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# Development Of Mathematics Learning Equipment Based On Critical Thinking Using SAVI Approach Assisted By Interactive CD

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## ABSTRACT

The problems that become focus of the research are (1) how to develop the valid mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD? (2) How was the result from implementation of mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD?

This research is categorized as development research by using Thiagarajan 4-D model. Through the defining and planning phases would be obtained the 1st draft. In the developing phase, the validation was carried out by expert such that obtained the suggestions to revise the 1st draft became the 2nd draft (learning equipment which was validated by expert). Furthermore, the limited try out was conducted at SMP Negeri 37 Semarang. Besides, to know the students' mathematics achievement, it is also used as basic to revise the 2nd draft became the 3rd draft.

The research found that (1) the learning equipment which was developed were valid and usable, it was supported by the result from validator, students' response, and the result of learning implementation, (2) the average of mathematics achievement in the experiment class was 82.95, it means that exceed the limit of KKM =70 and better than compared to the controlled class which has average 67.35. Based on the validity and the effectiveness result of learning equipment above, then the development of learning equipment reach the intended result.

Keywords: critical thinking, Somatic Auditory Visual Intellectual (SAVI), interactive CD.

## INTRODUCTION

In the globalization era which accompanied by a very rapid development of science and technology, education faces a challenge that requires to produce the human resourcesthat fulfil global demands. Since, education is a platform activity for developing communities and the nation character continuously that is a mental construct, ratio, intellectual and personality in order to form a real person. Therefore, education should receive attention, and priority handling intensively from the government, as well as the community and also education manager.

Mathematics played a role in advancing education. Mathematics is one of the basic sciences that are very important to equip learners face the further life in the society. Mathematics is a means of thinking to develop the mindset of a logical, systematic, objective, critical and rational that should be guided from basic education. Therefore, mathematics should be able to be one of the means to increase the students' power of reason and improve their skills in applying mathematics to face life's challenges in solving the problem. Glenda (2009: 6) stated that mathematics as the most important subjects in the curriculum throughout the country, because it affects a lot of things to create and master the technology of the future.

One of the purposes in mathematics learning is to foster critical thinking, such that in mathematics learning critical thinking skills should students get priority. Critical thinking is a manifestation of higher order thinking (higher order thinking). This is because the ability to think is the highest cognitive competencies that learners need to be mastered in the classroom. Critical thinking can be seen as thinking skills of learners

to compare two or more information, such as the information received from outside the information held. If there are differences or similarities, then he would ask a question or comment with the intention to get an explanation. The Secretary's Commission on Achieving Necessary Skills in 1990 stated, that the competencies critical thinking, decision making, problem solving, and reasoning as something important in job performance. Therefore, students are expected to have a stock of critical thinking skills, problem solving abilities, and decision-making ability.

One of the learning mathematics which is characterized by critical thinking is learning mathematics with SAVI approach. According to Meier (2004: 91), SAVI approach is a learning approach that combines physical movement with intellectual activity and also the use of all senses in learning. This learning approach has four elements, namely: Somatic learning (learn by moving and doing); Auditory learning (learning by listening and speaking); Visual learning (learning by observing and describing); Intellectual learning (learning by solving problems and reflection).

In addition, learners also need media that stimulate the mind, feelings, attention and ability of learners to a better direction. The results of the study Esra&Berna (2010: 154), indicated that multimedia can help in understanding mathematics more meaningful, to conceptualize the mathematics, and understand the importance of mathematics.

The results of data analysis showed that the percentage of samples increases, it is because in math using instructional media or multimedia. In addition, research Macaulay (2003: 185), indicated that multimedia can help learning, especially learning the abstract lesson, and the children who use multimedia have the higher scores than those who did not. To fulfil that requirement, the researchers chose an interactive CD media.

In fact, based on the initial survey, the learning equipment that existsis less support of teachers' efforts to develop the maximum potential of learners including learners in developing the ability to think critically. In addition, the use of media such as the LCD is not used optimally. Therefore, the design of mathematics learning based critical thinking is not enough, because of the need of learning equipment that support to use in in junior high school learning process. Based on the description above, this study will develop mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD.

Based on these descriptions, the researchers formulate some issues that become focus of research, as follows(1) how to develop the valid mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD? (2) How was the result from implementation of mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD?

## LITERATURE REVIEW

There were many previous researchers who have studied the benefits of multimedia in learning. The results of the study of Hughes (2009: 252), showed that to improve student learning activity, enhance their capabilities, and to apply the acquired knowledge; learning must take place in an environment which facilitates the intended learning outcomes. In accordance with the results of the study of Hughes such as mathematics teacher should be able to utilize the existing infrastructure using learning media or multimedia which is interesting for students, especially use the animation.

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In the year 2011, has conducted research that combines the SAVI and multimedia approaches. Dina Prasetyowati (2011) in her study stated that SAVI approach using Interactive CD that was used in the study were able to develop the ability of learners optimally, both cognitive abilities and psychomotor. Another research that has been done is about the hierarchy of high school students' critical thinking in solving a mathematical problem in terms of differences in mathematical ability (Rasiman and Kartinah, 2011). Research conducted by Rasiman et al (2010) on the level of critical thinking showed that there are four levels of students' critical thinking of class XI IA 2 SMAN 2 Semarang namely TKBK (Level Critical Thinking Ability) 0, TKBK 1, 2 and TKBK 3 where TKBK 0 is Not Critical, TKBK 1 is Less Critical,TKBK 2 is Critical enough, and TKBK 3 is Critical. For each TKBK have different indicators.

**Development Learning Equipment**

The educational research and development is known as the Research & Development (R & D). According to Borg and Gall (Setyosari, 2010: 194), research is the development of a process to develop and validate a product. Setyosari (2010: 196) said that research development has the aim to assess the changes that occur within a certain time.

Thiagarajan developed the learning equipment model that known as the Four-D Model or Model 4 - D. This model consists of four stages, namely: the define, design, develop and disseminate. The description of the four stages of the 4-D model as follows.

1) Define

The purpose of define stage is that set and define learning needs by analysing the purpose and limitations of the material. The activities undertaken at this stage include: (a) analysis of end-initial, (b) analysis of the learners, (c) analysis of the material, (d) analysis of the task and (e) specification of learning objectives.

2) Design

This stage aimed to design the learning equipment so obtained a prototype that appropriate to the learning that will be implemented. Some of the activities carried out at this stage as follows (a) preparation of test criteria; (b) the selection of media; (c) the selection of the format; and (d) the initial design refers to the standards process.

3) Develop

The purpose of this stage is to produce a draft of the revised learning equipment based on the recommendation of experts and data obtained from field trials. Activities at this stage include the validation by experts followed by revision, and field trials.

4) Dissemination

The learning equipment which developed reaches the final product stage when the field trials showed the consistent results and received the positive response from the validator. Prior to disseminate of the learning equipment, the summative tests was carried out. In the validation test phase, the learning equipment is used under the same conditions to explain "who is learning, on how conditions, and how many time" (Thiagarajan, 1974).

**The Valid of Learning Equipment**

Learning equipment is a set of media or means used by teachers and learners in the learning process at the classroom, as supporting the learning process in order to run smoothly, effectively and efficiently. According to Khabibah (Trianto, 2009: 25), to

look at the feasibility of a learning equipment for validity aspects needed experts and practitioners or field trials to validate the developed of learning equipment.

**Critical Thinking**

Critical and creative thinking are an embodiment of higher order thinking. This is because the ability to think is the highest cognitive competencies that learners need to be mastered in the classroom. Critical thinking can be seen as thinking skills of learners to compare two or more information, for example the information received from outside the information held. If there are differences or similarities, then he would ask a question or comment with the intention to get an explanation.

Critical thinking is a process by which a person attempts to answer rationally the questions which cannot be answered easily and there is no the available relevant (Inch et al., 2006: 5). Critical thinking as a study whose purpose is to assess the situation, phenomenon, question, or problem to obtain a hypothesis or conclusion that integrates with all available information and therefore can be convincingly justified.

Based on some notions of critical thinking above, it can be concluded that a person with critical thinking characteristics: (1) solve a problem with a particular purpose, (2) analyse, generalize, organize ideas based on facts or information, and (3) draw conclusions in solving these problems in a systematic way with the correct arguments.

**RESEARCH METHOD**

This research includes as research and development. Development undertaken is the development of mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD. The learning equipment which was developed in the form of that is (1) Syllabus, (2) Lesson Plan (RPP), (3) Students Worksheet (LKPD), (4) Interactive CD, and (5) Achievement Test (TPB).

Research instrument in this study were the observation sheet of teacher ability to manage the learning process, the questionnaire responses of learners and the validation sheet of the learning equipment which consists of a validation sheet of syllabus, validation sheet of Lesson Plan (RPP), validation sheet of Worksheet Students (LKPD), validation sheet of CD interactive, and validation sheet of Achievement Test (TPB).

The procedures development of learning equipment using model 4-D model of Thiagarajan (1974: 5-9), which consists of define stage, design stage, development stage and the disseminate stage. However, in this study the researcher only carry out the three stages not until the disseminate stage. As for the stages that taken in this study are: (1) the define stage by examining the mathematics learning equipment that had been developed by the teacher, then designing existing of the development of mathematics learning equipment based on the Regulation of the Minister of Education and Culture No. 68 Year 2013 on Basic Framework and Curriculum Structure Secondary school / junior secondary school, (2) the develop stage through testing the validity of the learning equipment based on the suggestion of experts and testing the effectiveness of the learning equipment in the learning process through limited testing.

The assessment from the expert aimed to obtain the suggestion and recommendation which is used as input to revise the learning equipment (the initial draft / 1$^{st}$draft) to produce the second draft. In this phase, the assessment from expert can be repeated to obtain a better repair of learning equipment. The main focus of the expert's assessment is primarily to verify the concept, readability, and suitability to

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support the teaching and learning activities. Based on the recommendation from the experts, it would be carried out a revision of the first draft to produce the second draft. The 2$^{nd}$ draft then was tested on the class experiment.

The subjects of the limitation trial of learning equipment were the seven grader students of SMPNegeri 37 Semarang. While, the sample were the seven grader students of SMPNegeri 37 Semarang which consist of theexperiment class, the controlled class and the trial class. The withdrawal process of three classes as subject conducted randomly using sample random sampling technique (Sugiyono 2009: 93). By using the cluster random samplingtechnique selected VIIC class as the experiment class and VII F class as the controlled class.

The purpose of the trial is to obtain the recommendationfrom the recording of all responses, reactions, comments from students, teachers, and observers to revise or refine the second draft. The trial of learning equipment aimed to describe the ability of the teacher to manage the learning process, the students' response to the learning process, and the students' critical thinking abilityto the learning material then will be reflected to improve the 2$^{nd}$ draft of learning equipment became the third draft (final draft).

The data collectionmethods were conducted through tests, observations, questionnaires, and documentation. The data analysis techniques in this study include 1) validation of data analysis from expert; 2) data analysis ofthe teacher's capabilities to manage learning process; 3) data analysis ofquestionnaire students' responses; 4) data analysis of achievement test; 5) analysis of initial data (homogeneity and normality test); 6) analysis of the effectiveness of learning (mastery learning test, proportion test, the comparative test).

## RESULTS AND DISCUSSION
### The Process of Development Learning Equipment by Using 4D Model of Thiagaradjan

The process of developing the mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD starts from the definestage. Through the analysis of the front end by using the literature found that the learning is an important component in determining the success of students learn the material. In Indonesia, the preparation of learning equipment such as syllabi, lesson plans and assessment tools adapted to the rules that exist in the Minister of Education and Culture No. 68 Year 2013 on the Framework for Primary and Secondary School Curriculum Structure. While the curriculum in 2013, related to the making of lesson plans contained in the Regulation of the Minister of Education and Culture No. 81 Year 2013. A fundamental problem that needs to be pursued in the development of the learning equipment is how the presentation of lessons and learning environment that allows students to feel happy during the learning process. After review of the materials and the learning theories that are relevant such as Piaget and Vygotsky's theory of social interaction in the activity and critical thinking then obtained a description of appropriate learning is to develop the mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD in rectangular material.

By using the documentation method and interviews with the teachers obtained the analysis of the students. The students of SMP Negeri 37 Semarang are potential enough, where the students who entering this school have an average NEM of elementary schools ranged from 6.8 to 8.9each year. Even though, the academic ability

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is quite good, but for mathematics result was not as expected. The learning process that was conducted is teacher-centred so that the students tend to be passive in the classroom. In addition, the use of existing LCD media in the classroom has not been used optimally. Through the concept analysis, task analysis and the analysis of the learning objectives produce information that rectangular material is one material that suitable to deliverby using learning equipment based on critical thinking using SAVI approach assisted by interactive CD.

Furthermore, is conducted the planning stage to design new learning equipment that developed from the old learning equipment to use the information obtained from the definestage. The activitiesthat undertaken at this stage describe as follows (a) preparation of test criteria; (b) the selection of media; (c) the selection of the format; and (d) the initial design that produce the first drafts. Then the last stage is the development stage to generate validlearning equipment. The validation is done by 4 people who are competent to assess the feasibility of learningequipment. The revisions were made based on the suggestion or instructions from the validator. The average value of the total given by the validator is 3.68 of the value of maximum 4 which means the learning equipment is good and can be used with a slightly revised so that the learning equipment based on critical thinking using SAVI approach assisted by interactive CDin material rectangular class VII is valid. Results of revision based on validators' assessment produce the second draft. The second draft then tested on the class experiment.

**The Used of Mathematics Learning Equipment Based on Critical Thinking Using SAVI Approach Assisted by Interactive CD**

Before the study was conducted in the experimental class and the controlled class, it needs to be tested first test of normality and homogeneity. The test for normality was conducted by using the Kolmogorov-Smirnov One Sample Test. For the experiments class VIIC obtained the Asymp.Sig value. (2-tailed) = 0.637 = 63.7% while the controlled group of VIIF obtained the Asymp.Sig value. (2-tailed) = 0.520 = 52%, which are both more than 5% then $H_0$ is accepted. It means that the data class of VIIC and VIIF are normal. To test the homogeneity of the experimental class and the controlled class used independent sample *t test* with SPSS. From the calculation results obtained sig = 0.314 = 31.4%> 5% then $H_0$ is accepted, meaning that variants of experimental class and controlled class are the same or homogeneous.

The testing of mastery learning outcomes conducted to seek answers effectiveness of learning process in the classroom experiment of achieving mastery learning achievement with a minimum completeness criterion (KKM) is 70.

To answer these questions, the hypothesis tested is

$H_0$: (average learning achievement test scores equal to 70)

$H_1$: (average learning achievement test scores is not equal to 70)

With the criterion reject $H_0$ if the significance value <5%.

In this study was obtained the data of achievement testfrom the experimental class. From the data will be conducted the data analysis of tested the classical completeness by using SPSS and obtained the results as shown in Table 1

Table 1. One-Sample Test

| | Test Value = 70 | | | | | |
|---|---|---|---|---|---|---|
| | t | Df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| Learning achievement | 5.242 | 31 | .000 | 11.281 | 6.89 | 15.67 |

Because the sig value = 0,000 = 0% <5%, then $H_0$ is rejected. It means that the average learning achievement test scores is not equal to 70 then to find out that the average value of the experimental class mastery over 70 seen from Table 2 below.

Table 2. One-Sample Statistics

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| Learning achievement | 32 | 82.95 | 12.174 | 2.152 |

Further investigation to see the average empiricalon the chart One-Sample Statistics output is seen that the average value of learning achievement of 82.95. This value shows the average test scores over completeness criteria can be concluded that learning achievement is complete.

Then the comparative test of learning achievement was conducted. The comparative test here is intended to compare the average of a variable between the experimental class and the controlled class. The data of achievement test scores between the experimental and control classes previously conducted prior variance equality test. The hypothesis to be tested is:

$H_0$: (there is no difference in the variance between the experimental class and the control class (bothclasses are homogeneous)

$H_1$: (there is a difference in the variance between the experimental class and the control class (both classes are not homogeneous)

In this study the comparative test data analysis using Independent Sample Test and the obtained results are presented in Table 3.

Table 3. Independent Samples Test

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | T | Df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |

| | | | | | | | | | Lower | Upper |
|---|---|---|---|---|---|---|---|---|---|---|
| Lear ning Achi eve ment | Equal variances assumed | 1.478 | .229 | 4.744 | 62 | .000 | 12.844 | 2.708 | 7.431 | 18.256 |
| | Equal variances not assumed | | | 4.744 | 57.973 | .000 | 12.844 | 2.708 | 7.424 | 18.264 |

By looking at the table independent sig Samples Test at 0.229 = 22.9%. The sig value greater than 5% then H0 is accepted, then there is no difference in the variance between the experimental class and the control class or second-class homogeneous. That information is used to perform the next test comparisons t. Since the second grade, the selected row is declared homogeneous line Equal variances assumed. The hypothesis to be tested is:

H0: (there is no difference in the average value of learning achievement between the experimental class with the control class)

H1: (no difference in the average value of learning achievement between the experimental class with the control class)

Furthermore, by looking at the value in column sig (2-tailed) column Independent sample t-test of 0.000 <0.05 indicates that H0 is rejected, meaning that the learning achievement of experimental class and control class differ significantly. To determine which class has an average value higher use Group Statistics analysis that can be seen in Table 4.

Table 4. Group Statistics

| | Class | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Learning Achievement | Experiment | 32 | 82.95 | 12.174 | 2.152 |
| | Controlled | 32 | 67.35 | 9.294 | 1.643 |

By looking at the average learning achievement in the mean column of table Statistics Group acquired 82.95 to 67.35 for the experimental class and the control class. These results indicate that the learning achievement of experimental class better than the controlled class. Based on these results, it can be concluded that the experimental class had an average value of completeness is higher compared to the average value of the thoroughness of the controlled class. The mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD is applied to the experimental class has been able to improve the learning achievements of students as compared to students in the controlled class.

From the questionnaire results indicate that the largest percentage of students responses to the components of teaching is fun and new. In addition, students interested in participating in the next lesson using learning equipment based on critical thinking using SAVI approach assisted by interactive CD, as well as the students can understand the language on the CD Interactive, student activity sheets, tests of learning

achievement. In general it can be concluded that the positive response from the students.

Positive responses were also given by the teacher to the learning equipment. The teacher stated that the learning equipment has been well made and can assist in the implementation of learning, particularly in terms of construction the material and develop critical thinking skills. By using learning equipment based on critical thinking using SAVI approach assisted by interactive CD, students can learn to be more responsible to construct the material for them and develop their critical thinking skills. This is in line with the opinion of Aida and Zah (2009) stated that the students are motivated and regularly go to class or active, then learn mathematics tend to succeed. Motivation of the students to grow through the use of interactive CD and LKPD which is makes learning more interesting.

## CONCLUSIONS ANDRECOMMENDATION
### Conclusion

Based on the process of development learning equipment by using a modified of development learning equipment use the 4-Dmodel that have been done, it can be concluded as follows. 1) The results of the development of mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD is valid and can be used; 2) The response of the students and teachers in the use of mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD is positive; 3) the learning process using mathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CDrun effectively. It can be seen from the average value of the experimental class mathematics learning achievement is 82.95 which exceeds the limits the KKM = 70 and better than the controlled class that has average 67.35. Based on the results of a valid and effective learning mentioned above, the development of the learning equipment achieved the intended results.

### Recommendation

Based on these results, some suggestions which can researchers suggested, as follows. 1) Research conducted only reached the stage of develop according to Thiagarajan development model that has been modified, has not reached the stage of disseminate. So that further research can be done to test the learning equipment for other researchers who are interested in this study; 2) learning equipment that have been developed in this study need to be tested on class and other schools that have similar characteristics / equivalent with a grade of experiments in order to obtain better learning equipment; 3) the learning process usingmathematics learning equipment based on critical thinking using SAVI approach assisted by interactive CD provides an opportunity for the students to be active within and between groups, so that learning with this method is suitable for use in the classroom that have low learning achievement.

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