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Analysis of Problem Based Learning Models to Improve Creative Thinking Ability of Senior High School Students on Momentum and Impulse Topic

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Abstract: Schools must have the 4C abilities, notably creative thinking, to keep up with the advancement of science and technology in the 21st century's educational institutions. The ability to think creatively strives to involve activities, analyze, synthesize, generate conjectures, create something new, and utilize the knowledge acquired in practical ways. Some studies show that students' creative thinking skills in momentum and impulse materials are not optimal. One of the factors that cause students' low creative thinking skills is the learning process. This study aims to provide an overview of students' creative aptitudes on momentum and impulse topics. This study used a mixed method with an embedded experimental design. At SMA 1 Menggala in Lampung, this study was carried out. 28 students of class X MIPA 2 involved in the study were taken as samples with a saturated sampling technique. For this study, the students participated in tests and interviews. Of the four essay questions on momentum and impulse that made up the creative thinking ability exam each validity value (0.686) and reliability (0.610) had a high category. A creative mind is characterized by fluency, flexibility, originality, and elaboration. Problem-based learning models can help students' creative thinking skills, according to the findings of research on the subject. According to the results of the investigation, most students have a high level of creativity on the indicator of fluency. The problem-based learning model is successful in enhancing the ability to think creatively and is expected to be applied in further research on different topics.

Keywords: Creative Thinking Ability, Problem-Based Learning, Impulse and Momentum

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INTRODUCTION

One of the key elements in developing qualified human resources capable of competing on the global stage is education (Satriawan et al., 2020). The advancement of science and technology in the 21st century about educational institutions necessitates the development of 4C capabilities in schools. One of them is Creative Thinking ability (Redhana, 2019.). Creativity is one of the goals of school education (Ainiet al., 2020). As a mental activity to generate fresh concepts and different approaches to a challenge, creative thinking is described (Aini et al., 2020). Introducing students to creative thinking can encourage the development of creativity, which is crucial in today'senvironment.

Learning activities that involve many activities, analysis, synthesis, speculation, creation of something new, and application of the knowledge gained in practical situationsare the focus of creative thinking ability (Duval et al., 2023). Students' ability to think creatively needs to be cultivated and trained so that they are confident in providing a variety of thoughts and concepts by soliciting feedback from other students (Alfiyah et al., 2023). When an issue arises, someone with strong creative thinking abilities can offer answers and always grow positively (Akmam et al., 2022). Students must possess the ability to think creatively to solve a problem (Asrizal et al., 2023; Batlolona & Diantoro, 2023; Sandopa et al., 2022). The ability that needs to be developed is the capacity for creative thought, as it is one of the essential qualities that pupils need to succeed in physics studies (Batlolona et al., 2019; Rosidin et al., 2023; Siburian et al., 2019). According to (Saputri et al., (2023) Four components (indicators), namely fluency, flexibility, originality, and elaboration, make up the ability to think creatively.

One of the challenges students encounter when studying momentum and impulseis having trouble solving collision problems and momentum and impulse problems (Adianto & Rusli, 2021). Difficulties faced can interfere with students' creative thinking abilities (Rokhmat et al., 2022). The capacity to think creatively when working with impulse and momentum material is crucial. One of the key 21st-century learning abilities that must be mastered and enhanced in science education to meet technological challenges is the ability to think creatively (Hadjarati et al., 2020; Hanni et al., 2018; Yehya, 2020). Numerous research indicates that kids still have poor levels of creative thinking ability (Bahtiar et al., 2020; Jamal et al., 2020). According to research (Asriani et al., 2021) shows that students' creative thinking ability on momentum and impulse material is not optimal. One of the factors that is the cause of the low creative thinking ability of students is the learning process. Learning by developing creative thinking skills can make learning more meaningful and fun and is needed to find innovations in human life (Saputri et al., 2019).

The research conducted by (Hendrik Wenno & Rafafy Batlolona, 2021; Zulkarnaen et al., 2022) demonstrated that the use of the PBL model can enhance students'creative and critical thinking skills. The delivery of problems, questions, prompts for investigations, and dialogues are all key components of the problem-based learning (PBL)approach to learning, which emphasizes the needs of the individual learner in problem-solving (Mustajab et al., 2019; Syahidi & Fartina, 2019; Zaidah et al., 2019). The issues being studied should be contextual problems that students encounter in their daily lives (Syahidi & Fartina, 2019). PBL has various benefits such as determining the problem, investigating the cause, making hypotheses about the cause, testing the

hypothesis, getting information, determining learning targets, developing problem-solving skills, and using the information obtained in every stage of life (Koray, 2013). PBL is a method of learning whereby students work together to solve issues using a variety of concepts and abilities from different subjects of science (Mutakinati et al., 2018). The PBL model contains downsides, such as the fact that it doesn't provide students enough time to be fully engaged in learning (Rahmadita et al., 2021).

Based on the description above, it appears that some have not been optimal in improving students' creative thinking skills on momentum and impulse material. As a result, it's essential to use problem-based learning models to improve students' how to think creatively about the topics of momentum and impulse. This study aims to provideand convey an overview of the creative thinking skills possessed by students on the topic of momentum and impulse. Research related to the identification of student's creative thinking skills is still rarely found, so based on the description of the problems above, it is important to conduct this research so that later it becomes a reference in a lesson that can facilitate students in mastering concept understanding and creative thinking skills, especially impulse and momentum topics.

METHOD

This study used a mixed method with an embedded experimental design. This study was carried out at SMAN 1 Menggala, Lampung. The sample of the study was X MIPA 2 class students totaling 28 people using the saturated sampling technique. This study used tests and interviews with students. The creative thinking ability test consists of four essay questions on the topic of momentum and impulse which have been validated by previous validators with a validity value of 0.686 and reliability of 0.610 (high category).The exam tool is meant to gather information on the student's creative thinking ability on the topic of momentum and impulse. Fluency thinking, flexibility thinking, originality thinking, and elaboration thinking are the componentsof creative thinking ability, according to (Wechsler et al., 2018). Data analysis in this study consists of two parts, namely qualitative data and quantitative data. In this study, an analysis of the interview and test findings for creative thinking capacity outcomes wasconducted.

RESULT AND DISCUSSION

Aspects of Fluency Thinking

The first creative thinking ability question of the fluency indicator, which addresses the idea of momentum and impulse in daily life, has significantly increased. In this indicator, students struggle to come up with suggestions for a collision between two buses that results in a perfect collision.

Figure 1. Questions on Fluency Thinking Indicators

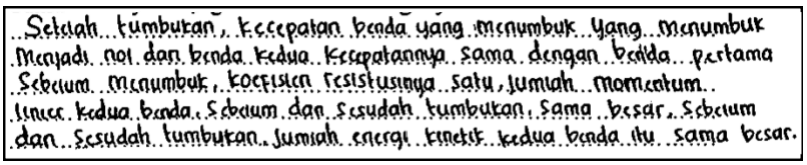


Figure 2. Answers Given by Students to the Fluency Thinking Indicators

Based on the answers given, students have been able to provide ideas from the events displayed in the problem correctly. Students have been able to analyze several concepts that occur in problem number 1. Students have also been able to make representations of perfect collisions based on the problems given well. Based on an interview with one of the students, the student said: *"I have been able to see some eventsin the picture that are associated with momentum and impulse material, one of which is collision. After studying momentum and impulse material related to the perfect collision, I was able to answer question number 1 well, according to the concepts taught".*

Following the intervention, student learning revealed that 6 students (21.4%) responded in the moderately creative group, 11 students (39.3%) in the creative category, and 11 students (39.3%) in the extremely creative category. There were still up to 6 students in the somewhat creative category after the treatment, which made it difficult for them to conceptualize solutions to the issues given.

Aspect of Flexibility Thinking

There has been a considerable improvement in creative thinking capacity question number 2 on the flexibility indicator regarding the relationship between momentum and impulse that exists in daily life. Students have trouble coming up with different experiences that illustrate the concept of impulse for the flexibility indicator.

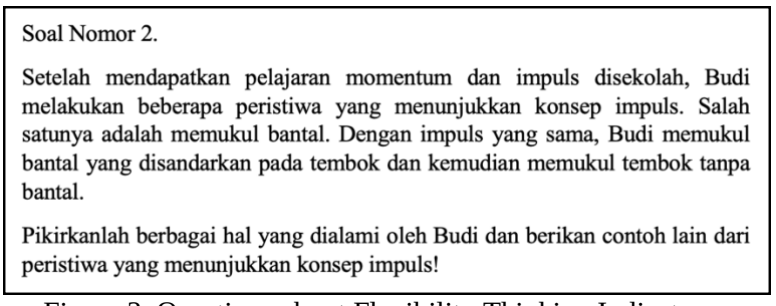


Figure 3. Questions about Flexibility Thinking Indicators

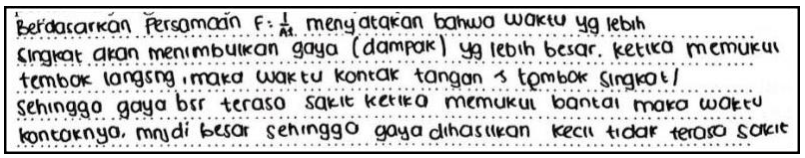


Figure 4. Answers Given by Students to the Flexibility Thinking Indicators

Based on the answers given, students have been able to analyze several concepts that occur in problem number 2. Berdasarkan permasalahan yang diberikan, siswa mampu membuat representasi yang berkaitan dengan konsep impuls. Based on an interview with one of the students, the student said: *"Based on question number 2, I can feel the events that he experienced directly, like hitting the table, etc. I have started to understand the concept of impulse, and I can also practice the concept of impulse directly, as in the problem".*

The results of the students' after receiving the treatment revealed that there was 1 student (3.6%) answered with the less creative category, there were 15 students (53.6%) answered with the moderately creative category, there were 10 students (35.7%) answered with the creative category and there were 2 students (7.1%) answered with the very creative category. After receiving treatment, there were still 15 students in the somewhat creative category who found it challenging to come up with different instances that illustrated the concept of impulse about the presented issue.

Aspects of Originality Thinking

Creative thinking ability question number 3 on the originality indicator regarding making a simple technology in solving momentum and impulse problems in everyday life has improved significantly. Students have trouble communicating their ideas or solutions when using or creating technology, according to the originality indicator.

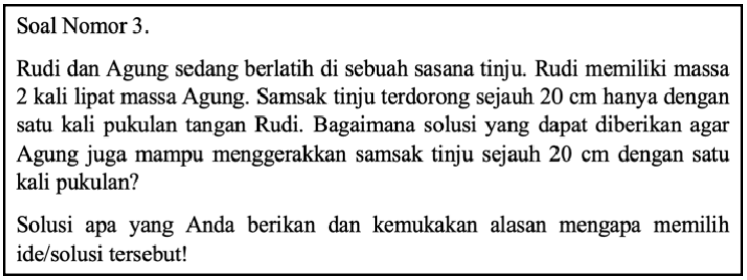


Figure 5. Questions about Originality Thinking Indicators

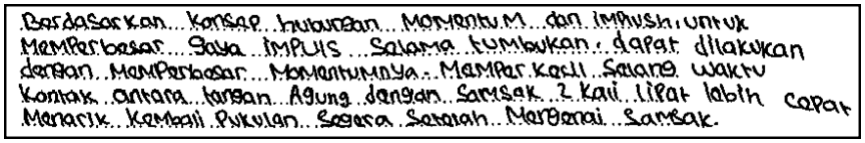


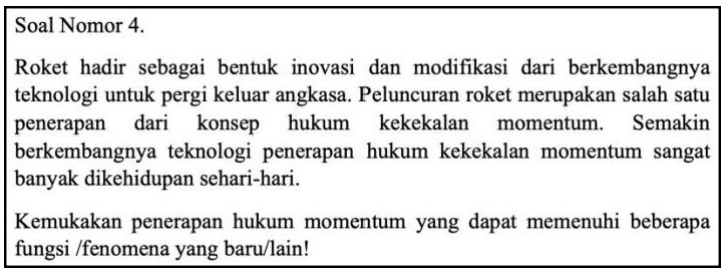
Figure 6. Answers Given by Students to The Originality Thinking Indicators

Based on the answers given, students have been able to provide ideas/solutions as desired in the problem. Additionally, students have been able to analyze the idea of momentum changes that take place in problem number 3. Based on an interview with oneof the students, the student said: *"When answering question number 3, I imagined myself as a boxer, and when giving a punch I estimated the punch I gave with the strongest possible force. After I answered this question, I began to understand that in boxing there are concepts of momentum and impulse".*

The results of the students after receiving the treatment revealed that there were 11 students 46.4% answered in the very creative quite creative category, 14 students 50.0% answered in the very creative category and 1 student 3.6% answered in the very creative category. 13 students fall into the moderately creative category, which means they have trouble expressing ideas or generating technologically connected solutions to the difficulties.

Aspects of Elaboration Thinking

Students' capacity to add or specify details of an object that uses the law of conservation of momentum has risen greatly, according to question number 4 on the elaboration indicator for creative thinking ability. Students had trouble elaborating on how the rule of momentum might be used in advancing technology, according to the elaboration indicator.


Soal Nomor 4.

Roket hadir sebagai bentuk inovasi dan modifikasi dari berkembangnya teknologi untuk pergi keluar angkasa. Peluncuran roket merupakan salah satu penerapan dari konsep hukum kekekalan momentum. Semakin berkembangnya teknologi penerapan hukum kekekalan momentum sangat banyak dikehidupan sehari-hari.

Kemukakan penerapan hukum momentum yang dapat memenuhi beberapa fungsi /fenomena yang baru/lain!

Figure 7. Questions about Elaboration Thinking Indicators

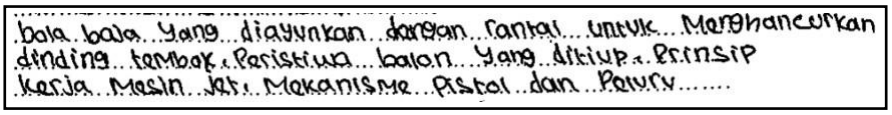

bola bola yang diayunkan dengan cantai untuk Menghancurkan dinding tembok, Perisai nya bolon yang ditiup, Prinsip kerja Mesin Jet, Mekanisme pistol dan Pauru.....

Figure 8. Answers Given by Students to the Elaboration Thinking Indicators

Based on the answers given, students have been able to provide four examples of the application of the concept of momentum. Additionally, students have been able to analyze the concept of momentum that occurs. Based on an interview with one of the students, the student said: *"I have learned examples of the application of the concepts of momentum and impulse during the learning of momentum and impulse material, such as the concept of impulse in helmets and the law of conservation of momentum in rocket launches."*

The results of the students after receiving the treatment revealed that there were 11 students 39.3% answered in the moderately creative category, 11 students 39.3% answered in the creative category and 6 students 21.4% answered in the very creative category. 11 students in the moderately creative category had difficulty in suggesting the application of the law of conservation of momentum in developing technology with the given problem.

DISCUSSION

The problem-based learning models can help pupils develop the capacity for creative thinking ability (Ernawati et al., 2022; Rudibyani, 2019; Ülger, 2016). Students who participate in problem-based learning simulations are exposed to real-world issues that pique their curiosity and encourage them to consider possible solutions (Simanjuntaket al., 2021). Sahyar et al., (2017) have shown that problem-based learning can help students develop higher-order thinking abilities like critical thinking, creativity, and problem-solving abilities. Students are required to exercise and exhibit creative thinking ability when addressing problems from the earliest to the last stage of problem-based learning (Simanjuntak et al., 2021). Each stage promotes the development of creative thinking ability through tasks such as information analysis and evaluation, idea synthesis and exercise of insight in the selection of new ideas, and development of problem-solving concepts (Ernawati et al., 2022).

The problem-based learning model encourages students to reflect before learningso that they are aware of what will be learned (Vistara et al., 2022). The problems given to students are done by students based on their thoughts according to the originality indicator. Students answer the problems faced in a way that is written clearly and in detailaccording to the elaboration indicator. The answers of each child can be different according to the flexibility indicator and students can come up with diverse ideasaccording to the fluency indicator. Fluency thinking was the indicator of the capacity forcreative thought that saw the greatest growth in the high category. By studies by (Saputri et al., 2023).

Students' capacity to offer a variety of responses to a question demonstrates their fluency in thought (Alwi & Suherman, 2020). The ability to communicate ideas or alternate answers allows students to approach an issue in many ways and come up with a variety of solutions. This is a facet of flexible thinking (Alwi & Suherman, 2020). In line with research (Alwi & Suherman, 2020) thinking flexibility students can provide varied answer ideas. Flexibility necessitates the understanding of multiple concepts. According to (Algiani et al., 2023) students must consider many points of view when creating original thoughts or ideas. One of the creative thinking skills that students struggle with is the thinking component of originality (Algiani et al., 2023). In this aspect, so that the formulation of the idea is easier to apply and clearer, students must be able towrite down or explain certain logical elements of the current ideas. In line with this, (Grégoire, 2016) Students with new perspectives be more can increase their creativity and hone their originality. The capacity to elaborate and add details to a concept is a component of elaboration thinking (Algiani et al., 2023). In line with (Algiani et al., 2023) reveal that students still have a limited and inadequate capacity to add or provide detailsor thorough explanations about the concepts student convey. To prepare pupils tosolve the difficulties they encounter, creative thinking is required (Kashani-Vahid et al., 2017). People with creative thinking skills can select ideas that are more innovative, beneficial, and creative (Zhu et al., 2017).

CONCLUSION

It can be concluded from the analysis that the problem-based learning models help students develop the improve for creative thinking ability. Though some students in class X MIPA 2 have quite good creative thinking abilities, most although are some less creative students. Fluency creative thinking ability indicators have better scores or the majority of students are very creative based on the results of creativethinking ability research that has been conducted by researchers. The problem-based learning model encourages students to reflect before learning so that they have an understanding of what will be studied and so that it can enhance their students' creative thinking ability. However, students still have difficulties, one of which is in thinking of various events that show the concept of impulse with the given problem. The problem-based learning model is successful at enhancing one's creative thinking ability and is expected to be used in future research on different topics.

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