



## Differences in Creative Thinking Ability of Vocational High School Students in Solving Contextual Mathematical Problems

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### Abstract

In learning activities, various problems that are often encountered include students who still do not understand the material, or students abilities that are not yet clear, so that teachers find it difficult to apply appropriate learning. In this study, the aim was to obtain information about several aspects of students creative thinking skills in solving contextual mathematics problems for class XI SMK Islamic Center Cirebon. The population is 750 students, with a sample of 238 students. The type of research used in this research is quantitative, by analyzing the results in the form of numbers that are processed by statistical analysis. The findings of this study indicate that the students creative thinking ability shows that contextual mathematical problem solving is still in the very low category with an average value of 37,78. But in it there is an aspect of Elaboration with an average value of 61,13 which is in the medium category. Thus, in solving contextual mathematical problems, especially in Three Dimensional Geometry, the ability to think in detail is sufficient when making image objects that are easier to understand from the illustrations provided. Therefore, the ability to think in the Elaboration aspect must be maintained and the Fluency, Flexibility, and Originality aspects must be further improved. The results showed that there were significant differences between the ability to think creatively with each major, including the best major is Accounting and Financial Institutions (AKL). Teachers can maintain relationships with fellow teachers and establish better communication so that mathematics learning is achieved even though students come from different majors.

**Keywords:** *Creative Thinking Skills, Contextual Mathematics, Problem Solving*

### A. Introduction

In the 2013 curriculum, the learning process is centered on students (Student Center Learning) and requires students to have competencies in accordance with the characteristics of 21st century learning. HOTS (High Order Thinking Skills) emphasizes 4 competencies that must be possessed by students, namely communication, collaboration, critical thinking, and creativity. This skill is very useful for students to become a generation that is competent, committed and moral in facing the challenges of changing times and ready to solve problems both in everyday life and problems in learning.

According to Puskurbuk, the application of the 2013 Curriculum is expected to produce productive, creative, innovative and affective human resources through strengthening attitudes, knowledge and skills competencies (Setiadi, 2016). Quoted from (Ratna et al., 2017), that the Partnership for 21st Century Skills emphasizes that 21st century learning must teach 4 competencies, namely communication, collaboration, critical thinking and creativity. Everything

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falls into the realm of higher order thinking skills. However, Indonesia's achievements in the 2018 PISA (Program for International Students Assessment) results were ranked 74 out of 79 participating countries (Hewi & Shaleh, 2020). Therefore, students' higher-order thinking skills need to be built in the face of 21st century learning. Although PISA is not the only benchmark that Indonesia is still weak in terms of literacy, it can be used as a reflection and evaluation to improve better learning. For this reason, a lot of analysis is needed to review education in each province, city, district, and even more specifically schools.

One of them is the Cirebon Islamic Center Vocational School which is a vocational school that has many competencies and their respective majors. Creativity as one of the abilities that supports them to be innovative in every problem both in learning and in everyday life. One of the lessons that can train and develop students' competencies to have higher-order thinking skills is in learning mathematics. One of the students' abilities in learning mathematics is problem solving, so that in learning students are able to solve mathematical problems and train students' high-level thinking skills in solving them.

Based on teaching experience and discussions with one of the mathematics teachers at the Cirebon Islamic Vocational Center, that in solving math problems, most students were still confused and would ask if questions were presented that were different or different from the examples of questions being taught, there were some of them who chooses not to do, tries to do as much as he can, or does it in another way that he knows. From this, it can be seen that students are not used to being faced with various questions, so that students' thinking abilities are also not clear. If students continue to be given questions that are in accordance with the examples, then learning will only be imitating and not training students' thinking skills. Meanwhile, seeing the demands of 21st century learning which emphasizes higher-order thinking skills, it is very possible that math questions will be more varied and contain HOTS (High Order Thinking Skills). Therefore, students' thinking skills need to be honed from an early age, especially in terms of creativity.

One of these abilities is creativity. Creativity will be valuable, because it was born from something different from usual. Of the many changing times and technological sophistication that have occurred, it cannot be separated from the influence of creativity that is born by a person. Therefore, it is very important for students to have creativity, so that they can become productive individuals and have many innovations, not just to see or enjoy. In learning, creativity is needed to solve problems, especially in solving math problems. According to Hadi (2013) states that to be able to solve math problems requires the ability to think critically and creatively. The combination of these abilities will be able to understand the material easily and of course be able to solve math problems in various ways.

In solving mathematical problems, there are lots of various questions and in solving them you don't just have to look, but you need to understand and think about how to solve the problem in question. In fact, there are still students who are embarrassed to ask about understanding mathematics (Nugroho & Riyanto, 2019). Of course, every student has a different or different procedure when solving math problems, some follow the procedure from the teacher and some solve it in another way. There are many ways to solve difficult math problems, but these are only found by creative people.

Meanwhile, according to (Aliyyatunnisa, 2018) that every human being has creative potential, so humans need to optimize this potential by creating an environment that can support the development of potential creative thinking abilities. Therefore, to support the potential development of students' creative thinking abilities, teacher creativity is needed in processing

learning and making appropriate learning instruments. Creative thinking can be stimulated through several things during the learning process, for example manipulating images, animations, instruments, materials, and problems (Mahanal & Zubaidah, 2017). As research conducted by (Ekowati et al., 2015) by manipulating the block numbers and the number of beads in number material using a contextual approach was able to improve student mastery of mathematical concepts and motivation in learning in class VII students of SMPN 1 Kupang.

In addition, the application of a contextual approach is also able to form cooperation between teachers and students in a harmonious relationship, so as to be able to encourage students to think creatively in expressing opinions, improve communication skills, responsibility, self-confidence, and also build student interest (Ekowati et al. ., 2015). Therefore, one way to stimulate students' creative thinking abilities is by incorporating contextual values in mathematics, so that the need for a culture of developing contextual mathematics either in learning or in learning instruments.

The ability to think creatively can be stimulated by various things, one of which is the environment. The environment can have the potential to optimize one's creative thinking abilities, and the environment in question can be in the form of teachers, methods, teaching materials, and learning instruments. Teachers can provide a good approach in learning such as by using a contextual approach. However, in the contextual approach at the Cirebon Islamic Center Vocational School it was not able to run well during learning, so the teacher gave contextual math questions in examples and practice questions so that it was expected to be able to stimulate students' creative thinking abilities. Thus, in solving contextual mathematical problems, it is not clear how one's thinking skills are.

For a teacher, knowing student abilities is important, because teachers need to facilitate students who have difficulties or deficiencies in learning or students with high learning abilities. If the teacher can find out how students are able to solve math problems, then the teacher can take action to achieve learning objectives. Therefore, it is necessary to know how students' creative thinking abilities in solving contextual mathematical problems, the relationship of several aspects and their comparisons. In the creative thinking skills themselves, there are several aspects that are seen, namely fluency, flexibility, originality, and elaboration.

According to Munandar in (Nurhayati, 2011) that there are four aspects of students' creative thinking abilities, namely fluency, flexibility, originality and elaboration. For this reason, from the several things that have been described, the author wants to know how students' creative thinking abilities in solving mathematical problems are contextual from the four aspects that have been mentioned and the differences between each aspect and its major.

According to Anggiat M. Sinaga and Sri Hadiati define ability as a basic person which itself is related to carrying out work effectively or very successfully (Astuti, 2015). Meanwhile, (Sakti, 2011) considers ability as a person's skill or ability to complete or undertake a job. So, ability is a skill possessed by a person when he carries out a job well and succeeds in accordance with certain goals. In learning at school, one of the abilities that need to be trained and possessed by students is the ability to think. Formally, thinking involves the process of mentally using information by forming concepts, solving problems, making decisions, and demonstrating them in critical or creative ways (King, 2016).

In learning at school, one of the abilities that need to be trained and possessed by students is the ability to think. According to Purwanto, thinking is an activity of the human person that results in discovery directed at a goal (Sunardjo, Yudhianto, & Rahman, 2016). Meanwhile, Subanji defines thinking as a mental activity that is used to formulate and solve problems, make

decisions and understand problems (Wardhani, Subanji, & Dwiyanana, 2016). For this reason, the authors conclude that thinking is a mental activity that requires a person's active involvement to understand, find solutions, and provide views on a particular goal. Formally, thinking involves the process of mentally using information by forming concepts, solving problems, making decisions, and demonstrating them in critical or creative ways (King, 2016).

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According to (Alma, 2009) creativity is the ability to create combinations or a new relationship between pre-existing elements, data, variables. Meanwhile, according to Wane (2003) which states that creativity is a mental ability to form new ideas (Nurhayati, 2011). So it can be concluded that creativity is something that is born with new characteristics so that it is different from the previous thing. Thus, the ability to think creatively is a person's skill when he carries out mental activities to understand, find solutions, and provide new and varied views well and successfully at a particular goal.

From the explanation of the definitions that have been mentioned, the writer concludes that the ability to think creatively is a person's skill when he carries out mental activities to understand, find solutions, and provide new and varied views well and successfully at a particular goal. So that the ability to think creatively is needed by students in dealing with problems related to learning or in everyday life. The ability to think creatively can be seen through 4 aspects, namely Fluency, Flexibility, Originality, and Elaboration. The following are each aspect put forward by Munandar in (Nurhayati, 2011).

Table 1  
Indicators from Aspects of Creative Thinking Ability

Aspect	Indicator
<i>Fluency</i>	- Spark lots of ideas, ideas, answers to problem solving, or questions.
	- Gives lots of ways, suggestions for doing things.
	- Always think of more than one answer.
<i>Flexibility</i>	- Generate various ideas, ideas, answers or questions.
	- Can look at problems from a different perspective.
	- Finding many alternatives or different directions.
<i>Originality</i>	- Able to change the way of approach or thinking.
	- Generate new and unique expressions.
	- Think of unconventional ways to express yourself.
<i>Elaboration</i>	- Able to create unusual combinations of parts or elements.
	- Developing an idea, detailing it so that it becomes more complete and interesting.

Meanwhile, problem solving can be interpreted as a process that is carried out by someone by combining previous knowledge to complete a task that is unknown procedure (Romli, 2017).

So, problem solving is a procedure that is carried out by involving a person's thinking process in solving a problem he faces. Problem solving itself is a learning approach that optimally involves active students and allows students to explore, observe, experiment and investigate (Bernard et al., 2018). Thus, in problem solving students are actively involved in exploring, observing, trying, and investigating a science, case or problem at hand.

As explained earlier, a problem is a condition in which an individual or group is faced with a challenging task that is not only solved with ready-to-use knowledge, so another procedure is needed to complete it. In this regard, what is meant by challenging assignments is mathematics. Mathematical problems can be considered as challenging tasks that are done by students, to then find a good solution.

Meanwhile, the definition of context according to Nelissen (1997) is a situation that attracts children's attention and which they can recognize well (Anggo, 2011). Thus, in learning activities what is meant by context is a learning situation that can be recognized by students so that it makes it easier for them and attracts their attention to be actively involved in learning. (Toheri et al., 2020) defines contextual learning as a learning concept that connects subjects and their applications in everyday life.

Thus, contextual is a condition that can be recognized as real life or everyday life that can be known by students. So it can be concluded that contextual problems are conditions in which students are faced with challenging mathematical tasks related to contexts or situations that students can recognize in real life, thus encouraging students to find solutions to solve them. Contextual mathematical problems can be seen as problems that are directly related to concrete or abstract objects such as facts, concepts, or mathematical principles (Anggo, 2011). In this study, what is meant by contextual mathematical problems are problems, cases, or mathematical problems that can be connected or related to everyday life that are known by students, so that students can find solutions by involving thinking about objects, facts, concepts and principles in mathematics.

## **B. Methods**

This research is intended to see the extent to which students' creative thinking skills in solving contextual mathematical problems. For this reason, the type of research conducted is quantitative research. In this research, the researcher seeks to find and reveal the phenomenon to be examined, namely students' creative thinking skills in solving contextual mathematical problems based on several aspects or concepts of the creative thinking skills themselves. The data is in the form of test results for students' creative thinking skills in each department as many as 238 students. The majors are Online Business and Marketing (BDP), Multimedia (MM), Accounting and Institutional Finance (AKL), Computer and Network Engineering (TKJ), Automotive Light Vehicle Engineering (TKRO), Automation and Office Management (OTKP), Engineering and Motorcycle Business (TBSM). The instrument used was a test instrument with data analysis techniques used namely descriptive statistical analysis and non-parametric statistical analysis, with the Friedman test and Dunnett's test (T3) to find out whether there was a significant difference between the creative thinking abilities of students in each major and the magnitude of the difference. The data will be presented in the form of a bar chart on each aspect.

### C. Findings and Discussion

The results of the study showed that the average creative thinking ability of students in solving mathematical contextual problems for class XI at the Islamic Center Cirebon Vocational School was 37.78, which was still in the very low category. However, it should be noted that in the average student's creative thinking ability, there are several aspects possessed by students including aspects of Fluency, Flexibility, Originality, and Elaboration which have different categories. The research findings also show that there are significant differences between students' creative thinking abilities in every aspect. This is obtained from the value of Sig. 0.00 < 0.05 so that H0 is rejected and Ha is accepted. From these differences, it can be seen that the Elaboration aspect is the best aspect among the other aspects with an average value of 61.13 which is in the low category. Other aspects in the very low category are Fluency at 40.39, Originality at 36.45, and Flexibility at 24.16. This finding is slightly different from the findings of research conducted by Rahmawati (2006) entitled "Analysis of the Mathematical Creative Thinking Ability of Junior High School Students" which concludes that the highest aspect that students have is the Flexibility aspect of 68.75%, below that is the Fluency aspect. of 68.52%. Meanwhile, the Elaboration aspect is 34% and the Originality aspect is 32.41%.

These differences could have occurred, because in essence each study was conducted with different samples, instruments and other factors at the time the research was conducted. However, from this it can be seen that in students' creative thinking abilities, not always one aspect will occupy the highest position compared to other aspects. This depends on the stimulation given to students. In this study, the stimulus given was in the form of contextual math problems, resulting in the finding that in contextual math problems, especially in Three Dimensional Geometry material, students have better detailing abilities than other aspects of creative thinking abilities. Students have enough ability to break down ideas or illustrations into a more understandable image object

The data obtained are data on student test results on contextual math questions on Three-Dimensional Geometry material. Based on the results of the Friedman test, it can be seen from the Asymp value. Sig. i.e. 0.000. Based on the test criteria, namely if the significance value (Sig.) < 0.05 then H0 is rejected. So it can be seen that 0.000 < 0.5 then H0 is rejected. Thus, it can be concluded that H0 is rejected, so there is a significant difference between students' creative thinking abilities in the BDP, MM, AKL, TKJ, TKRO, OTKP, TBSM majors.

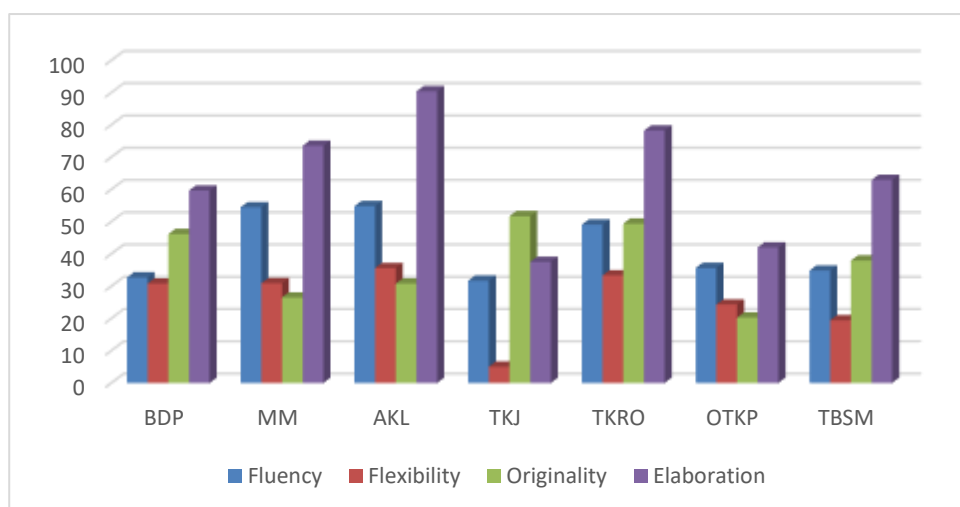


Figure 1 Diagram of Students' Creative Thinking Ability

It can be seen that from the ability to think creatively the best students are majoring in Accounting and Financial Institutions (AKL) of 50.32. Even though the average value is still in a very low category, there are aspects in it that are in a very high category. According to (Nafarin, 2004) accounting can be said to be an art, namely ability, belief, hunch, creativity, coupled with the expertise or intelligence applied in carrying out individual work that arises because of the study of an event or possibility. Thus, accounting majors are trained to have the ability to organize various financial transactions into an overview that is easy to understand when the results are communicated. So, it is not surprising that in solving contextual mathematics problems, the ability to think creatively in AKL is higher than other majors, especially in the Elaboration aspect of 90.38 which is in the very high category. Because they are able to detail an idea to be more interesting and easy to understand. Other aspects, namely Fluency, Flexibility and Originality, are in the very low category. This could happen because the department encourages students to study bookkeeping which has certain rules, so they are not trained to think of different or unique ways when dealing with a problem.

The research findings show that the Online Business and Marketing (BDP) major has an average value of creative thinking ability of 38.78 which is in the very low category, has an aspect of Fluency with an average value of 32.69, an aspect of Flexibility of 36.54, and the Originality aspect of 46.15 which is also in the very low category and the Elaboration aspect of 59.62 which is in the low category. This finding is slightly different from the theory which shows that the characteristics of majors who study business have more original thinking skills. This finding is slightly different from the theory which shows that the characteristics of majors who study business have more original thinking skills. (Wiley et al., 2003) suggests that "Entrepreneurs are out of the box thinkers. They question the conventional wisdom and think of newer, better ways of doing things." From this statement it can be seen that business people have the ability to think outside the box. They question conventional ways and think of new, better ways of doing things. Thus, majors that study business and marketing should have more ability to think in terms of originality.

It should be noted that the average value for the Originality aspect which indicates a very low category obtained actually gives a different method than usual, but is still not understood or accepted. This affects the assessment of the Originality aspect to be very low. Thus, it may be caused by other factors such as a lack of understanding of the problem or an error in the calculation process. These deficiencies and mistakes are found in the aspect of fluent thinking, so if the Fluency aspect is lacking, the Originality aspect is also lacking. This is in line with the statement put forward by Amtiningsih, Dwiastuti, & Sari (2016) that in efforts to develop the Fluency aspect, the teacher should encourage students to issue other answers as an alternative to developing flexibility, if flexibility is not developed enough, then the Originality aspect will not appear.

The research findings show that the ability to think creatively in TKRO majors is better than TBSM majors. The mean score for the TKRO major is 48.72, while the TBSM major is 34.86. The findings of this study are in line with research conducted by (Raviansyah & Nasir, 2019) entitled "The Relationship between Creativity and Student Learning Outcomes in Automotive Engineering Drawing Training Class X Light Vehicle Engineering SMK Negeri 1 Pariaman" which shows that there is a positive and significant relationship creativity with learning outcomes.

The research findings show that the Computer and Network Engineering (TKJ) and Office Management Automation (OTKP) majors have the lowest average scores compared to other majors. Based on the background of their majors, the TKJ and OTKP majors are majors that study more closely related to computer technology. So, this can happen because they are more concerned with the field of technology than calculations in mathematics. Meanwhile, in the Multimedia (MM) major, the highest aspect is the Elaboration aspect with an average score of 73.53 which is in the high category, while other aspects are still in the low category.

From several research findings which show that the Elaboration aspect is more owned when solving contextual mathematical problems than other aspects. In the medium category, students are able to provide detailed descriptions of objects according to illustrations on contextual math problems, although they are still lacking in detail. However, the results of these findings indicate that the Elaboration aspect of students must be maintained, while the Fluency, Flexibility, and Originality aspects must be further improved by providing other questions, to train students' creative thinking abilities.

In this study, students' creative thinking skills which are still in the very low category need to be a concern for the teacher to provide even better learning. The result of the ability to think creatively is the potential or capacity of students to develop. Thus, students' creative thinking skills can be improved by looking at some aspects that are lacking, then developing problems that are able to improve these aspects or provide meaningful mathematics learning according to the needs and characteristics of each department.

The ability to think creatively which is still very low can be raised and trained by teachers using a contextual approach in learning mathematics through learning tools, such as Learning Implementation Plans (RPP), teaching materials, and learning methods. That way, when students are faced with instrument questions about contextual math problems, they can solve them well. Because it has been introduced maturely in learning.

The Elaboration aspect is the best among other aspects, although it is still in the low category, teachers can develop contextual math problems on Three Dimensional Geometry material which encourage students to detail ideas or illustrations into an easy-to-understand image object. For example, through questions, describe the situation according to the illustration, describe the location of the object in question in that situation, and write down the location of the object in the following picture. After that, the teacher can see the second aspect, namely Fluency by providing contextual math problems that encourage students to give lots of ideas or answers. For example, by asking questions, write down at least two possible distances between the two objects in this situation, or write down the possible lengths of objects in that situation.

The third aspect is Originality, by providing questions that encourage students to provide unique ideas. For example, through questions, write your own way to solve the problem, or give your own reasons when solving the problem. The fourth aspect is Flexibility, by providing questions that encourage students to provide various ideas using different approaches. For example, through the question, write down two ways that can be done to solve the problem, or provide different ways when determining the distance between the two objects.

In this study, each department has different creative thinking skills and tends to be related to the interests and background of each department, so that teachers can provide learning that attracts the attention of students from their department. For example, through learning and introducing contextual math problems that take themes or terms related to their environment, so they can understand and recognize these situations well. Contextual mathematical problems in this study are only limited to the material of Three Dimensional Geometry. In Three Dimensional



Geometry material, there are questions that are visualized with objects that students are familiar with, so that students understand more clearly the meaning of the problem.

#### D. Conclusion

Students' ability to think creatively in solving contextual mathematical problems in class XI at the Islamic Center Cirebon Vocational School is still very low with an average of 37.78. If viewed from the Fluency aspect with an average of 40.39 in the very low category, only a small number of students are able to provide many and relevant ideas about contextual mathematics problems. If viewed from the Flexibility aspect of 24.16 in the very low category, then most students have not been able to provide 2 or more ways of solving contextual mathematical problems. If viewed from the Originality aspect of 36.45 in the very low category, then only a small number of students are able to think uniquely when solving contextual math problems. If viewed from the Elaboration aspect of 61.13 in the low category, then some students have been able to detail ideas about contextual mathematics problems, even though they are still lacking in detail.

There is a significant difference between students' creative thinking abilities in each major. This can be seen from the Sig value obtained from the Friedman test which shows a value of 0.00 or  $<0.05$ . Thus, giving the conclusion that  $H_0$  is rejected and  $H_a$  is accepted, which means that there is a significant difference between students' creative thinking abilities in each department. Of the several majors, the department with the best creative thinking ability is the Accounting and Financial Institutions (AKL) major.

In this study, the result of the ability to think creatively is the potential or capacity of students to develop. Thus, students' creative thinking abilities can be improved by looking at some of the aspects that are lacking, so as to develop problems that are able to improve these aspects or provide the same and meaningful mathematics learning according to the needs and characteristics of each department. This research is the result of an analysis of students' creative thinking abilities in solving contextual mathematical problems. So, in the future it is hoped that this research can be a contribution to further research to further develop contextual questions that can improve students' creative thinking abilities.

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