ME – 65

Development Interactive Learning Media to Excavate Ability Mathematical Creative Thinking Students

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***Abstract*—** The purpose of this study was to design an interactive learning media, identify the beginning and end of the ability of creative thinking mathematical students, excavate student response to the implementation of media interactive learning, analyze the difficulties of mathematical creative thinking students. The method used is Research and Development, with the steps: identify of teaching material, organize media interactive learning, considered by the experts, try out media interactive learning and research instruments, examine the pre-test and post-test of mathematical creative thinking, implement of interactive learning media in Mathematics Capita Selecta course, distribute questionnaires and interviews. Data collection techniques include: media interactive learning test, mathematical creative thinking ability tests, questionnaires and interviews. The research instruments are mathematical creative thinking ability tests, questionnaires and interviews sheet. The population in this study are all students majoring in mathematics education semester of academic year 2015-2016. Sample used is cluster random sampling technique as much as 2 classes. The results showed that media interactive learning in Mathematics Capita Selecta course is fine to be implemented. The pre-test showed that students' mathematical creative thinking was low, but the post-test showed that students' mathematical creative thinking performed in an medium level. Students' difficulties in mathematical creative thinking were on the flexibility and orginality indicators. In addition, students feel happy, challenged and motivated to learn in Mathematics Capita Selecta course.

Keywords: *interactive learning media, mathematical creative thinking ability, difficulty thinking, response*

I. INTRODUCTION

Along with the demands of advanced science and technology, there are continuous efforts to improve the quality of education in Indonesia, especially in the field of mathematics education. Require new breakthroughs in curriculum development, human resources, learning and innovation in meeting the educational facilities. In connection with the development of human resources, the lecturer gives a very important role in providing supplies to students as future teachers through lectures. The activity based-learning pedagogy is expected to make students feel responsible for their learning and support their own personal development (Festus, 2013). The use of instructional media is one way to lecturers so that students can understand the concepts that are presented, besides that lectures more interesting and fun so that students can learn more optimally. Various media that can be used in the lecture, including computer-based learning media or Information Technology (IT). One computer-based learning media is an interactive learning media, learning media is more interesting and the material is abstract can be visualized in animation media in accordance with actual conditions in the field, following the development of science and technology so that the motivation of students to learn and build knowledge becomes easier to do (Ali, 2009). One computer-based learning media that are popular today is an interactive medium. The use of interactive media in the learning of mathematics in the classroom is expected to attract interest and motivate students to improve their achievement. According to Kusuma (2009) in general, students have a high curiosity to try something new, including the technology in this decade is loved by teenagers and school children.

Lectures by using interactive learning media is one form of realization of the curriculum in Mathematics Education courses, so that students can learn actively on the Mathematics Capita Selecta course, understand the concepts and be able to develop creative thinking skills. Now, lectures on Mathematics Capita Selecta course already using computer-based learning media but only a powerpoint media that looks less attractive and not interactive, so students seemed less motivated to learn. Currently

each class at mathematics education department of Siliwangi University already available means to support computer-based learning. In this condition, the lesson should no longer be a tedious thing, as a few decades ago. Thanks to the development of information technology so rapidly, teaching materials can be presented with sounds and images are dynamic, not boring, as well as solid information. Therefore, the development of Information and Communication Technologies (ICT) based learning is expected to improve the quality of the learning process in the classroom. United Nations Educational Scientific and Cultural Organization (UNESCO, 2002) states that the use of ICT in learning has three objectives: to build a knowledge-based society habits like problem solving, communication skills, ability to find and manage information, turn information into new knowledge and share them with others, and to improve the effectiveness and efficiency of the process learning.

To foster the spirit of learning students, lecturers are required to create learning more interesting and innovative, so as to encourage the learn optimal learning and can develop the capacity to think. Efforts to create exciting and innovative learning and can facilitate develop creative thinking abilities, that is mathematics lectures using interactive learning media. Results of research Kusumah et al (2008, 2009) and Wardani et al (2013) that: a computer-based interactive learning can be presented in an interesting, efficient, and effective interaction patterns tutorials, simulations, or games; increase the ability of reasoning, communication, connection, problem solving, critical thinking, and creative thinking mathematically through learning computer media better than students in the regular classroom learning; implementation of the use of computer media can significantly increase positive attitudes and interests of students in learning mathematics.

Mathematical creative thinking ability toward Guilford model structure of human intelligence which consists of several factors including the operation of divergent product includes fluency, flexibility, and elaboration. Then Torrance (Hudgins et al., 1983) add components originality as a concept fundamental to the components of divergent thinking so that there are four components namely divergent thinking fluency, flexibility, elaboration, and originality. Evans (1991) suggested that components of divergent thinking: the problem of sensitivity is the ability to recognize the existence of a problem or ignore the misleading fact to recognize the real problem; Fluency is the ability to build a lot of ideas are easy; flexibility refers to the ability to build a diverse ideas; Originality is the ability to generate ideas that are unusual or extraordinary, solve problems in ways that are unusual or non-standard. Starko (1995) dan Munandar (2004) suggests that the model structure of the intellect of Guilford is a model of intelligence complex, consisting of 180 components are formed through the combination of content, products, and operations. From the opinions above about divergent thinking of Guilford could conclude that line divergent creativity thinking. Understanding creativity according to Jones (1972) is a combination of flexibility, originality, and sensitivity. Hudgins et al. (1983) provide an understanding of creative thinking is a process that is productive in the sense that the creative thinking to produce a new idea or product.

The purpose of this study to design, develop and implement Adobe flash interactive learning media at Mathematics Capita Selecta Course to explore mathematical creative thinking ability. The purpose of this research:

a. Design, develop and implement interactive learning media at Capita Selecta Mathematics Course.
b. Evaluating the feasibility of interactive learning media based on expert assessment of materials and interactive media and empirical testing.
c. Measuring mathematical creative thinking abilities after using interactive learning media.

II. RESEARCH METHOD

This research is the depelovment with used Research and Depelovment method. The population are all students majoring in mathematics education semester of academic year 2015-2016. Sample used is cluster random sampling technique as much as 2 classes as many as 110 students.

Instruments in this study: open questionnaire, a questionnaire is closed, and questions of mathematical creative thinking ability tests. In developing interactive learning media includes 4 stages: define, design, develop , and implementation. Each stage is explained as follows:

a. Stage define include: study literature, course material identification, analyze the characteristics of students, formulate learning objectives, and designing test questions mathematical creative thinking abilities. At this stage, analyze and identify all the needs required in designing interactive learning media and creative thinking abilities make about mathematics.

b. Stage design includes: the early design of interactive learning media and create questions test ability to think creatively about mathematics as much as 5. At this stage to make a preliminary draft media interactive learning using Adobe Flash program and about the mathematical creative thinking abilities will be tested.
c. Stage develop include: consideration of subject matter experts and media, data analysis and revision, instructional media and about the test results of the revision, the trial is limited to students, data analysis results of limited testing, test empirically, the feasibility of interactive learning media and about the test's ability to think creatively mathematics. At this stage, an evaluation by subject matter experts and media, limited trial against 9 students to see contant validity and face validity, then the empirical testing of students outside a sample of 30 people. The goal is to get advice and feedback to revise media interactive learning and creative thinking abilities about mathematics so that used in this research.
d. Stage Implementation includes: pretest, interactive learning media used in lectures, post-test mathematical creative thinking abilities, distributing questionnaires and interviews to students.

Interactive learning media assessment by experts include indicators: the typeface used, operating instructions, menu navigation, completeness menu display, menu design overall, musical accompaniment, animated illustrations, color harmony, clarity and editorial images, use the button, and interactive. After media interactive learning and creative thinking abilities about mathematics is declared fit for use, and then implemented in the Mathematics Capita Selecta course during one semester. Of each indicator broken down into several aspects of the measure. Scores of interactive learning media assessment rubrics as follows:

Table 1. Rubric Score Assessment Interactive Learning Media

Assessment Criteria	Score
Choose one of assessment criteria	1
Choose two of assessment criteria	2
Choose three of assessment criteria	3
Choose four of assessment criteria	4

Questionnaire for students include positive statement and negative statement. Selection positive statement: strongly agree (5), agree (4), disagree (2), strongly disagree (1) and negative statement: strongly agree (1), agree (2), disagree (4), strongly disagree (5). The ability to think creatively mathematical measure includes five indicators: sensitivity, fluency, flexibility, elaboration, and originality. The following rubric score mathematical creative thinking abilities.

Table 2. Rubric Score Assessment Mathematical Creative Thinking Ability

Number	Indicators	Aspect Measured	Score
1	Sensitivity	Did not answer or answered incorrectly	0
		Detecting deficiency and advantages of the problem but it is not clear	1
		Detecting deficiency and advantages of the problem but there is no mistake	2
		Detecting deficiency and advantages of the problem but not completely	3
		Can detect problems deficiency and advantages with complete and correct	4
2	Fluency	Did not answer or answered incorrectly	0
		Asking just one idea to solve the problem	1
		Propose various ideas solve the problem but there is a mistake	2
		Propose various ideas solve the problem but incomplete	3
		Propose various ideas solve the problem completely and correctly	4
3	Flexibility	Did not answer or answered incorrectly	0
		Solve the problem in only one way, but incomplete	1
		Solve problems with just one complete and correct way	2
		Solve the problem in various ways but incomplete	3
		Solve the problem by various means complete and correct	4

4	Elaboration	Did not answer or answered incorrectly	0
		Completing problem only small fraction	1
		Completing problem but there are still many deficiency	2
		Completing problem but less complete and clear	3
		Completing problems so complete and clear	4
5	Originality	Did not answer or answered incorrectly	0
		Solve problems by using standard formula	1
		Solve the problem in his own way but it is not clear	2
		Solve the problem in his own way but not yet completed	3
		Solve the problem in his own way and true	4

III. RESULTS AND DISCUSSION

After identifying the teaching materials and student characteristics, then the early design of interactive learning media which further validated by subject matter experts and media as well as students as users. The following are examples of page views:

Figure 1. Examples of Display Interactive Learning Media

To validate interactive learning media, expert material selected 2 mathematics education lecturers and 2 lecturers computers, both criticism and suggestions, which are summarized as follows:

a. The material was as it should be delivered.
b. There are still some wording should be corrected, should be short, dense, clear and straightforward
c. Operating instructions and the flow should be more clear, systematic, logical and easy to understand; navigation menu is complete.
d. Less harmonious blend of colors should be more contrast, the look of each slide should be more interesting, interactive to be discreet in order to increase interest in learning and curiosity, backround more interesting and not boring, not too loud background music, interesting and appropriate.
e. Operating instructions presented in clear and unambiguous, straightforward, and easy to understand.
f. Should be from menu to menu; from one concept to another concept; from the beginning, middle and end should be interrelated.

Based on input and advice from subject matter experts and interactive learning media, then discuss with programmers to improve software interactive learning media. Once repaired, then validated again by the experts, having been declared feasible, then tested on 30 students from the 7th semester were already studying Mathematics Capita Selecta course but previously tested are limited to 9 students representative of the ability of high, medium, and low to see the face validity and content validity. In general, the students argued against interactive learning software media that is semantically understandable, attractive colors, and display instructions are clear, but the time available is not sufficient. During the trial progresses, researchers observed the activity of students. Based on observations obtained some information: enthusiastic students using interactive learning software media, a discussion with a friend who was beside him, if anyone does not understand to ask. There are constraints experienced, some unresolved issues, but his time is up.

At the end of the trial, distributing questionnaires to students with the aim of asking in response to the use of this interactive learning software media. The response of students to interactive learning media are summarized as follows:

a. The sentences short, dense, and clear; color interesting and not boring; can facilitate self-learning.
b. The procedure of the menu is clear and can be followed, helping to more easily understand the concept, but the time not enough.
c. The problem that is written is clear, but sometimes confused finish so curious to continue to finish.
d. The concept is found through the problem, and completion is full of challenges, linking with the previous concept.
e. Problems and questions provided are varied that no question of easy, moderate and difficult.
f.

Student response to interactive learning media, problems experienced that time provided insufficient, the problems have not been resolved. Based on the results of the validation of the subject matter experts and interactive learning media, limited testing and test empirically the students, as well as the questionnaire to the student can be concluded that interactive learning media is feasible to implement in the lecture Mathematics Capita Selecta course for one semester though in terms of the time provided less adequate. This is because the software media interactive learning, facilitate students find the concept (not notified), lecturer just drive away. If students are having problems, not directly notified but was directed to use the referral question. Thus the automatic will invariably take longer than learning directly notified. Before to the implementation of interactive learning media in lectures, lecture held at the beginning of the pre-test mathematical creative thinking abilities against 110 students obtained a mean 12.21 from maximum score of 20. The results of the pre-test are presented as follows:

Table 3. Pre-test Results of Mathematical Creative Thinking Ability

Number	Criteria	Number of Students	Percentage (%)
1	Very High	2 Person	1.82
2	High	5 Person	4.54
3	Medium	10 Person	9.09
4	Low	93 Person	84.55
Sum		110 Person	100.0

Noting the results table pre-test creative thinking abilities in classical mathematics students are at low criteria, although individually 2 students are at very high qualification and 5 students were in qualifying frequency. Achievement of this kind naturally, because the students have not been trained mathematical creative thinking. At the end of the lectures by using interactive learning media, carried out post-test mathematical creative thinking ability, gained a mean 16.80 results are as follows:

Table 4. Post-test Results of Mathematical Creative Thinking Ability

Number	Criteria	Number of Students	Percentage (%)
1	Very High	9 Person	8.18
2	High	27 Person	24.55
3	Medium	53 Person	48.18
4	Low	21 Person	19.09
Sum		110 Person	100.0

Based on the results of post-test that mathematical creative thinking ability students are at medium levels, meaning the ability to think creatively mathematics of students increased from a low level to medium although the increase is less significant. This is consistent with the results of research Kusuma (2009) and Wardani (2013). Furthermore further explored means on each indicator of the mathematical creative thinking abilities, with the following results:

Table 5. Means Post-test of Mathematical Creative Thinking Abilities In Every Indicators

Number	Indicators	Means
1	Sensitivity	2.9
2	Fluency	3.3

3	Flexibility	2.3
4	Elaboration	3.1
5	Originality	1.8

Judging from the creative thinking abilities mathematical means every indicator, it can be concluded that the students had difficulty in orginality and flexibility indicators. Based on interviews on students, because thinking about orginality use that is not standard or common or not to use the formula, student difficulties in solving problems in their own way. Similarly, in a matter of flexibility, confused students solve problems in 2 ways. On two indicators, students are not familiar with how to solve the problem alone and in various ways. This is consistent with the results of research Ratnaningsih (2010), the results of research Patmawati dan Ratnaningsih (2015) that students have difficulty in mathematical creative thinking abilities in the indicator flexibility and originality. After the implementation of the post-test, students are given a questionnaire and conducted interviews to determine the interest of students to use interactive learning media in lectures. The results of questionnaires and interviews with media use interactive learning: learning interesting and fun, motivated and enthusiasm for learning, challenging, but the time available is not enough.

IV. CONCLUSION

This research obtained conclusion: based validation experts and media interactive learning materials, empirical testing, and student responses through questionnaires and interviews that the design of interactive learning media worthy implemented at Mathematics Capita Selecta Course. Mathematical creative thinking ability of students increased from a low level into a medium level. Students having difficulty in the ability to think creatively mathematical indicator flexibility and originality. Students get excited and motivated to learn using interactive learning media.

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