Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.13, No.9, 2022

Development of Flash-Based Learning Media to Improve Mathematics Problem Solving Ability and Students' Learning Independence at Putra Jaya Stabat Junior High School

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Abstract
This study aims to: (1) describe the validity, practicality and effectiveness of the flash-based learning media that have been developed; and (2) Produce a valid flash-based learning media development product to improve mathematical problem solving ability and independent learning of students at Putra Jaya Stabat Junior High School. This research is a development research. The development model used is the ADDIE model which consists of five stages, namely analysis, design, development, implementation and evaluation. The subject of this research is the learning media on the subject of a two-variable linear equation system. The trial was conducted on eighth grade students of SMP Putra Jaya Stabat. Trial I in class VIII and trial II in class VIII SMP Putra Jaya Stabat. From the results of this development obtained: (1) The learning media developed is valid, (2) The learning media developed is practically seen from the responses of experts who state that the learning media can be used with little or no revision (3) The learning media developed is effective, seen from the classical student learning mastery has been achieved, positive student responses to the components of learning media and learning activities developed; and the ability of teachers to manage learning gets an average score which is in the good category. The increase in student learning independence reached an average of 79.09 in the first trial and increased to 82.35 in the second trial.
Keywords: Development of learning media, flash multimedia, mathematical problem solving abilities, student learning independence.
DOI: 10.7176/JEP/13-9-07
Publication date: March 31st 2022

INTRODUCTION

Educational issues have always been an interesting topic of conversation, both among teachers, parents and education experts. This is something that is natural because everyone with an interest wants the best education for students, children or for the next generation of this nation. Rajagukguk (2011) says that true education is education that prepares students to become quality human resources. The educational process is carried out in such a way that humans can understand and live the meaning of education so that it can be useful for themselves in living life.

In the learning process sometimes there are learning problems that can lead to failure in the learning process. Surya, Sabandar, Kusumah, and Darhim (2013) stated: The teachers' are concern in the problem or question in class which is done by teachers and students is become routine activity and must activity to do in the learning process to emphasize students more active to get involved in the process of knowledge delivery. This means that the teacher's attention to problems or questions in class carried out by teachers and students become routine activities and activities that must be carried out in the teaching and learning process so that students are more actively involved in the process of delivering knowledge.

Problem solving ability is part of the mathematics curriculum which is very important and even becomes the main target in learning mathematics. This can be seen from the objectives of learning mathematics at the secondary education level as stated in the attachment of Permendikbud No. 59 of 2014 which contains the skills or abilities that students must have in learning mathematics.

The students' lack of problem solving ability, this is also supported by several previous researchers, namely Revi Kristenngsih and Novisita Ratu (2019). The results of their research found that VIII grade junior high school students had difficulties in tangent to a circle material including: (1) difficulty in understanding concepts, skills and problem solving abilities by 52%; (2) the difficulty in solving the given circle problem is 5.18%; (3) the difficulty that is influenced by other factors is 94.82%. In this case the problem solving ability of students is still lacking and needs to be improved. Jovita Gabriella and Adi Ihsan Imami (2021) suggested from the test results and analysis obtained that the problem solving ability of students was still very lacking. Most of them were able to understand the given problem, but students seemed to have difficulty in the next stage.

This is reinforced by the opinion of Novriani and Surya (2017) who stated: In solving problems, students are expected to understand the process of solving the problem, identifying relevant conditions and concepts, seeking generalizations, formulating a plan of completion and organizing previously owned skills. This means that in

solving problems, students are expected to be able to understand the problem solving process, identify relevant conditions and concepts, seek generalizations, formulate settlement plans and organize the skills they previously possessed.

The lack of students' mathematical problem solving skills is directly related to the learning process that students receive at school. Generally, teachers teach the material conventionally. Herlawan and Hadija (2017) suggest that conventional learning models cause students not to provide optimal active responses, because students are forced to accept knowledge from the teacher without knowing what the meaning of the knowledge gained is. Such learning activities are often encountered and become a daily routine and the lack of active student learning activities such as manipulative activities, experimenting and discussing. As a result, students do not understand the underlying knowledge about a concept, how to build a concept and its application to problems in everyday life, as well as the relationship between concepts and problem solving. Laine, Navery, Pehkonen. Ahtee, and Hannula (2012: 70) suggest: In learning situations, problems should be on such levels that every learner would be able to solve at least some of the problems to some extent, to encourage his/her motivation. This idea supports the argument for the use of open problem tasks. This means that in a learning situation, the problem must be at an appropriate level, so that each student can solve at least some problems to some extent, to encourage his motivation. Eviyanti, Surya, Syahputra, and Simbolon (2017) stated: To obtain the ability in problem solving, one must have a lot of experience in solving various problems. This means that to get the ability to solve problems, one must have a lot of experience in solving various problems. This idea supports the argument for the use of open problems. But in reality there are still very few teachers who use problem solving in learning mathematics.

In addition to the importance of problem solving skills in mathematics, students also need to have an independent learning attitude. Suhery, Saragih, and Syahputra (2013) suggest that the independence of learning mathematics is one of the important factors that determine student learning success, especially those related to students' mathematical problem abilities.

Nurhayati (2017) expressed her opinion that students who have high learning independence are better able to manage time and control themselves in thinking, planning strategies, then implementing them, as well as evaluating or reflecting. The level of student learning independence can be determined based on how much initiative and responsibility students take to play an active role in learning planning, learning processes and learning evaluations. Rafika, Israwati, and Bachtiar (2017) expressed their opinion that independent learning can also be created by teachers by fostering student interest in what is being taught so as to help students in learning activities through motivating and planning subject matters. Therefore, every teacher must be able to create learning situations that enable students to develop independent learning well.

Field observations show that the learning independence of the Putra Jaya Stabat Junior High School students is still lacking, this can be seen from the many students in the class who do not yet have learning independence. this can be seen from the lack of self-motivation in learning, lack of awareness of thinking in learning mathematics and inability to set targets and goals in learning.

In addition, if given questions that are not the same as what is exemplified or non-routine questions and then story questions, many students lack confidence in solving them, and the efforts they make to solve the problem are considered less capable, as a result. they are not interested in trying to solve the problem properly. This means that 60% of students in this school have problems with independent learning abilities.

Based on some of the facts above, it can be concluded that the level of students' mathematics learning independence is still lacking. Therefore, it is necessary to strive so that students' learning independence in mathematics is high. Suhendro (2018) expressed his opinion that the teacher is the main source of knowledge so that students become passive because they only listen and take notes on the material presented. In such conditions, the opportunity for students to find and build their own knowledge is almost non-existent, resulting in students lacking the ability to develop an attitude of independent learning.

One of the competencies that a teacher needs to have in carrying out their duties is to develop more interactive learning media. The development of more interactive learning media is important for teachers to make learning more effective, efficient, and not confusing from the competencies they want to achieve. Competence in developing learning media that ideally has been mastered by the teacher well. In her research, Shabrina Amalia (2019) stated that the teacher's role is very important in the learning process, so teachers are required to have broad knowledge and be able to take advantage of modern technology. who have not mastered it. Thofan Aradika Putra (2018) suggests that there are still many teachers who have not developed multimedia-based learning media in computer-based learning in order to assist teachers in teaching and assist students in learning.

Based on the observations, it also appears that learning mathematics in the classroom has not been effective. This is because teachers still use conventional teaching methods, students only get information from the teacher. Whereas students should not only get information from what is conveyed by the teacher but from other sources.

Rizma Panca Patriani and Indrati Kusumaningrum (2020) expressed the opinion that the use of technology-based learning media such as Student Worksheets / teaching materials / modules, interactive learning or other valid, practical and effective learning media did not appear to be used optimally. Teachers do not have much time to

create learning media that are more attractive to students' learning interest. In addition, in her research, Shabrina Amalia (2019) suggests that with this valid, practical and effective interactive learning media, it is hoped that it can reduce student boredom because so far the learning process carried out by most teachers is a face-to-face method (lecture) which causes students to become bored and bored, causing students' motivation to decrease.

The teacher is responsible for making students to increase their interest, motivation, and interest and change the students' perceptions of mathematics, so that the objectives of learning mathematics are achieved properly. One way that can be done is by developing learning media such as flash-based interactive media, either using Adobe Flash software or flash media macros.

METHOD

Research Pattern

This research includes research on the development of flash-based learning media that refers to the ADDIE model. This development research is carried out to produce learning media products which will then be tested in class.

Subject

The subjects of this research are students of class VIII semester 1 of the academic year 2021/2022. The object of this research is to produce valid learning media development products on SPLDV material, describe the validity, practicality, and effectiveness of learning media, and describe student responses to learning media that have been developed.

Data Analysis

Validity Analysis

This validation is based on the opinion of five experts in the field of mathematics education. Based on the expert opinion, the average value for each aspect will be determined, so that the average value of the total aspects is obtained. The criteria states that the learning media has a good degree of validity, if the minimum level of validity achieved is the valid level. If the level of attainment of validity is below valid, it is necessary to make revisions based on input (correction) from experts. Furthermore, validation activities are carried out again. And so on until the ideal learning media is obtained from the size of the content validity and construction.

Practical Analysis

Student response questionnaires were given after the learning media trial. The questionnaire consists of positive statements and negative statements, each with a choice of answers strongly disagree, disagree, agree and strongly agree.

Effectiveness Analysis

The criteria states that students are said to have mathematical reasoning abilities if 80% of students who take the test have at least moderate mathematical reasoning abilities (getting a value of more than or equal to 2.66 or B-). If the above criteria have not been met, it is necessary to conduct a review of the learning process and results. Then a re-test was carried out with the aim of getting an effective learning device in terms of students' mathematical reasoning abilities.

The teacher's ability to manage the learning process is the ability to develop a friendly and positive learning atmosphere, including the ability to open learning, organize learning, close learning, manage time and manage the learning climate.

Student response data obtained through questionnaires were analyzed based on percentages. The percentage of each response is calculated by dividing the number of student responses for each aspect that appears by the total number of students multiplied by 100%. Student responses are said to be positive if 80% or more students respond in a positive category (happy, new, interested, clear, and interested) for each aspect that is responded to.

Data Collection Techniques

To measure the validity and effectiveness of interactive mathematics learning media, research instruments were compiled and developed. The instruments developed in this trial can be described as follows:

Students' Early Mathematical Ability Test

Initial ability test is the knowledge that students have before learning takes place. The students' initial mathematical ability test can be seen from the results of the SMP/MTs Semester Exam tests that are given back to students. The students' initial mathematical ability test aims to determine the high, medium, and low abilities of students before learning is carried out and see changes in students' initial abilities whether there is an increase or not.

Problem Solving Ability Test Validation Sheet

The data collected by this validation sheet is data about the validity of the students' mathematical problem solving and critical thinking ability tests. The validation sheet of the problem solving ability test and the student's mathematical critical thinking ability test consists of three components, namely instructions, assessed aspects, and results. evaluation. The assessment of the validity of the problem-solving ability test and the student's mathematical

critical thinking ability test developed in terms of 3 aspects, namely (1) content; (2) construction; (3) use of language. The results of the assessment of the students' mathematical problem solving and critical thinking skills tests that were developed were valid, quite valid, less valid, and invalid. The problem-solving ability test instrument will be given to obtain information about the data on students' problem-solving abilities.

Item Validity

A measuring instrument is said to be valid if the measuring instrument actually measures what is to be measured. To test the validity of the test, the Spearman-Brown correlation formula is used (Asmin and Abil, 2014: 278). To interpret the significance of the value of the validity of each item, the price is confirmed to the critical price of the product moment table for N students and at the level of significance = 0.05. The criteria used, if > , then it is concluded that the correlation is significant so that the test is said to be valid.

Validity of Questionnaire Items for Student Learning Independence

The validity of the questionnaire items is the measuring accuracy possessed by a questionnaire, in measuring what should be measured through the questionnaire items. A questionnaire item is said to be valid if it has great support for the total score. The stages of calculating the validity coefficient of this questionnaire item are calculating the validity coefficient of a questionnaire item using the Pearson Product Moment Correlation formula (Arikunto, 2009).

Result and Discussion

Description of Learning Media Development Stage

The learning media development stage uses the ADDIE development model developed by Dick and Carry. The first stage starts from the analysis stage, the second stage is design, the third stage is development, the fourth stage is implementation and the last stage is evaluation.

Analysis Stage

At this stage the researchers obtained data about the conditions of mathematics learning that had occurred so far. The learning carried out tends to be teacher-centered. Learning materials are never associated with problems in everyday life. Students only take notes and do the questions. As a result, students are not accustomed to constructing their own knowledge. Teachers and students only use ready-to-use learning package books as a reference, even 74.4% (about 29 people) of students only have one book as a reference.

The difficulty of students in solving story problems in the Two Variable Linear Equation System (SPLDV) material is that students find it difficult to convert story problems into mathematical sentences, students find it difficult to understand the information presented so they cannot make solutions, students cannot determine the set of solutions using elimination and substitution and students find it difficult to understand the concept of SPLDV.

Design Stage

In this flash-based learning media, it is described in the form of the adventures of pirates looking for treasure, only if in real animation the pirates compete for treasure by fighting physical strength. However, in this learning medium, pirates search for treasure by using the knowledge they use as a weapon in answering questions to obtain the treasure.

Figure 1. Example of question design in flash media

If you succeed in answering the question, you will add one friend to the journey to find one piece treasure.

Development Stage

The initial screen that will appear when the user opens the learning media that has been created.

Figure 2. initial display of flash media

The initial display of the learning media above shows the front page which is the beginning of introducing the characters in the One Piece anime who will go on an adventure to find treasure. The first friend to be saved is Usopp. Usopp will go on an adventure with Luffy if Lufyy manages to answer the questions correctly on the practice questions display. However, if Luffy answers the question incorrectly then Usopp will not be free and cannot join the adventure of accompanying Luffy to find treasure. How to answer a question is by pressing the answer choice button in the question, (A), (B), (C), or (D).

If the answer is correct, students can continue the mission of the pirates to find treasure by pressing the arrow buttons on the display. Meanwhile, if the answer is wrong, it means that students still do not understand the material provided and students must return to the material display to understand the material again and answer questions again until their answers are correct.

Implementation Stage

At the implementation stage of the product that has been developed and validated, trials are carried out on class VIII SMP Putra Jaya Stabat, the first trial is carried out and the results show that there is an increase in mathematical problem solving ability and student learning independence but not significant, so an evaluation is carried out to see product deficiencies. that have been developed and revised to the product.

Evaluation Stage

In this stage, an evaluation of the product developed and learning activities is carried out, the product used in the first trial after being evaluated still has not succeeded in significantly improving students' mathematical problem solving abilities, then revisions are made to the product developed, especially in the appearance to make it more attractive and attractive. the content of the material is more detailed so that in the next trial the product developed can significantly improve students' mathematical problem solving abilities.

The Validity of the Developed Flash-Based Learning Media

Based on the results of the validation of the developed Flash-based learning media, it was found that the Learning Media, Learning Implementation Plans (RPP), and Student Worksheets (LKPD) were declared valid or had a good degree of validity. Student learning independence is also valid or has a good degree of validity. This shows that the flash-based learning media developed by the RPP learning media, LKPD, mathematical problem-solving ability tests and student learning independence questionnaires have met the validity criteria.

Although the developed flash-based learning media has met the validity criteria, there are several things that must be corrected according to the notes provided by the validator including content, language and constructs. So based on the notes from the validators that this flash-based learning media has met the criteria for validity in the "valid" category and with a small note of slight revision. Furthermore, revisions were made to the flash-based learning media according to the suggestions from the validator.

Then, the results of the validation by the validator on the mathematical problem-solving ability test and learning independence questionnaire also meet the content validity criteria. The mathematical problem solving ability test consists of 4 posttest questions where each question contains four indicators of the measured mathematical problem solving ability. Furthermore, statistical validation or instrument testing outside the sample

is carried out in the form of giving tests to students to see the validation of test items. From the results of this statistical validation, it was obtained that 4 posttest questions of mathematical problem solving ability had met the valid criteria.

The validity criteria were obtained through expert assessment of the developed flash-based learning media. The acquisition of valid learning media is caused by several factors, including: (1) the developed learning media has met content validity. This means that in the development of flash-based learning media, it is in accordance with the demands of the existing curriculum, which is related to core competencies (KI) and basic competencies (KD) that must be achieved by students in learning activities that are adapted to the material or content of the lessons provided. The above is in line with Arikunto's opinion (2009: 57) which states that good content validity is if a learning device can measure certain specific objectives that are parallel to the material or content of the lessons provided. Content validity is also often referred to as curriculum validity.

Then, (2) the flash-based learning media developed has met the construct validity. That is, the development of flash-based learning media has been in accordance with the concepts and indicators of mathematical problem-solving abilities which are then combined with the developed flash-based learning media. The flash-based learning media that was developed were arranged to complement each other between Learning Media, RPP, and LKPD which were used to measure mathematical problem solving abilities. Fulfillment of good validity aspects as stated above, Akbar (2013:152) added that high validity was obtained through validation tests on the developed learning media.

Based on the results of research and supporting research, it can be concluded that the flash-based learning media developed has met the validity criteria as expected. Thus, the developed flash-based learning media can be used.

Practicality of the developed flash-based learning media

Practicality is that the learning media are arranged considering the convenience. Ease in the sense that the learning media that are arranged are easy to understand and also easy to implement or use. (Nieveen, 2007: 127-128).

Practicality is viewed from two indicators, namely: (1) based on expert/practitioner assessment which states that the developed flash-based learning media can be used with little or no revision. Based on the results of expert assessments, the components of the learning media developed in the form of learning media, lesson plans, LKPD, mathematical problem solving ability tests and student learning independence questionnaires are practical/can be used with minor revisions.

For further practical assessments, (2) based on the results of observations of the implementation of flash-based learning media in the classroom, it is in the high category ($3 \leq P < 4$) or very high ($4 \leq P$ 5). In the first and second trials, the implementation of the instructional media has met the established criteria, that is, it has reached a high category of $3 \leq P < 4$. Indeed, in the first trial, some students were still not familiar with the use of flash-based learning media which required students to be more active, but in the next trial the students became more accustomed and happy.

The obtaining of practical flash-based learning media is caused by several things. There are several things that support practicality, namely: (1) the developed flash media which is arranged to be easily understood and used by teachers in the learning process; (2) Learning Implementation Plans (RPP) that are prepared are easy to understand and use by teachers in the learning process (3) Learner Worksheets (LKPD) that are prepared are easy to understand by students because the instructions given are clear, the writing is easy to read, and the pictures are easy to understand. use easy to understand and attractive; and (4) Sentences of questions and statements on the mathematical problem solving ability test and student learning independence questionnaire are clear and not confusing so that they are easy to understand.

Based on the description above, it can be concluded that the learning media developed has met the practicality as expected. Thus, the flash-based learning media developed is easy and can be implemented by teachers and students.

The Effectiveness of the Developed Flash-Based Learning Media

In determining the effectiveness seen from three aspects, namely: 1) complete learning classically; 2) students' positive responses to the components of the flash-based learning media that were developed; and 3) the ability of teachers to manage learning in the good category. Aspects of each effective category above, are described as follows.

Classical student learning completeness

Description of the results Classification of students' mathematical problem solving abilities in the first trial is shown in Table 1. below.

Table 1. Classification of Students' Mathematics Problem Solving Ability Test I

No	Student Mastery Level		Results	
	Number Range	Letter	Frequency	Percentage
1	3,85 – 4,00	A	-	-
2	3,51 – 3,84	A-	-	-
3	3,18 – 3,50	B+	2	5.88 %
4	2,85 – 3,17	B	8	23.53 %
5	*2,51 – 2,84*	*B-*	*7*	20.59 %
6	2,18 – 2,50	C+	9	26.47 %
7	1,85 – 2,17	C	3	8.82 %
8	1,51 – 1,84	C-	3	8.82 %
9	1,18 – 1,50	D+	2	5.88 %
10	1,00 – 1,17	D	-	-
Total			**34**	**100**

The explanation from table 1. above can be explained that individually many students have mastery levels of A and A – none, at the level of mastery of B+ as many as 2 students, at the level of mastery of B as many as 8 students, at level B- as many as 7 students, at the level of mastery of C+ as many as 9 students, at level of C as many as 3 students, at the level of mastery of C- there are 3 students, at the level of mastery of D+ as many as 2 students and at the level of mastery of D as many as 1 student.

From the table listed above, it can be concluded that the level of mastery of students' problem-solving abilities has not reached the criteria that have been determined in those listed in chapter III. The mathematical problem solving ability of the indicators in detail can be seen in the summary of the results of the data analysis of the problem solving ability test in the first trial.

The description of the results of the classification of students' mathematical problem solving abilities in the second trial is shown in Table 2. below.

Table 2. Classification of Mathematics Problem Solving Ability of Trial II Students

No	Student Mastery Level		Results	
	Number Range	Letter	Frequency	Percentage
1	3,85 – 4,00	A	6	18,75
2	3,51 – 3,84	A-	17	53,13
3	3,18 – 3,50	B+	7	21,88
4	2,85 – 3,17	B	0	-
5	2,51 – 2,84	B-	0	-
6	2,18 – 2,50	C+	1	3,13
7	1,85 – 2,17	C	0	-
8	1,51 – 1,84	C-	1	3,13
9	1,18 – 1,50	D+	0	-
10	1,00 – 1,17	D	0	-
Total			**32**	**100**

The explanation from table 2. above can be explained that individually many students have a mastery level of A as many as 7 students and A – as many as 18 students, at the level of mastery of B+ as many as 5 students, at the level of mastery of B none, at level B- not there is, at the level of mastery of C+ as many as 1 student, at level of C there is none, at the level of mastery of C- there is 1 student, at the level of mastery of D+, there is no D.

From the tables and graphic images listed above, it can be concluded that the level of mastery of students' problem solving abilities has reached the criteria that have been determined in those listed in chapter III. The results of the problem-solving ability test can be seen more clearly based on the analysis per predetermined indicator.

The increasing ability to solve mathematical problems can be studied theoretically by paying attention to the principles, characteristics, and learning steps with the scientific learning approach applied in this study. The application of the discovery learning model with the scientific learning approach has several advantages, where if these advantages can be maximized in classroom learning, it will be able to improve students' mathematical problem solving abilities. These advantages can be seen from the principles, characteristics, and learning steps.

When associated with the characteristics of the discovery learning model according to Hosnan (2014: 284) "the main characteristics of learning to find are (1) exploring and solving problems to create, combine and generalize knowledge (2) student-centered; (3) activities to combine new knowledge and existing knowledge." This was also emphasized by Kamal (2015) who stated that "with the Scientific learning approach students will be

even more challenged to be able to solve an existing mathematical problem". By paying attention to these main characteristics, it is clear that the application of a scientific learning approach can improve students' mathematical problem solving abilities. Besides that, learning that takes place is student-centered so that students can really connect new knowledge to existing knowledge.

The results of this study are in line with research conducted by Dewi (2014) where the media used with a scientific approach can improve students' problem solving and reasoning abilities. Thus the scientific approach has the potential to improve students' mathematical problem solving.

Based on the results of the research and support from previous studies above, it can be seen that the flash-based learning media developed can help students achieve classical learning mastery. Thus it can be concluded that the use of flash-based learning media that has been developed has met the effective criteria in terms of classical student learning completeness.

Student Response

The criteria for student responses to the developed learning media are met if 80% of students give a positive response to the components of the developed teaching materials. Based on the results of the data analysis of the results of the first and second trials, it was found that the average percentage of student responses in each trial was positive. This means that students feel helped and happy with the problem-based teaching materials developed. The student responses given in each trial have reached the predetermined criteria category, namely 80%. This shows that the scientific approach-based learning tools developed have met the effective criteria in terms of student responses.

In line with the results of the research above, flash-based learning media is based on the premise that confusing or unclear problematic situations will arouse students' curiosity so that they are interested in investigating. In other words, the flash-based learning media developed can arouse students' interest in learning, causing learning activities to be effective.

Based on the characteristics of the students, the teacher makes a lesson plan that contains activities carried out by students, time, and evaluations that are adapted to problem-based learning. Teaching programs are also contained in learning media such as lesson plans, and LKPD as a guide for students and teachers in directing students to obtain solutions to problems and achieve learning objectives. Therefore, a teacher must prepare a mature and accurate learning plan because with a learning plan the teacher will be able to predict how much success will be achieved. In other words, the teacher is a very decisive component in the implementation of a learning strategy.

This is reinforced by the results of Sinaga's research (2007) in his research stating that "the criteria set to say that students have a positive response to the learning media developed if the number of students who give a positive response is greater than or equal to 80% of the many subjects who received a positive response. investigated for each field trial.

Based on the exposure of research results and supporting research, it can be concluded that the components of flash-based learning media that were developed contributed positively to student responses in learning.

Teacher's Ability to Manage Learning

The third criterion for the effectiveness of flash-based learning media is the teacher's ability to manage learning. In the first trial and second trial the teacher's ability to manage learning has met the good category ($3.50 \leq KG \leq 4.50$).

Based on the results of the data analysis of the results of the first and second trials, it was found that the average value of the teacher's ability to manage learning in each trial was in the good category ($3.50 \leq KG \leq 4.50$) if it was referred to the teacher's ability criteria. manage learning that has been determined in chapter III. This is supported by Widiyasari's research (2013: 5) which shows that the ability of teachers to manage learning based on the observations of teachers managing learning has reached an average total score, meaning that learning has been carried out well.

According to Hosnan (2014: 39) "teachers' activities in learning are providing learning resources, encouraging students to interact, asking questions from interaction results, providing scaffolding, encouraging students to have dialogue, confirming the understanding gained and encouraging students to reflect on their learning experiences". From the explanation above, it can be concluded that the application of discovery learning with a scientific learning approach can improve the ability of teachers to manage learning.

Based on the description above, it can be concluded that flash-based learning media with a scientific approach can improve the ability of teachers to manage learning.

Improving Students' Mathematical Problem Solving Ability

Based on the results of the analysis of increasing students' mathematical problem solving abilities in the first trial and second trial, it showed that the average mathematical problem solving ability of students in the posttest results of the first trial was 62.3%. Then in the second trial, the average result of the students' mathematical problem solving ability increased in the post-test II of 88%. Thus, there was an increase in the average posttest of trial I and trial II of 25.7%.

Based on the exposure and data analysis of students' problem solving abilities above, it is known that flash-

based learning media with a scientific approach can improve students' mathematical solving abilities.

This is in line with research conducted by Dewi (2014) where the media used with a scientific learning approach can improve students' problem solving and reasoning abilities. Thus the discovery learning model with a scientific learning approach has the potential to improve students' mathematical problem solving.

Improving Student Learning Independence

Based on the results of the questionnaire data analysis of student learning independence in the first and second trials, it showed that the students' learning independence increased (better). This increase in learning independence can be seen from the average results of the learning independence questionnaire filled out by students, from an average of 79.09 increasing to an average of 82.35. This shows that flash-based learning media with a scientific approach has a good effect on increasing student learning independence with an average value of 3.26. Increased learning independence is also seen in each indicator of learning independence, namely: (1) learning initiatives; (2) Diagnosing learning needs; (3) Regulating and controlling learning progress; (4) Setting learning targets and objectives; (5) Seeing difficulties as challenges; (6) Finding and utilizing relevant learning resources; (7) Select and implement learning strategies; (8) Evaluating the process and learning outcomes; and (9) Have a self-concept. This shows that the use of flash-based learning media that was developed has an impact on increasing student learning independence.

To be clearer about the average score of learning independence for each indicator in the first and second trials, see Figure 3. and Figure 4. below.

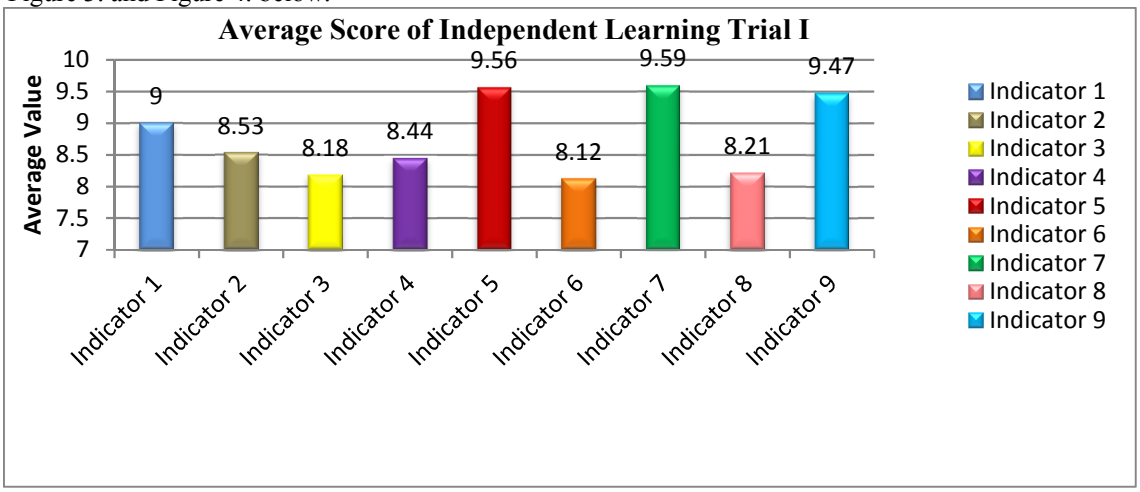

Figure 3. The Average Score of Learning Independence for Each Indicator in Trial I

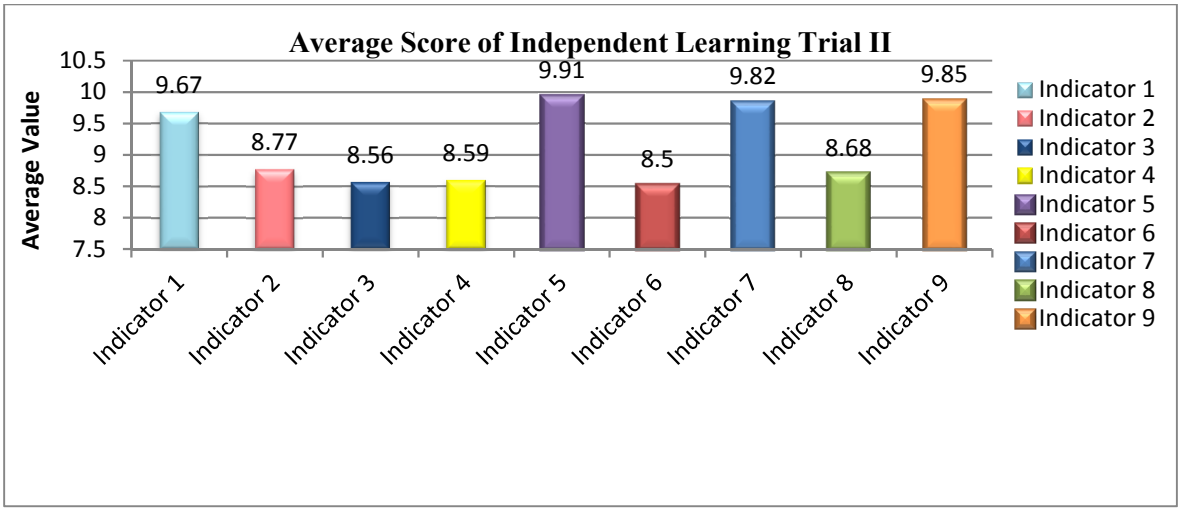

Figure 4. Average Score of Learning Independence for Each Indicator in Trial II

The results of Kamal's research (2015) show that after implementing learning through a scientific approach in learning mathematics on trigonometry material in class X.3 SMA Negeri 10 Banjarmasin, the independence in learning mathematics of class X.3 students has begun to increase, this can be seen from the observations of researchers and observers by assessing student activities, interview results and strengthened by giving questionnaires to students based on indicators of student learning independence, namely self-confidence, initiative,

responsibility and learning motivation, the result is that students are able to show activities in learning mathematics that show their increased learning independence in students, after the implementation of the scientific approach in learning mathematics in class X.3 SMA Negeri 10 Banjarmasin.

This is reinforced by the results of research conducted by Eliserio (2017) which shows that "This research examines the relationship between self-regulated learning and mathematics achievement. The sample included 10 students enrolled in fourth grade at a small, private elementary school in the Midwest. During the third quarter of the school year, students were taught methods of learning mathematics through self-regulation. The grades were recorded before the implementation at the conclusion of the second quarter and again at the conclusion of the third quarter once self-regulation was implemented. A t-test was used to compare the mathematics scores. There was no significant difference between the second and third quarter mathematics grades. This is an important result as it differed from the findings in research". In other words, learning mathematics through individual guidance and learning strategies has a better influence on the achievement of student learning independence.

From the description above, it can be concluded that flash-based learning media with a scientific approach can increase student learning independence.

CONCLUSION

The learning media developed is included in the valid category with an average total media validity of 4.3, RPP of 4.34, LKPD of 4.42. The developed mathematical problem solving ability test items can be used or are valid. and the statement item questionnaire of students' independent learning attitudes with a significant level of 5%, dk = 24, obtained ttable = 1.71. If you refer to the test criteria, with the test criteria being tcount > ttable, the learning independence questionnaire can be used or is valid.

The developed learning media has met the practical criteria in terms of: (1) expert/practitioner assessment states that the developed flash-based learning media can be used with a few revisions; and (2) the implementation of learning media has reached a high category in the first trial, which is 3.82 and reached a very high category in the second trial, which is 4.17.

The developed learning media has met the effective criteria. Effective criteria in terms of: (1) classical student learning completeness has been achieved 88.5% in the second trial; (2) positive student responses to the components of learning tools and learning activities developed have reached more than 80%; and (3) the ability of teachers to manage learning obtained an average of 4.07 which was in the good category (3.50 KG 4.50).

The improvement of students' mathematical problem solving skills using flash-based learning media on the material of a two-variable linear equation system is stated to increase when viewed from each indicator of trial I to trial II, namely understanding the problem 91.2% - 100%, planning problem solving 53% - 94 %, carry out problem solving 32.4% - 88.2%, and recheck 6% - 80%.

Increased student learning independence using flash-based learning media when viewed from the categorization of student learning independence from trial I to trial II, namely 4 of 34 students (11.76%) – 5 of 34 students (14.71%) obtained very high learning independence , 15 of 34 students (44.12%) – 14 of 34 students (41.18%) obtained high learning independence, 6 of 34 (17.65%) – 10 of 34 students (29.41%) obtained learning independence low, and 9 of 34 students (26.47%) – 5 of 34 students (14.71%) obtained very low learning independence.

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