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Mind Mapping Based Creative Problem Solving: Train The Creative Thinking Skills of Vocational School Students in Physics Learning

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Abstract

This study aims to train the creative thinking skills of vocational school students in physics learning by implement the mind mapping based creative problem-solving. This study used experimental methods with one-shot case study design. The population of this study was class X SMK Pelayaran Wira Samudera Semarang. The sample was 30 students selected by purposive sampling technique. The instrument used in this study was student discussion sheets and four items of essay tests. Each item essay test represents an indicator of creative thinking skills. There are learning media used to support learning activities such as powerpoint, Macromedia Flash, and students' discussion sheets. The results showed the average creative thinking skill of students in physics learning was 58.33% in the sufficient categorized. The highest percentage of that result found on fluency indicator and the lowest found on elaboration indicator. These can conclude that students' creative thinking skills can trained by implementation of mind mapping based creative problem solving, but not optimally.

Keywords: creative problem solving, mind mapping, creative thinking skills

INTRODUCTION

Creative thinking skills have strategic values in the 21st century (Songkram et.al., 2015). During recent years, creative thinking and creativity become one of important skills to be obtained to adapt to rapid changes of globalization (Gencer, Gonen 2015). Creative thinking is defined as a thought process that enables students to apply their imaginations to generate ideas and using ideas creatively to provide solution (Kamplys, Berki 2014; Wahsheh 2017). Creative thinking skills are defined as skills required on almost all subjects (Heilmann, Korte 2010). Creative thinking skills can be obtained through education and learning in schools (Cachia et al. 2010; Dyer et al. 2011). Creative thinking skills are important to be empowered in school because it is one of the skills to be able to live functionally and meaningfully (Trilling, Fadel 2009).

There are four cognitive characteristics that include in the characteristics of creative thinking, namely originality, flexibility, fluency, and elaboration (Munandar 2009). Nevertheless, expertise in one's creative thinking can be trained through early learning (OECD 2016). In deciding whether or not someone is creative by relating to the environment where they are located. The environment can affect one's creative ability to innovate and think. Many students are still afraid to try, doubt to do new things, and issue their talents. In line with the research of Widiastuti & Putri (2018) concluded that students' thinking skills were considered quite sufficient as in completing the test questions some students were still hesitant in giving their solutions. Sujarwo & Yunianta (2018) concluded that the ability to think

creatively looks different in students with high mathematical abilities, so it would be better if the exercises given were open-ended. According to Yunianta (2014) one of the factors that inhibit students from thinking creatively is habit.

The results of preliminary observations done at Wira Samudera Maritime Vocational School were found that students had difficulty in learning physics due to lack of creativity, interest, mastery of concepts, no opportunity to develop thinking skills, and were weak in mathematical abilities. This research was conducted in Vocational School in line with the results of Turkmen & Sertkahya (2015) creative thinking skills are the most important competency that students must have, especially vocational students who are required to always develop their creativity in working. This study uses supporting media in the learning process in the form of Microsoft PowerPoint, Macromedia Flash, and student discussion sheets. Some Physics learning materials such as a concept, facts, principles, and generalizations require the help of the media. It can be more easily understood by students.

CPS is a learning model that applies learning centered on problem-solving skills followed by strengthening creativity (Pepkin 2004). Sophonhiranraka et al. (2015) stated that CPS is a combination of the problem-solving process with creative thinking. Concept understanding of material comes from the owned potential in order that it brings new creative ideas Wittrock (2010). According to Mayasari et al. (2013), the CPS model can make learning take place become more joyful, and it can also arouse students' motivation and encourage them to build their knowledge. CPS can develop adaptive skills (Muin et al., 2018), influence the creativity of junior high school students (Triyono et al. 2017), significantly influences students' ability to solve physics problems (Hariawan et al. 2014) and can improve understanding of concepts and communication skills (Oktaviani, Nugroho 2015).

Research by Swestyani et al. (2014) shows that CPS can improve creative thinking skills, but not significantly. This seen from the category of creative thinking skills that were initially low to sufficient. As for the research Syamsu et.al. (2016) shows that the application of CPS can improve the creative thinking skills after learning carried out in cycle II, but the improvement that occurs is also not significant. Besides, research by Fitriyah et.al. (2015) shows that there are differences in the ability to think creatively between students with the CPS model and students with conventional learning models in the form of lectures and discussions.

One way to overcome the shortcomings in previous research, mind mapping is needed, which is learning to improve understanding of the material and creative power of students through freedom of imagination. Mind mapping is a note-taking technique developed by Tony Buzan by utilizing the whole brain that makes us able to make a comprehensive note on one page that can generate original ideas and trigger easy memories (Tee et al. 2014). Mind mapping used at the stage of finding solutions in the steps of CPS. Students at this stage evaluate ideas to obtain appropriate problem solving and new knowledge as results of student thinking made by involving creativity and understanding material as a result of students' convergent thinking. Mind mapping can help students use the full potential of the brain to be optimum and can improve memory by using visual images and other graphics to form impressions. Previous research shows that mind mapping can improve creative thinking skills in conceptualizing science learning (Agustina 2018), can improve students' mathematical thinking skills (Darusman 2014) and this is related to Ningrum et al. (2018) that creative in mathematical thinking will find solutions with new ideas, and mind mapping can increase creative thinking skills and learning outcomes significantly (Karo-Karo et al. 2017; Ningrum et al. 2018). Therefore, a study was conducted by applying mind mapping based creative problem-solving learning models to train the creative thinking skills of vocational high school students.

METHODS

This research uses an experimental method with a one-shot case study design. The research design is often called one-group posttest-only design as the absence of pretest and control class in this study, and the samples were not randomly selected (Sugiyono 2012). The design of this research is illustrated in TABLE 1.

TABLE 1. The one-shot case study design

Group	Treatment	Post-test
A (KE)	X	O

with:
KE : Experimental class
X : Treatment of mind mapping based creative problem-solving learning
O : Post-test

The study was conducted on November 21st and 22nd, 2018. The initial step taken was to determine the sample of the existing population. The population of this research was grade X students at SMK Pelayaran Wira Samudera Semarang. The sample used was 30 students selected by purposive sampling. The next step is to develop the research instrument. The research instrument used was student discussion sheets and four items essay tests each representing indicators of creative thinking. After that, applying mind mapping based CPS learning models in classroom learning activities and give the student discussion sheet. Then give an essay test to measure students' creative thinking skills. The final step is analyzed the results were made in the form of a percentage for each indicator by:

$$S = \frac{R}{N} \times 100\%$$

with:
S : The score of creative thinking skills
R : Obtained score
N : Maximum score

According to Sugiyanto et al. (2018), the conclusion profiles of students' abilities in creative thinking are obtained by comparing the percentage obtained with TABLE 2 as follows:

TABLE 2. The criteria of creative thinking skills

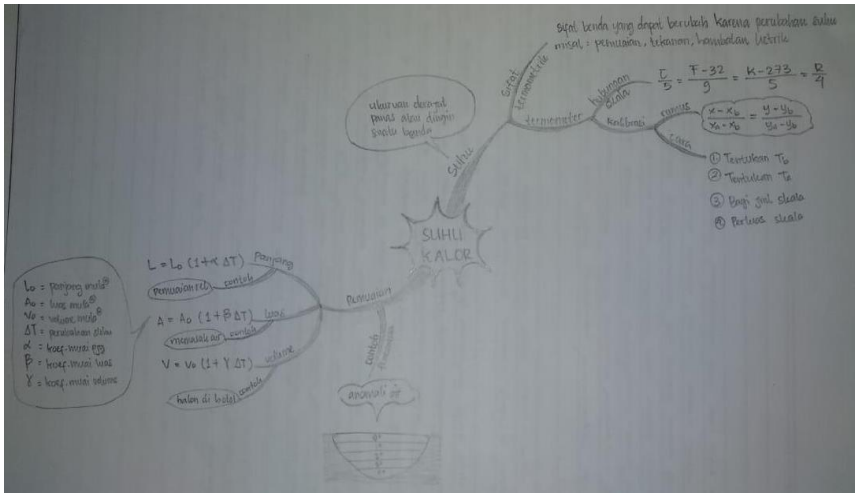
Percentage (%)	Criteria
81,00 – 100,00	Very High
61,00 – 80,00	High
41,00 – 60,00	Sufficient
21,00 – 40,00	Low
0,00 – 20,00	Very Low

RESULTS AND DISCUSSIONS

This research was conducted at SMK Pelayaran Wira Samudera Semarang in class X Teknika Kapal Niaga with a total of 30 students who all of them are male students. Learning in the classroom uses the 2013 curriculum. Learning is carried out with small group discussion activities. Each group consists of 5 students. Learning begins with the provision of the topic to students using powerpoint and Macromedia Flash.

Furthermore, students are given several questions on the discussion sheet related to the concept of temperature and heat which they must solve in groups. Students in learning activities take notes and give their answers in the form of mind mapping. The results of the group discussion are then presented in front of class. Documentation of learning activities and mind mapping can be found in FIGURE 1.

(a)



(b)

FIGURE 1. (a) Learning activities. (b) Mind mapping made by students

After the learning activities are finished, students are given a question sheet related to the topic that has been taught. The question given was four essay tests related to temperature and heat topic in class X. The test is limited to 30 minutes. The research data were obtained based on answers to the questions in which each number represented an indicator of creative thinking. The results of the analysis of creative thinking skills tests are shown in FIGURE 2.

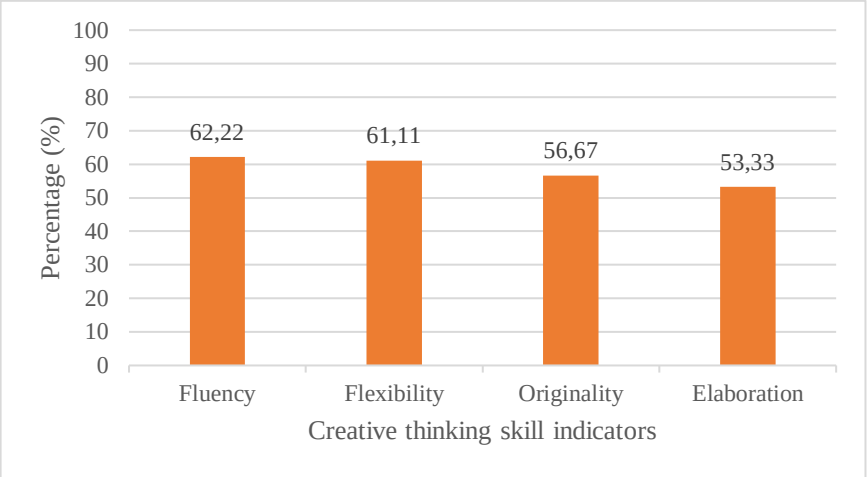


FIGURE 2. The result of the creative thinking skills test analysis.

Students' creative thinking skills are represented by four indicators. The first indicator, namely fluency represents the ability to generate many ideas in a short time. The second indicator, flexibility, represents the person's ability to consider various approaches to have solutions. The third indicator, originality represents the ability to spark ideas in ways that are as original as possible and different from others. The fourth indicator is elaboration representing the ability to withstand a situation or problem so that it becomes complete and detail.

The results of the study in FIGURE 2 showed that the indicators of students' creative thinking skills at SMK Wira Samudera Semarang in the topic of temperature and heat were 62,22% on the fluency, 61,11% on the flexibility, 56,67% on the originality, and 53,33% on the elaboration. The average creative thinking skill of students in physics learning was 58.33% in the sufficient categorized. Based on the results shows that almost all students reach the target in the indicators of fluency and flexibility. The lowest percentage of that result found on originality and elaboration indicator, there are many students who have not reached the target properly. The lowest indicator is seen on the students' answer sheets who are still hesitant in giving their own opinions and tend to write answer that are the same as existing theories. Students also find it difficult to answer the problem in detail. Some students are also still confused about making mind mapping when learning in class. As a result, it indicated that students' creative thinking skills can trained by the application of mind mapping based creative problem solving, but not trained optimally. Effective training to contribute to creative thinking usually focuses on strategies related to problem definition, conceptual combinations, idea generation, and implementation planning (Mumford et al. 2012).

Some previous research shows that creative thinking skills in Indonesia are still low. The low level of creative thinking is proven in several studies on a national scale (Syafi'i et al. 2011; Suparman & Husen 2015; Yuliani et al. 2017). Moreover, the lack of creative thinking does not only occur on a national scale but also occurs in Arabic (Wahseh 2017). Some factors can affect the development of creativity, such as intelligence, knowledge, motivation, social environment, cultural context, and personality (Chang 2013). However, various researches have analyzed teachers' perception of creativity skill; the overall result indicates that teachers are aware of the positive impact of learning and daily life from creativity (Pizzingrili et al. 2014).

The creative problem-solving learning model used in this study has six stages as stated by Treffinger et al. (2003). Those six stages in the creative learning problem-solving model have an effect on training indicators in creative thinking skills namely fluency, flexibility, originality, and elaboration. By combining mind mapping in creative problem-solving learning models in the form of writing, symbols and images made by students will make it easier for them to remember and understand the material, rather than just in the form of ordinary notes. The implementation of mind mapping toward the creative problem-solving learning model has several advantages such as (1) activating the entire brain, allowing us to focus on the subject, (2) helping to show the relationship between the separate parts of

information, (3) giving a clear picture of the whole and details, and (4) getting fun to see, read, digest and memorize.

The first stage is to recognize the problem; at this stage, students understand and analyze the context of the problem guided by the teacher and they then practice their fluency skills. After that, Stage 2 is confirmation of information, at this stage students pay attention to the explanation of the context of the problem by the teacher, process information/data and facts through question and answer to form some concepts needed in solving the problems. In Phase 2, students are also directed to pay attention to the teacher's explanation and record it in the form of a mind mapping, and practice fluency and flexibility skills. Then, stage 3 is the discovery of the problem; at this stage students compile problem statements chosen to be solved through group discussions, as well as practice flexibility skills. Stage 4 is finding a solution; at this stage students produce a variety of problem-solving solutions or ideas through group discussions, as well as practice originality skills. Stage 5 is the selection of solutions; at this stage students strengthen the solution, evaluate and choose the right solution for the problem they want to solve, and train elaboration skills. Eventually, stage 6 is acceptance; at this stage students share solutions regarding problems that are solved through presentations and provide responses toward the solutions presented by other groups to be corrected together through class discussions, as well as training elaboration skills.

In the case of learning process, it is certainly not just the matter of bringing books as teaching materials, but there need to be other media either in the form of power points or other media that can support the learning process. The learning process must be optimized so that students can better understand the material being taught. In this study, teaching media used in the classroom is in the form of power points, which include Macromedia Flash illustrations and the use of students' discussion sheets, which are expected to be able to support learning so that the creative thinking skills are trained may reach good results. The use of Macromedia Flash learning media is also supported by the presence of facilities from the school such as the LCD projector.

This result is in line with the research of Sudiantini & Shinta (2018) that Microsoft powerpoint learning media have an effect on students' creative thinking abilities and mathematical reasoning abilities. Research by Dianto & Estidarsani (2015) concluded that Macromedia Flash learning media had an influence on learning outcomes seen from improving student learning outcomes. Research by Amin & Susanti (2017) that the application of Macromedia Flash learning media to learning technical drawings can improve student learning outcomes. Yori et al. (2017) study that there is an effect of the application of problem-solving based Macromedia Flash learning media to improve student learning outcomes in electric power protection courses.

CONCLUSIONS

The conclusion of this research is the students' creative thinking skills trained using mind mapping based creative problem solving on temperature and heat topic was relatively insufficient category. The results indicated that students' creative thinking skills not trained optimally and should be serious attention, especially originality and elaboration indicator.

For further research, optimal results will be obtained if students can be trained by applying other learning methods that are more suitable by the conditions of students to improve students' creative thinking skills.

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