Physics learning based contextual problems to enhance students' creative thinking skills in fluid topic

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Abstract. This study aims to improve students' creative thinking skills in physics learning on fluid topics by applying contextual problem-based learning. The research location was in one of the senior high school in a remote area in Bima district. The research subjects were selected by purposive sampling technique on eleventh-grade students with the number of students' as many as ten peoples. The data were collected by using creative thinking skills test in essay and reasoned multiple choice that conducted before and after learning. Based on the results of data analysis, it was found that out of ten students there were two students who had an increase in creative thinking skills in the very creative category and six students who had an increase in creative thinking skills in the creative category. While two students who had an increase in creative thinking skills in the less creative category. Therefore, it can be said that the use of contextual problems in physics learning can help improve students' creative thinking skills.

1. Introduction
Education is one of the factors that plays an important role in preparing qualified human resources and ready to compete in global competition. Along with preparing themselves for the competition, improving the quality of education is something that will not be discussed and sought. One effort to improve the quality of education is to change the educational paradigm from teacher-centered learning to student-centered learning \[1,2\]. This requires every teacher to continue to improve the quality of learning, so that students can be able to develop their potential optimally. One form of learning improvement process is the development of learning strategies \[3\]. The development of learning strategies needed is a learning strategy that is rich in information and meaningful and embodies dynamic and high-level thinking activities \[4\].

Contextual learning with the constructivism approach is seen as one strategy that meets the principles of competency-based learning. With five contextual learning strategies (contextual teaching and learning), namely relating, experiencing, applying, cooperating, and transferring, it is expected that students are able to achieve competence to the fullest \[5\]. Contextual teaching and learning is a learning concept where the teacher presents real-world situations into the classroom and encourages students to make connections between the knowledge they have and their application in their lives as
family members and society [6]. With this concept, learning outcomes are expected to be more meaningful for students. The learning process takes place more naturally in the form of activities students work and experience, not the transfer of knowledge from teacher to student. Contextual teaching and learning are a learning concept that helps teachers associate the material they teach with students' real-world situations and encourages students to make connections between their knowledge and their application in their daily lives, involving seven components [7,8].

In learning physics, it is necessary to use a real context to be explored, meaning that learning activities are based on contextual problem problems. Then students express the contextual problems in the language of physics. Next, students solve the problem with the tools in physics and finally can reiterate the answers that are still in the language of physics into everyday language. Contextual problems in question are problems or phenomena or physical phenomena that really arise and are experienced by students in everyday life [9,10]. The use of contextual problems in physics learning has a strong reason, namely (i) the absence of a relationship between learning in school and in the real world and real life problems contributing to low student motivation, (ii) learning using appropriate contextual problems can help students understand the role and the responsibility of students as members of society, and (iii) the benefits of learning using contextual problems according to the theory of cognition which states that knowledge cannot be separated from the context and place of development of that knowledge. Besides requiring contextual problems, learning physics requires also a model that can help students to be active and independent in developing thinking skills in solving problems.

Problem based learning (PBL) is a learning model that can help students to be active and independent in developing thinking skills in solving problems, through data search so that solutions can be obtained rationally and authentically [11–13]. PBL process strongly supports the development of skills in self-regulating, collaborative, high-level thinking skills which include creative thinking, being able to explore information that is all needed in the workforce. There are four characters of creative thinking according Torrance [14], namely: (1) Originality which is the uniqueness of the ideas expressed; (2) Fluency is the ability to create as many ideas as possible; (3) Flexibility, namely flexibility in thinking, This is indicated by the absence of the same idea when someone is asked to express their ideas or opinions; (4) Elaboration is indicated by a number of additions and details on each idea so that simple stimulus becomes more complex. While measuring the ability of students to think creatively can be done by basing on what students communicate, verbally or in writing [15]. So, learning based contextual problem is problem-based learning that using contextual problem while creative thinking skills are thought processes to solve problems.

2. Methods

This research is conducted in eleventh grade students in one of the senior high schools in Bima districts in which small class that is consists of ten students about fluid topics. Research samples were selected by purposive sampling technique. The design used in this study was a pre-experimental one-group design-posttest design, because it used one group without a comparison group. This design involves one group observed at the pretest (O1) stage which is then followed by a certain treatment by using PBL model based contextual problem (X) and posttest (O2).

Steps in learning refers to PBL learning models, namely: (1) Providing contextual-based problem orientation (2) Organizing students for investigation (3) Guiding individual and group investigations (4) Developing and presenting the results of investigations (5) Analyzing and evaluating investigation process (5) concluded [16]. The PBL model is oriented towards solving problems that are designed by the teacher both from the results of reading or direct observation by students. Opportunities for students to develop creative thinking in the PBL model are in the 3rd to 5th phases.

Instruments developed to measure students' creative thinking skills are test descriptions and performance or student activities. In line with Gregor [15] that measuring students' creative abilities can also be done by basing on what students communicate, verbally or in writing. The questions developed are open ended, namely the type of question that has many possible correct answers [17],
whereas according to Sternberg [18] in his study states that open ended questions can help increase creativity by generating diverse ideas, and students can solve their own problems in the future.

In addition, the tests used were essay and reasoned multiple choice that integrated indicators of creative thinking from Guilford to measure elaboration, fluency, originality and flexibility [19]. The example of the tests as shown figure 1. The question of compiled creative thinking tests was tested on students at the beginning of time, namely before being treated as a pretest and after being treated as a post-test. The pretest problem was given to find out the initial ability of students’ creative thinking before they gotten learning using a device developed with the PBL model that refers to contextual problems. The post-test problem aims to determine the extent to which the devices developed can train students’ creative thinking skills.

![Figure 1. Example the test of the creative thinking skills](image)

Increased creative thinking ability is obtained by analyzing the students' creative thinking test scores before and after learning. Increased creative thinking ability was obtained by analyzing the test scores of students' creative thinking before and after learning which refers to contextual problems in fluid material. Percentage of creativity thinking criteria of students with the following categories as shown table 1.

| Average Score Interval | Category          |
|------------------------|-------------------|
| 81% - 100%             | Very Creative     |
| 61% - 80%              | Creative          |
| 41% - 60%              | Creative Enough   |
| 21% - 40%              | Less Creative     |
| 0% - 20%               | Not Creative      |

3. Result and discussion
Contextual problems in problem-based learning in this study were not only seen as a problem related to concrete objects but also include problems related to abstract objects such as facts, concepts. The process of learning physics by applying a problem-based learning model using contextual problems as a starting point in learning. In this case students organize problems and try to identify physical phenomena related to everyday life on the problem. Students are free to describe, interpret and solve contextual problems in their own way based on their initial knowledge. Based on the data was obtained from the measurement of creative thinking skills (Guildford framework) in contextual problem-based learning of students using essay test and reasoned multiple choice test on the fluid
concept. And then analyzed through descriptive statistic shown that learning process was effective as shown by table 2 and there was an increase in students’ creative thinking skills as shown by figure 1 and 2.

### Table 2. Results of student activity analysis in PBL process

| Students Activity | Meeting 1 | Meeting 2 | Meeting 3 |
|-------------------|----------|----------|----------|
|                   | R        | R (%)    | r        | R (%)    | R        | R (%)    |
| 1                 | 1.55     | 96       | 1.60     | 100      | 2.45     | 97       |
| 2                 | 0.75     | 80       | 1.25     | 96       | 2.35     | 97       |
| 3                 | 0.75     | 66       | 1.35     | 96       | 2.60     | 92       |
| 4                 | 0.95     | 94       | 1.15     | 95       | 2.25     | 97       |
| 5                 | 2.15     | 93       | 2.20     | 90       | 2.80     | 96       |
| 6                 | 1.05     | 95       | 1.40     | 100      | 2.30     | 95       |
| 7                 | 1.5      | 93       | 1.55     | 96       | 2.50     | 96       |

| Percentage of Agreement (R%) | 1.24 | 88.14 | 1.50 | 96.14 | 2.46 | 95.71 |
|-----------------------------|------|-------|------|-------|------|-------|
| Note:                        | 1)   | 2)    | 3)   | 4)    | 5)   | 6)    | 7)    |
|                             | Formulating Problems, Conduct an investigation, Do group work, Record the results of observations, Discuss the results of observations, Expressing opinions, Take note of conclusions. |

Observations of student activities obtained with values ranging from 1 to 3, then the average value of student activities in the first meeting 1.24, the second meeting 1.50 and the third meeting 2.46. This means that during the activities of learning activities students experience a significant increase. While the percentage of agreement during the learning activities was 93.33%. The increase in student learning activities was caused by the high motivation of students in participating in learning that presents contextual problems. This was indicated by the results of interviews with several students where students were very interested in the problems presented because they have been experienced by students themselves. Active involvement of students in learning has a positive impact where students were better trained to find solutions and other alternatives in solving problems. Fasko [20] said that "Creativity is associated with the ability to handle high task novelty" by means of a problem someone would get used to thinking, he would associate his knowledge with existing problems, bring up ideas as alternative solutions to problems that he faced. This is in line that intelligence develops because people face new experiences and embellish, then try to resolve differences by linking new knowledge with initial knowledge and building new meanings [15]. In addition, teachers can also combine teaching and experience in the classroom every day to create a culture of thinking while the culture of thinking is part of teaching thinking [21]. Students are required to produce creative products in the form of ideas. A creative product is if it is new, valuable, and unique [22].
5

Figure 2. Results of Analysis of Student Creative Thinking Skills

Based on Figure 2, students' creative thinking skills before participating in the learning process were still in the less creative category with an average value of 37.5. This can be seen from the students' answers that were very normative, whereas the questions given were open ended questions which answer was very varied. In addition, most provide answers that were exactly the same as those in the textbook where the answer was not in accordance with the answer to the problem given. While the creative thinking ability of students after following the learning process by applying problem-based learning in which the problem was given in the form of contextual problems as a whole increases to students with creative categories with an average value of 69.4. There is an increase in creative thinking skills because during the learning process students were accustomed and given the freedom to solve problems with many alternatives [18,23]. This can be seen in the answers of students who are varied but still answer according to the problems given. In addition, during the dominant learning process students were able to express unique ideas in answering questions raised by their friends. And sometimes students were also able to interpret the questions given with different points of view [24].

Another thing that can be explained from Figure 1 that there is an increase in learning outcomes which describes students' creative thinking skills which are significant where there are 20% of the number of students getting N-Gain with a high category (g > 0.7) and 60% of students obtaining N-Gain with medium category (0.3 ≤ g ≤ 0.59). This means that there is an increase in students' creative thinking skills in problem-based learning by presenting contextual problems. In addition, based on interviews with several students that students were increasingly motivated and interested in learning because of the problems presented in the form of phenomena or events that they have experienced in everyday life [7,9].

The obstacles found by researchers during the learning process was that of 10 students there were 2 students who have not been able to use problem-based learning, not yet accustomed to high-level thinking, in this case creative thinking even though they have high interest and motivation in learning. They were only used to thinking in one direction, while creative thinking is to think with all directions, provide many alternatives, think quickly and openly when faced with problems. This is in line with Zhanetta's statement [25] that when someone applies creative thinking in a practice of problem solving, intuitive divergent thinking produces many ideas.

4. Conclusions

Based on the results and discussion it can be concluded that there is an increase in students’ creative thinking skills in fluid learning by applying a problem-based learning model that presents contextual problems. In addition, there is an increase in student learning activities because students are increasingly motivated and interested in the learning process because the problems presented are in the
form of phenomena or events they have experienced in everyday life. And to anticipate the existence of students who find it difficult to develop creative thinking skills special attention is needed and continue to be trained and accustomed to how to think with all directions, provide many alternatives, think quickly and openly when faced with a problem.

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