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Optimizing Styrofoam Media to Improve Year 8 Student's Mathematics Learning Outcomes in Linear Equation

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Abstract **– This study aims to examine the improvement in student learning outcomes, students' activity and teachers' ability in managing the learning. The learning media used is Styrofoam and threads to create linear equation graphs. This classroom action research (CAR) was conducted in two cycles, with each cycle consisting of planning, action, observation and reflection. The research subjects were 23 Year 8 students in one of the junior high school in Pidie Jaya District, Aceh, Indonesia. Pre-treatment showed that 52% of the students did not satisfy the minimum criteria for mastery learning. Data collection was under taken by tests and observations. The research instruments were test items, student activity sheet and the teacher activity sheet. The percentage of students who satisfied the minimum criteria of mastery learning was 65.3% (Cycle I) and 78.3% (Cycle II). The data of the student activities observation showed that 61.4% of students were active in Cycle 1, and the figure increased in Cycle II, reaching to 69.9%. Besides, the observation results of the teaching and learning process conducted by the teachers were 62.5% (fair) in the first cycle, and it was increased to 72.3% (good) after the improvement in the teaching and learning. This research concluded that the Styrofoam media for the topic of the linear equation could improve student learning outcomes, increase student activity and improve the ability of teachers to conduct teaching and learning.**

Keywords **– Learning Outcomes, Styrofoam, Linear Equations.**

I. INTRODUCTION

Learning is a sophisticated action and behaviour involving students. Students are the determinant factor for learning to occur. Learning can be said to be successful if the students master the subject matter. Mathematics learning requires the ability of teachers to manage the teaching and learning so that students can fully engage in learning, which ultimately impacts on the better learning outcomes. To date, mathematics remains to be considered as a hard subject, so the students learning outcomes are far from what is expected. For example, the results of daily tests for the previous materials showed that only 12 out of 23 students (52.17%) fulfill the minimum criteria of mastery learning (known as KKM in Indonesia, the score of ≥ 75). Mathematics is also one of the subjects tested in the national examination; thus, students must master all existing competencies to reach the graduates mastery learning standards (knows as SKL in Indonesia) set. Learning that can minimizes student learning difficulties is necessary to anticipate these problems.

Learning is the process of maturing students while interacting with their fellow students. The learning that runs well will result in good learning outcomes. Lestari [1] argued that learning outcomes are the result of the process followed by changes. The change can be a change in behaviour, attitude and knowledge. Learning outcomes of the students will be seen because of the changes and better development. Suhendri [2] said that learning outcomes are patterns of changes in one's behaviour, including cognitive, affective or psychomotor aspects, after participating in certain learning activities; the quality level of the change is mainly determined by

internal factors of the students and the social environment. Mathematics learning outcomes are the key to success in all subjects in school. Mathematics is a language, meaning that mathematics is a way of expressing or explaining. The language used by mathematics employs symbols.

Bernard et al. [3] stated that mathematics is the science underlying the technology development and has an important role in various disciplines. Mathematics builds communication of ideas, ideas on mathematical operations or proofs involving many words, mathematical symbols, and numbers. Learning mathematics is a mental activity to understand the meaning of structures, relationships, symbols, and manipulation of concepts created by a real situation; thus, it leads to change. By mathematics learning, students are expected to be able to organize their reasoning, shape their personality and apply mathematics in their daily lives or respective educational levels. Teaching and learning are two inseparable concepts. Learning refers to what a person must do as a subject in learning, while teaching refers to what a teacher should do as a teacher. These two concepts are integrated into one activity. Therefore, the learning outcome is the student's ability after getting the treatment from the teacher, as stated by Sudjana [4]. Besides, Horwart Kingsley in Sudjana [4] divides the teaching and learning outcomes into three types: (1) Skills and habits, (2) Knowledge and direction, (3) Attitudes and ideals.

Media are all forms of instruments used for conveying information is an integral part of the learning. Rohani [5] argued that the media is not just teaching aids but is an inseparable part of the learning. Learning may continue without teaching aids, but it will not run without media. Media is anything that can be used to convey messages from the sender to the recipient so that it can stimulate students' thinking, feelings, concerns and interests in such a way that the learning process occurs. Sudjana [4] classified media into two types: two-dimensional media and three-dimensional media. Two-dimensional media is media that has length and width, such as pictures, photos, graphics, charts or diagrams, posters, cartoons, comics, and others. On the other hands, three-dimensional media are solid models, cross-section models, stacking models, working models, and mock-ups. We cannot deny the existence of learning media as a tool in teaching and learning because teachers need it to facilitate their work in conveying messages or learning material to their students. The teachers are aware that without the help of media, students find it hard to understand the learning materials, especially the complex and difficult ones.

Student learning difficulties can be reduced by creating an enjoyable learning atmosphere for meaningful learning. Meaningful learning is expected to decrease students' learning difficulties and ultimately increase their learning outcomes. According to Yeni [6] students' learning difficulty is students' inability to solve the tasks given by the teacher. The students with learning disabilities have their characteristics in learning and different learning styles. The linear equation of a slope determines the position of a line with respect to the x and y coordinates [7]. This mathematical calculation is part of analytic geometry assisted by algebra. Today, during the learning activities, the teachers deliver the concept of linear equations only by giving worksheets. The students then conduct group discussions and class discussions guided by the teacher. The teacher further explains this concept using a blackboard to describe the Cartesian coordinates and show a graph of linear equations classically. Based on the initial observation analysis, this method is ineffective, and many students have difficulty in understanding the concept. Therefore, the researcher tried to create a simple teaching aid as a learning medium that can assist students in interpreting the meaning of the symbols in the linear equation

concept. Students are expected to develop their learning independence so they can understand concepts and improve their learning outcomes. Our effort to seek meaningful learning in mathematics was by using styrofoam learning media. It enabled students to build their knowledge based on their experiences and connect with their prerequisite knowledge. This research aimed to improve year 8 students' mathematics learning outcomes in linear equation in one of the junior high school in Pidie Jaya District, Aceh, Indonesia. It also aimed to improve the activities and ability of teachers to manage the learning. This research will be beneficial to improve learning using media.

II. RESEARCH METHOD

This study was conducted in one of the junior high school in Pidie Jaya District, Aceh, Indonesia, and involved 23 year 8 students (18 female and five male). This research adopted the Kemmis and Taggar Classroom Action Research (CAR) [8], consisting of two cycles. Each cycle consisted of the following steps.

Planning

The activities conducted in this step is planning the learning by preparing the syllabus, lesson plan and the instruments. This step also involved creating the learning media made of styrofoam, pushpin and thread. The instruments included the student activities observation sheet and teacher activities observation sheet.

Acting

All activities in the planning stage were conducted in this step. The learning the linear equations conceptsusing styrofoam learning media as a teaching aid was conducted.

Observation

Observations were undertaken in this stage. The researcher teacher observed the students during the teaching and learning to see student activities. Also, the collaborator teacher observed the researcher teacher conducting the teaching and learning.

Reflecting

Reflection was conducted at the end of the learning to examine the results of teaching and learning. The reflection results in the first cycle were a reference for the researcher to take action in the next cycle (cycle II). In Cycle II, some changes were made concerning the teaching and learning to fix the shortcoming in Cycle I. Thus, the results of the teaching and learning can be better following the expectations and goals to be achieved.

Data in this study were collected through observations and test. Wina Sanjaya in [9] argued that observation is a technique of data collection by observing every event taking place and recording them in an observation sheet. The tests carried out at the end of the Cycle I and II were used to evaluate the student learning outcomes after the two treatments using styrofoam media.

The researcher developed a media made of Styrofoam, pushpin and threads in different colours. This thread was used to show a linear graph and different colour used to distinguish between the linear equation graphs. The process to make it was simple. On the styrofoam, size 50cm x 40cm, a box of 4x4 cm were made. Next, a pushpin was mounted on each intersection of each intercept lines. The thread was used as a tool to create the x- and y-axis, and to illustrate the graph.

At the end of Cycle I and II, a test was administered to measure the students' ability after the learning using styrofoam media. In this study data were taken on student learning outcomes through tests. The percentage of mastery learning was calculated using the following formula,

$P = \frac{\sum siswa\ \ yang\ \ tuntas\ \ belajar}{\sum siswa}$ x 100% [10], and the average score of students' score was generated using the following formula, $X = \frac{\sum X}{N}$ [10]

Where:

X = Average of students' score.

∑X = The total of students' score.

N = The Number of Students.

III. RESULTS

Students were expected to be able to explain how to make a linear equation from the equation given using styrofoam. Styrofoam media used in the first cycle to determine the location of two points that would be connected with a thread,that was a linear equation. Based on the analysis of the learning outcomes at the first lesson, 14 out of 23 students satisfied the Minimum Criteria of Mastery Learning (scored above 75). At the second meeting, 16 out of 23 students satisfied the criteria. These findings mean that the average of students meeting the criteria is 65.22%, while the remaining 34.78% did not fulfil the criteria. Student learning outcomes can be seen in Table 1.

Table 1. Student learning outcomes in Cycle I.

Cycle I	The mastery learning (≥75)		Mastery learning (%)	
	≥ 75	< 75	Satisfying	Not satisfying
Meeting I	14	9	60,87 %	39,13 %
Meeting II	16	7	69,57 %	30,43 %
Average	15	8	65,22 %	34,78 %

Based on Table 1, the average percentage of teacher's ability in conducting the teaching and learning process was 62.5% (fair category). In Cycle II, the number of styrofoam media for each group is added and the thread, a means to create the straight lines, were provided in more varied colours. These colourful threads were used to distinguish the graphs of the linear equation of y = mx and y = mx + c.

Table 2. Student learning outcomes in Cycle II.

Cycle I	The mastery learning (≥75)		Mastery learning (%)	
	≥ 75	< 75	Satisfying	Not satisfying
Meeting I	17	6	73.9 %	26.1%
Meeting II	19	4	82.6 %	17.4 %
Average	18	5	78.3 %	21.7 %

Table 2 shows an increase in student learning outcomes in the Cycle II. in In the first meeting, 17 out of 23 students (73.9%) fulfilled the minimum criteria of mastery learning, and the number was increased to 19(82.6%)

at the second meeting. Thus, the average learning outcome of students in Cycle II was 78.3%. The data of the observations of student activity also indicated the increase from 61.5% in Cycle I to 66.2% in Cycle II. The increase in the percentage of student activity is due to student activities in group and class discussions. Furthermore, the teacher's ability was also improved in Cycle II. The aspects observed in the teaching and learning in the second cycle were carried out well, increased from 62.5% to 80.5%, due to the improvements made.

IV. DISCUSSION

Based on the results of the implementation in Cycle I and II, it can be said that there had been an increase in student learning outcomes in the concept of linear equations. This can be seen from the results of student learning outcomes, student activities during the teaching and learning, and the ability of teachers in conducting the teaching and learning. The analysis showed that the increase was directly related to the use of styrofoam media as a learning media, most importantly, in the aspect of improving student learning outcomes. Styrofoam media not only improved student learning outcomes but also enhanced students' thinking abilities on the concept of linear equations, which had been considered a difficult topic. Besides, styrofoam can also be used as a medium for the discovery of the Pythagorean theorem.

Student learning outcomes in the first cycle did not meet the expectations of 75%, with only 15 students (65.1%) who scored 75 and above. As for the results of learning did not fulfil the desired expectations, the second cycle was conducted to improve and fix the aspects with shortcomings in Cycle I. In Cycle II, the number of students who scoredabove 75 was 18 out of 23 students (78.3%). This figures clearly showed that there had been a significant increase from Cycle I to Cycle II.The results were also in line with the expectation, namely 75% of students satisfying the mastery learning criteria. The data on student learning outcomes between the cycles are presented in Table 3.

Table 3. Student learning outcomes between the cycles.

Activities	**The mastery learning (≥75)**		**Mastery learning (%)**	
	≥ 75	**< 75**	**Satisfying**	**Not satisfying**
Cycle I	15	8	65.1%	34.7 %
Cycle II	18	5	78.3%	21.7 %

Based on the observations on the students' activities in the first cycle, 61.4% of students were active in teaching and learning. The students' engagement was not optimum, some students did not work in their groups, and the students' group and class discussions were lacking. This finding was due to the lack of teacher guidance in conducted these activities. After some improvements in teaching and learning in Cycle II,the student activities increased to 67.0%. The data concerning students' activities between cycles are displayed in Table 4.

Table 4. The average of student activities between meetings in the cycles.

The activities between cycles				
	Meeting I	**Meeting I**	**Total**	**Average**
Cycle I	60.9	62.1	123.0	61.5 %
Cycle II	67.7	71.4	139.1	69.6 %

The percentage of teacher's ability in conducting the teaching and learning between cycles also increased, from 65.3% (fair category) in in the first cycle to 76.1% (good category) in the second cycle.

The finding of this study is consistent with [11] who found that the use of Styrofoam as a teaching media improved the students' performance and revealed that that using Styrofoam media enhanced students' learning outcomes by 83%.In addition, it agrees with [12] who argued that the influencing factor of successful mathematics learning is the learning media used, one of which is styrofoam media that can help students to make abstract mathematics become concrete.

V. CONCLUSION

The results of the treatment or action the action research conducted in two cycles indicated that there was an increase in student learning outcomes, student activities and the teachers' ability to run the teaching and learning. Hence, it can be concluded that styrofoam media can be used as a learning medium on the concept of linear equations for year 8 students in the school studied. It is recommended for future researchers to create other learning media on the concept of linear equations for variation in education and to use the styrofoam media for other topics to enrich the finding related to the media.

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