

Analysis of mathematical thinking skills and self-regulated learning in capita select mathematics

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The objectives of this research are to explore mathematical thinking; critical and creative thinking mathematical skills. The research methods and properties used at the beginning of this study, particularly in the first phase, consisted of theoretical and literature studies, considering the rational, empirical studies conducted when testing teaching materials and instruments that are interactive of critical and creative thinking mathematical skills. The sample in this research were mathematics education students who took courses in Capita Selecta math; three groups consisting of 110 people. Data was collected to measure the ability to think critically and creatively, mathematically, through a written test while learning autonomy used to measure a questionnaire with the Likert scale. The results of the research indicated that a character-based interactive learning media facilitates self-regulated learning in the course of Capita Selecta. The ability of students to think critically and creatively, mathematically, was adjusted at a high-level qualification. The highest error of mathematic critical thinking made by students was at the focus indicator, while the highest error of mathematic creative thinking was at the originality indicator.

Key words: *Mathematics, Self-Regulated Learning*

Introduction

In developing countries, computers have been part of the learning process in the classroom. However, in Indonesia, the fact that a fast-growing number of schools are equipped with computer labs, the use of computers for learning, including for mathematics, is still not optimal. Therefore, research on the effectiveness of utilising computers in teaching is necessary and the use of computers for educational purposes, especially mathematics



education, can be further improved. The Curriculum 2013 is designed with the aim to prepare the Indonesian people to have the ability to live as a person and a citizen who believes, is productive, creative, innovative, and effective and is able to contribute to the society, nation, state, and world civilisation. To satisfy these objectives, students as mathematics teacher candidates should be prepared themselves to be part of the development of technology. The advantages of interactive multimedia applications of mathematics in explaining a concept can require students to analyse, try out and explore the concept, as well as the principles contained in the object problem.

The presence of the developing science and technology provides opportunities for all students to the unimpeded access of information relevant to their needs and demands; to explore and find their own mathematical concepts contained in the computer program given. This will touch up an optimal utilisation of the ability of students, so mathematically critical and creative thinking will be increased.

The one objective of the Faculty of Teacher and Education Siliwangi University in Tasikmalaya is to prepare teachers in middle and high school in accordance with the needed quantity and quality. While one of the missions of Mathematics Education is organising a quality education to prepare skills in mathematics education professionals. Based on this fact, students in Mathematics Education, as mathematics teacher candidates, need to prepare themselves to the maximum to be able to fill up the mission of Mathematics Education. To carry out this mission, one of the subjects that a provision student teaches in middle and high school is *Capita Selecta Math*. This subject discusses more depth some selected topics in mathematics and secondary school, as well as the way they are presented in accordance with the secondary school mathematics curriculum and secondary regulations. The scope of the subject includes the topics middle school math and essential and common misconception, or a topic that is considered difficult for students and teachers in middle school math.

To facilitate self-learning students, the use of instructional media is one of the alternatives in the development process of learning to be better. Samsudin (2008) stressed the importance of the media as a tool to stimulate the learning process. Using instructional media, independently, students better understand certain materials that seem abstract by becoming more easily visualised. In addition, students are expected as mathematics teacher candidates to be motivated and able to actively participate in classroom learning. Kusumah (2008) also noted that one solution which is deemed appropriate, is to realise that self-learning is the application of information technology as a medium of learning mathematics, which provides opportunities for students to learn independently and interactively via programmed instructional materials.

Previous research has had a significant impact on interactive media teaching. Currently, each class already has the available means to support learning based on Information and Communication Technology (ICT). In the current circumstances, the lesson should no longer be a tedious thing, as it was a few decades ago. Thanks to the rapid development of information technology, teaching materials can be presented with sounds and images that are dynamic, not boring, as well as provide solid information. Therefore, the development of ICT-based learning is expected to improve the quality of the learning process in the classroom. UNESCO 2002 states that the use of ICT in teaching has three objectives: (1) to build "knowledge-based society habits", such as problem-solving skills, communication skills, the ability to find or manage information, and transform the information into new knowledge to inform others; (2) to develop the ability to use ICT or "ICT literacy"; and (3) to improve the effectiveness and efficiency of the learning process. Media can literally be interpreted as an intermediary or introduction. Sanjaya (2008) argues, "The media is a channel of Communications" (Sanjaya, 2008). Derived from the Latin word for 'between', the term refers to anything that carries information between a source and a receiver. Moreover, Sanjaya (2008) also states that the media is "a tool to provide incentives' for learners that learning occurs". Media in the learning process tends to be interpreted as graphics tools, photographic, or electronically to capture, process, and reconstruct the visual or verbal information (Arsyad, 2007). With the presence of media in learning, students can learn the material independently and are provided an opportunity to discover mathematical concepts and develop their creativity.

Media is classified into five groups: (1) human-based media, such as teachers, instructors, tutors, role playing, group activities, field-trip; (2) print-based media, such as books, guides, exercise books or workbooks, work tool, and loose pages; (3) visual-based media, such as books, work tools, charts, graphs, maps, drawings, transparencies, slides; (4) based on audio-visual media, including video, film, slide-tape program, television; and (5) computer-based media, such as computer aided teaching, interactive video, hypertext. Thinking involves two major aspects of the critical and the creative. Both types of thinking use reasoning to build a variety of ideas. According to Fisher (2005) thinking happens in everyone mental activity that serves to formulate or solve problems, make decisions, or gain understanding. Judging from the dimensions, Marzano (1988) found thinking includes the five dimensions of metacognition, critical and creative thinking, thinking ability of the core, and the relationship between thinking with particular knowledge. In line with these opinions, Fisher (2005) argues that thinking critically and creatively involves aspects of the mind, and both are used in reasoning and to build ideas. Additionally, thought is to be involved in any mental activities that help to formulate or solve a problem, make a decision or to build understanding, and then through thinking, it can be interpreted as something.



Ennis (1991) defines that critical thinking is a thought process with the aim of making sensible decisions about what is believed to be or do. Moreover, there are six basic elements of critical thinking including focus, reasons, inference, situation, clarity, and an overview (Ennis, 1991). According to Baron (1987), there are five key elements in critical thinking; they are practical, reflective, reasonable, beliefs, and actions (Baron & Sternberg, 1987). Combining the five key elements into a definition for thinking, critical thinking is a reflective mind that is focused on deciding what is believed to be or do. In addition, the notion of critical thinking is something reasonable; reflective thinking that is focused on what is believed to be the decision, or done (Marzano, 1988). Ervynck (2002) argues that the mathematical creative is the ability to solve problems and to develop the structures of thought to the nature of deductive logic (Ervynck, 2002). The resulting concept is to integrate into the things that are important in mathematics. Sriraman (2009) defines creativity as a process that results are not unusual, in the solution of the problem given and regardless of the level of complexity. Sriraman (2009) also suggested that creativity can be applied in the classroom. Thus, these issues are not only about the motivation and perseverance, but also have a very broad level of reflection.

Mathematical creative thinking is the ability to find and resolve problems with components of mathematical proficiency or fluency, flexibility, and originality and elaboration of detail. Fluency is the ability to put forward similar ideas to solve a mathematical problem. Flexibility is the ability to produce a wide variety of ideas to solve problems outside of the usual categories. While the new thing is the ability to provide responses that are unique and unusual. Therefore, this research aims to explore mathematical thinking: critical and creative thinking mathematical skills in *Capita Selecta* mathematics.

Method Research

This research explores the development of a character-based interactive learning media on a course regarding mathematical models in *Capita Selecta*. According to Russefendi (2005), research and development (developmental research) is research that aims to assist in making decisions about better things to be carried out from the others, from the standpoint of effectiveness, and others. In taking the decision, the element of subjectivity certainly cannot be removed. Furthermore, Russefendi (2005) also said that "research development find patterns and sequences of growth or change, and primarily aims to develop of teaching materials that are beneficial to the school."

This research was a study of development in the medium term (over two years). The research methods and the nature of the study in the first phase initiated theoretical studies, mainly carried out in the literature study, and considered what the rational, empirical studies do when guided interactive teaching materials and instruments have an ability to engage mathematical critical and creative thinking.

The sample in this study were students who took the mathematics education course, Capita Selecta; as many as three classes consisting of 110 people. The data collected to measure the ability to think critically and creatively, mathematically, was undertaken using written tests in narrative form with as many as six questions for critical thinking and four for creative thinking, while self-regulated learning was used to measure a questionnaire with the Likert scale.

Result and Discussion

The trial results about the ability to think critically and creatively, mathematically, demonstrated that all matter is valid. This included the test results on the questionnaire of independence, which declared valid student learning with as many as 40 statements. The results of the observations during the learning process, student enthusiasm and the spirit of learning, indicated an interactive learning media motivated students to learn. In addition, an interactive learning media can facilitate self-learning students, both at school and at home. To enhance the learning motivation of students, lecturers should devise their own interactive learning media in accordance with the condition or characteristics of the students, so that students are able to learn independently. In addition, students must be trained in higher order thinking, such as critical and creative thinking skills.

The second year of research begins with the preparation of pre-test and post-test matter of critical thinking skills and creative mathematics. The number of critical thinking skills matter as much as six mathematical problems, and creative thinking abilities about mathematics as much as four. Critical thinking mathematically included indicators focus, reason, inference, situation, clarity, and overview. While, creative thinking mathematically includes indicators fluency, flexibility, originality, and elaboration. As many as 38 students were tested. The pre-test critical thinking and creative mathematical skills were given before the lecture using textbooks and interactive learning media. The objective was the ability to see the beginning of creative and critical thinking in maths students. Once the entire lecture was completed, a post-test was given to see the end of creative and critical thinking in maths students. The results showed that pre-test and post-test compared with an increase in critical thinking skills and creative mathematics in the students.

Interactive learning media presents concepts and high-level skills in mathematics that include their connection between one element and the other element, which was difficult to be taught and learned through books alone. The advantages of interactive multimedia applications of mathematics in explaining a concept can require students to analyse, try and explore the concepts and the principles contained in the material. Therefore, it was relatively faster to build a structure of student understanding. This was due to the integration of components such as voice, text, animation, pictures or graphics, and video functions to optimise the role



of the senses in receiving information into the system memory. Regular learning done without the help of interactive media did not give the opportunity for students to explore and develop their creativity. Therefore, the development of interactive learning media predicated to facilitate students to independently develop high-level thinking skills.

Conclusion

It was concluded that the ability of students to think critically and creatively occurred at a high-level qualification. Students experienced the highest error of mathematical critical thinking on the focus indicator, and the highest error of mathematical creative thinking on the originality indicator.



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