyes stated that visually impaired students will have a good intellectual achievement in learning when their environmental gives chances and motivation [10]. So, the visually impaired students will have a good ability in understanding geometry if exist a supported facilities. A research done by [4] stated that by developing of worksheet of rectangle and square for Grade VII SMPLB-A visually impaired students, they are able to mastery the concept individually.

One of purposes of learning mathematics is ability to think creatively or creative thinking. Cropley stated that creative thinking skills will help students to solve problems in mathematics [2]. Creative thinking skills is improved by doing challenging problems [1]. Creative thinking skill is improved by problem based learning (PBL). NCTM stated that solving problem activities help students to improve their creative thinking skills. PBL is one method of learning by posing a problem at the beginning of lesson [9]. The problem is solved as part of human activities [2]. Mathematics concepts is taken from constructive activity through solving problem. "In order to complete the educational needs, they need three principles such as: (1) concrete experience, (2) statements within concepts, and (3) learning by doing" [8]. Those principles are in line with Dewey PBL steps [12]. Dewey steps in problem based learning are: students face problem, students formulate the problem,

students stated hypothesis, and then students test their hypothesis. Djamarah [5] also stated a steps in PBL which is in line with Dewey and Sunanto steps.

The aspects used to know the development of creative thinking skills are fluency, flexibility, and novelty [1]. Fluency aspect are talking about how students answer the question and express their opinions. Flexibility aspect are talking about how students make a variety opinion from different point of view. Novelty aspect are talking about how students create a new idea or opinion in order to solve the problem [1].

Based on the problems occurred, this research' orientation is to develop a Braille Module based on problem. The steps of PBL and indicator of creative thinking skills become a orientation of this module. The problem discussed is limited for Quadrilateral with Competence Standard: 6. Understanding the concept of quadrilateral and triangle and determine the size. The module for visually impaired students are arranged to be agree with perceptual and cognitive needs of this group. For a normal students, the concepts of mathematics are usually learnt through picture and vision spatial manipulation such as line or graphic [6]. Therefore, the Braille Module needs audio media, tactual picture, and visual aids supported. Audio media is used to anticipate the interruption of hearing. Research of [7] also stated that visually impaired students need an audio media to improve their mathematics ability through Audio Interface (Theo and Seth). Audio media mentioned is the about instruction to observe tactual pictures, questions, and answers key.

The aims of this research are to know: 1) process and product development of Braille module problem based learning with audio as a valid, practical and effective to enhance visually impaired students' creative thinking skills on mathematics; 2) whether learning using Braille module is more effective or not than learning using ordinary module to enhance visually impaired students' creative thinking skills on mathematics.

METHODS

This research is done at MTs Yaktunis Yogyakarta for visually impaired students Grade VII A, VII B, and VII C in even semester of academic year 2015/2016. This research is a development research using 4D model of development [17]. The 4D model consist of four stages: define, design, develop, and disseminate. Nieveen stated the quality of the development module is assessed through three criteria: validity, practical, and effectivity [14]. The stages of define, design, and develop

have purpose to know the process and result of module which is valid, practical, and effective. In case the module is not practical and effective yet, there will be a Focus Group Discussion (FGD, modification of 4D) of mathematics teacher, visually impaired students, and expert of special needs students. On define stages, the data is collected through interview, documentation, and observation. This stage has purpose to determine the problem and needs of visually impaired students. Based on result of define stage, the design stage is done by designing Draft 1 of Braille Module. On develop stage, Draft 1 Braille Module is validated by expert of mathematics, learning, Braille and media. They used module assessment sheet to state the validity of each aspect. After that, the module are tested through readable test for one visually impaired students and through trial test for Grade VII A. Trial test is done by purpose to know the practical of module. The practical aspect is assessed using sheets of learning implementation. The effective aspect is assessed using students response questionnaire. Module is practical if the percentage of learning implementation is good ($p > 70$). The formula is

$$p = \frac{\sum x}{n} \times 100\%$$

Notes:

- p : Percentage of learning implementation
- $\sum x$: Sum of score achieved
- n : The number of observed activity

Module is effective if more than 50% students five positive response by Ratumanan [11]. The formula is:

$$P = \frac{\sum R}{\sum s} \times 100\%$$

Notes:

- P : Percentage of number of students who give respons to the questionnaire
- $\sum R$: Sum of students who give positive respons to the questionnaire
- $\sum s$: Sum of students

On disseminate stage, module is tested through effectivity test using experiment research in Grade VII B (experimental class) and Grade VII C (control class). The experimentresearch is used quasi experimental method and nonequivalent control group design. There are pretest, treatment, and posttest. The treatment is a learning method using Braille Module which is developed in this research. The purpose of disseminate

stage is to know whether the mathematics learning using module is more effective in improving students' creative thinking skills in mathematics than using a usual module. The data of improvement of creative thinking skills is taken from pretest and posttest which is measured using the following N-Gain formula [3].

$$g = \frac{p - p_t}{m - p_t}$$

The analysis of creative thinking skills in disseminate stage is using t test with pre condition using normality test and homogeneity test.

RESULT AND DISCUSSION

Based on define stage, there is information stated that the existing of Braille Module in mathematics is insufficient in MTs Yaketunis. Moreover, teacher are usually use a normal module which is dictated. Those things effect to the students' achievement especially the creative thinking skills which is low. On design stage, the module is validated through two steps. First steps is validation of draft 1 module which is written on usual format to the expert of mathematics and learning. The process of validation is continued by revise the module based on expert suggestions. On the second step, the module is written in Braille format with help of MBC4 software and DBT Win. Tactual picture is drawn through making a emboss picture. Audio media is done by help of audacity software. By using media audio, a survey done by Willis stated that visually impaired students are able to read twice than not using media audio [8]. Before process of printing and making audio, developer consulted the module to the expert of Braille and media. Those activity is a second step of validation. After that, 2nd draft after revision is tested through readable test to one visually impaired students. Readable test conclude that there are some mistype on module and students has difficulty on reading index symbol. After revision for the mistype, the module is tested on Grade VII A on trial test. Developer or researcher taught how to make a Braille index symbol. The trial test done by 4 times meeting.

There are a problem on the beginning of module in order to build the concept. Learning activities is consist of definition, group, properties, area, and perimeter of quadrilateral. All question and answer key

are available on audio media in order to make module easy to use for students and for economic reason. Students are able to correcting their answer through listening to the answer key.

Students solve problem based on the steps stated by Djamarah [15] and Dewey [12]. For example in solving problem for group and properties of quadrilateral. On the first step, students state the problem by define things that could define and describe group and properties of quadrilateral. On the second step, students state a temporary answer based on question from audio media through process of finding data. On the third step, students test the validity, conclude summary after read summary at the module.

Trial test result conclude that the module is practical and effective. It is practical because the learning implementation percentage from each meeting are 82.33%, 84.13%, 79.37%, and 77.14% respectively. It is effective because the positive response given by students from each meeting are 100%, 50%, 75%, and 100% respectively. Module is effective because there are a problem section “Improving Creative Thinking Skills”, for example “Draw a kite with different size of each angle (minimum 2 kites)!” That problem is an open ended problem which is arranged based on creative thinking skills. On novelty aspect, students are able to use their own method on solving problem using right process and result. On fluency aspect, students are able to give more than one related ideas to solve problems and state it clearly. On flexibility aspect, students are able to give variety interpretation to the picture, stories, or problems. They also are able to use variety of strategies to solve the problems. Creative thinking skills are also improved because of the help of visual aids on the problem in finding the concept of formula and area of quadrilateral.

On the second lesson meeting, module is not effective yet so researcher held an FGD involved teachers and visually impaired students. FGD result state the need of revision of string tools which is help students to measure perimeter of quadrilateral. Therby the result of development the Braille Module using problem based learning with the help of audio media meet expectation of the quality of development: valid, practical, and effective to improve creative thinking skills of visually impaired students. Module and tools of learning can be seen on the following **Figure 1**.

The data of disseminate stage is taken from pretest and posttest of students’ creative thinking skills as shown at the following Table 1.

Table 1. Description Data of Creative Thinking Skills of Visually Impaired Students

Class	Notes	Pretest	Posttest	N-gain
Eksperiment	N	4	4	4
	Total	97	140	0,979
	Mean	24,25	35	0,339
	Std.Dev	3,304	2,63	0,124
Control	N	4	4	4
	Total	126	139	0,52
	Mean	31,5	34,75	0,13
	Std.Dev	2,646	1,893	0,053

Descriptively, creative thinking skills of students at experiment class is higher than control class. It can be seen from their score of pretest, posttest, and N-gain. All data of pretest, posttest, and N-gain are normally distribute and have homogenyvariance. Based on calculation of t-test, the t observation is 3.094 and t table is 2.132 ($t_o = 3,094$ and $t_t = 2,132$), so H_0 is rejected. In conclusion, the learning using Braille Module using problem based learning with the help of audio media is more effective to improve creative thinking skills of visually impaired students. It is happened because on the control class, teacher become the center of learning. Teacher gives lesson to be memorized, continued by giving example and question based on usual module. That learning method does not give opportunity for students to construct understanding by themselves. It is in line with statements of Isaksen et al which describe the creative thinking as the process of constructing ideas [1].



Figure 1. Braille Module Using Problem Based Learning and Its Tools

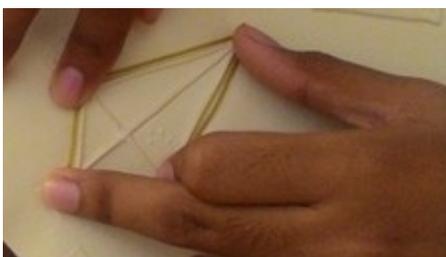


Figure 2. Measure Perimeter of Kite Activity

The revision of string tools (based on trial test) make students easier to find the concept and formula perimeter of quadrilateral in experiment class. This activity pass faster than on the trial test. The use of revision string tools can be seen on **Figure 2**. The process of solving problem of **Figure 2** encourage students to find the concept and formula of quadrilateral perimeter. Students have many way to find the perimeter of quadrilateral, after this activity.

The creative thinking skills of students at experiment class improved due to process of the problem solving. The process of problem solving at **Figure 3** encourage students to construct the concept and formula of area of quadrilateral especially parallelogram, Students have many ways to calculate the area of parallelogram by gathering the area of two congruent right-angled triangle and rectangle.

The other supported aspect to improve creative thinking skills for visually impaired students is the use of section motivation on the module. That section is given at the beginning of lesson as opening in order to motivate visually impaired students to learn mathematics. The motivation is contains by success story of blind mathematicians to improve the creative thinking skills of visually impaired students. It is in line with Collins and Amabile who stated that creative thinking skills is not only effected by the process and cognitive skills, but also by the motivation [20].

Arends also state that PBL is one of learning approach that students do authentic problem in order to develop their knowledge, inquiry, high order thinking skills, and autonomous in learning [19]. Creative thinking skills is one of high order thinking skills. The use of module, audio media, visual aids/tools, and tactual picture in this research is an appropriate intervention to improve the creative thinking skills of visually impaired students. This statement in line with Sunanto [9]. He state that the appropriate intervention develop a better cognitive skills of visually impaired students.

In this research, FGD is still held after disseminate stage. It is happened because there are some

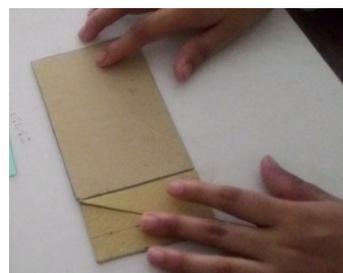
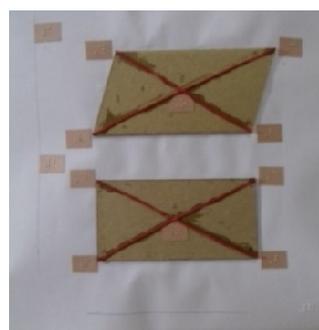
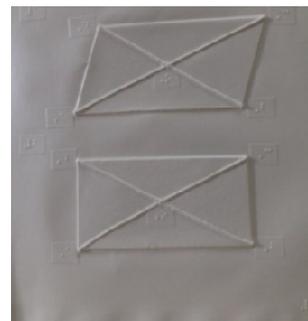


Figure 3. Puzzle Game of Area Quadrilateral Activity



(a)



(b)

Figure 4. Revision of Tactual Figure Based on FGD (a) prototipe (b) tactual figure

obstacles in the learning implementation of module. The follow up of FGD result is done by researcher supported by Braille expert and media expert at MTs Yaketunis and Research Center SLB Negeri 1 Bantul. One of the revision coming from FGD is in one page there are three tactual figure as seen at **Figure 4**.

CONCLUSION

The conclusion of this research are: 1) the development process of Braille Module using problem based learning with the help of audio can be done with following define, design, and develop stages in order to have a valid, practical, and effective module: 2) on the disseminate stages, it can conclude that the use Braille Module using problem based learning with the help of audio in learning is more effective than the use of usual module (for normal students) in order to improve the mathematics creative thinking skills of visually impaired students.

The suggestion based on this research are: 1) (for teacher) teacher should be able to understand the guidelines of module and characteristic of PBL before using module, besides that teacher should be able to understand the definition and indicator of creative thinking skills of visually impaired students; 2) (for researcher) the result of this research can be used to develop the other relevant research. The follow researches are expected to done all the trial test first before go to experiment test in purpose to have appropriate time to revise the module. Audio media are supposed to use for exercise only because students tend to have difficulties in understanding audio rather than Braille. The follow researches are expected to complete Braille Module in mathematics by the other concepts of geometry which is hard to be understand by students. The tools of measure length and degree can also be added to the next researches.

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