Implementation of creative physics experiment on the creativity of students’ ability

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Abstract. Creativity is the result of a creative thought, therefore the education system that is applied to the school environment should be able to build, awaken, and stimulate logical and creative thinking towards the reasoning of students. One of the ways taken is by focusing, intensifying, and directing the development of students’ abilities in solving problems or creating a work, project or product in classroom learning activities in the form of implementation of creative physics experiments through assigning tasks (Task Based Learning). The research aims were: 1. To find out the creativity of students in learning physics towards the implementation of creative Physics experiments. 2. To find out the implementation of the Task Based Learning model through creative Physics experiments on the student’s creativity. This research uses the Mix Method in the form of Sequential Explanatory design that emphasizes quantitative data as the main data, and qualitative data as supporting data. The results of the study of student’s creativity based on the achievement of indicators of creativity that was equal to ≥70% and the creativity of students based on work groups have high creativity that can be seen that has a value of ≥70%. As for the results of implementing task-based learning, it was found that it was very good. Based on these data it was concluded that the results of students' creativity research when implementing Task Based Learning in the form of creative Physics experiments was said to be good.

1. Introduction
The development of science and technology (IPTEK) affects all fields and aspects of life. One development that has changed is the education sector. So to deal with the development of science and technology and information needed high skills resources that involve critical thinking, systematic, logical, creative and the ability to work together to create creativity.

Creativity is the result of a creative thought, therefore the education system that should be applied to the school environment is able to build, arouse and stimulate logical thinking towards students' reasoning. From this it can be predicted that creativity can later determine a learning outcome from the teaching and learning process. One way is to focus / intensify and direct the development of students' abilities in solving problems or creating a work/project. So that these activities can be used as a correction of the results of learning activities. We can identify the creativity itself and can also be trained through an appropriate and correct education system [1]. Creativity was a process in the form of mental abilities that exist in every individual in the form of ideas or ideas to create a new product that already exists / is attached to him from birth [2]. This opinion is also supported by [3]; [1]
revealed that creativity is a person's ability to create/give a birth to something that innovates new, both in terms of ideas and real works that are relatively different or renew existing ideas and also includes the ability to think at a high level which implies being grounded by discontinuity, differentiation, integration between each stage of development.

According to [4], learning that creates a work or project provides a positive learning atmosphere for students and becomes an educator's self-efficacy which will lead to creative ideas between the two. According to [5], the ability to create and implement many ideas, ideas and suggestions and think differently is a framework in a creativity. In addition, [1] said that creativity was the process of seeing, feeling and observing a problem, making prejudices about an issue, proving and testing the assumption or hypothesis then finally delivering the results already obtained. [6] operationally creativity can be formulated as an ability to reflect fluency, flexibility and originality in thinking, as well as the ability to collaborate (develop, enrich, detail) an idea or idea. The importance of creativity is stated in the Law of the Republic of Indonesia Number 20 in 2003 concerning the Education System, the core of which, among others, through education is obtained to develop the talents, interests and potential of students in themselves so that they become pious, noble, capable, creative and independent human beings.

The creativity ability of students can be seen from cognitive traits or aptitude traits such as curiosity, happy asking questions, developing creative thought patterns or can be measured through creativity tests given to students. In addition to using the test, there are other ways to look at creativity in the form of the work or project created. [2] states that for the characteristics of creativity can be grouped into two categories, namely cognitive including originality, flexibility, fluency, and elaboration. While non-cognitive include motivation, attitude and creative personality. Both of these characteristics are equally important for intelligence which, if one of them is not supported by an example of creative personality, it will not produce any ideas or ideas in cognitive abilities.

Creativity can be created well if it starts with a small/simple education, namely from home. In this case, parents must provide freedom and opportunity for each child to develop their imagination so that it stimulates questions, and explores the wonders of the world and the greatness of nature that exists [7]. Children should be accustomed to finding and exploring themselves by discovering literature from history, encyclopedias and phenomena. So that they are accustomed to having good initiative ability in solving a problem that they will face in life and can know the child's creative mindset from how to analyze it. When they are in school and get assignments to solve problems or have the opportunity to carry out experimental activities or develop their creativity, they are easier to implement creative mindsets.

This is consistent with the nature of science which involves creative activities and imagination as well as discoveries that can encourage students to develop divergent, original thinking, make predictions, give rise to questions and trial and error. The teaching and learning activities that are asking questions and solving problems applied by educators is the beginning of a creative attitude that shows that students have the ability to create, imagine and work in a divergent way through various points of view [8]. [9] said that the purpose of science education is knowledge and understanding, exploring and discovering, imagination, creativity, scientific attitude, and application. The special characteristics in science material are studying the symptoms of natural phenomena that are factual in the form of reality (reality), or events (events) and correlation cause-effect [10]. Physics problem solving not only uses a method of solving the given task, but can also be done through the ability to use media and illustrations. In teaching and learning activities many aspects that affect learning outcomes include: objectives, materials learned, strategies, students and educators as learning subjects, teaching and learning media as a support of the process [11].

If students have creative thinking, it will bring out the creativity and innovation of these students, so it is necessary to create an environment that can respect a freedom that is responsible for students both in the learning process and in social life. This is in line with what was conveyed by (7) everything must be consistently applied and programmed to improve the creative and innovative nature of society at large. Just like students must be given the opportunity and their freedom to learn to think
independently and solve problems using logic, especially in learning physics where the knowledge is related to everyday life.

According to [1] developing the ability of creativity is important because it has several reasons, namely: a) By being creative, people can realize and see the potential that exists in themselves, this is one of the basic needs in human life to be able to survive and adapt to the surrounding environment. According to [1] creativity is also a manifestation of oneself in one's self-realization. b) Creativity or creative thinking as the ability to see opportunities in solving or facilitating a problem, this is a form of thinking in education [12]. When in school creativity can be trained in terms of knowledge, memory, and reasoning (logical thinking). c) Busy yourself creatively which is where this is not only useful for yourself to the satisfaction of the individual and the environment. d) It is creativity that makes it possible for humans in their efforts to improve the quality and standard of their lives. Creativity in this case one of its uses can help students to solve problems in terms of learning. As his research, [13] shows that there was a positive and significant correlation between students' creativity with the ability to solve physics problems. It can be said that the higher the creativity, the higher the ability to solve problems in physics. Other research results state that aspects of creative thinking have different ways of solving physical problems, especially aspects of respondents' elaboration showing better results in problem solving compared to other aspects of creative thinking [14].

Based on the results of observations and background problems that exist researchers want to measure the creativity that students have in learning physics. It aims to determine the level of creativity that students have. Various aspects of creative skills have been recommended to be developed and can be measured in learning by [1, 3, 12, 15-17].

2. Methods
This research uses quantitative research. The stages of this research are used first to see the problems that exist in the school of the learning process, especially in Physics by initial observation, and interviewing some students then determine ideas to find solutions or ways so as to reduce the problems faced, after getting ideas for the solution to the next stage formulate instruments that will be used in measuring students' initial creativity. The assessment that will be carried out at this research stage is in the form of observation and documentation study.

The assessment that is carried out or measured in the learning process takes place, namely when students carry out creative physics experiment activities so that it can be seen that the creativity possessed by each student.

3. Results and Discussion
Based on research results at the Banda Aceh 2 High School, it was found that students had a very low level of creativity when learning began. This shows that about 70% of students in the school have low creativity in physics. Some factors that cause the low creativity in these schools are: learning methods that are less attractive, educators who do not provide opportunities for students to develop creative thinking patterns, learning that is still centered on educators. As for the condition of the school it can be said to be very good where there are laboratory rooms and tools in good condition to support experimental activities. This is actually contrary to the teaching and learning process activities based on the results of researchers' interviews with several students that there are very few practical activities or experiments conducted, so that students' creativity is also very difficult to be developed if students have talent.

Based on observations when learning before entering into the material to be taught it turns out that the creativity of these students is low. This is shown when educators give a question to give an idea or an idea about a problem there are only a few students who are able to answer. This situation can be said that these students not lack creativity to answer but are afraid and shy to answer. The cause of this situation is because educators rarely provide opportunities for students to provide arguments or ideas in the learning process. This is supported based on the results of interviews with several informants, that is, we were rarely given a motivation or addressed problems from previous learning before
learning began so that we were rarely able to develop our creative mindset when getting an issue from the previous material. Based on these results researchers conducted an assessment of the creativity of students through group activities. The assessment used is in the form of observation of the achievement of creativity indicators. Indicators used in the assessment of creativity, among others, according to [18], namely: 1). Give a lot of ideas or suggestions for a problem; 2). Respond to the opinions of friends, 3). Asking questions to educators, 4). Have alternatives in solving problems, 5). Can answer the questions well, 6). Discussing things that are known and not known, 7). Student notes made with their own language, 8). Write the results of group work neatly and correctly, 9). Current in expressing ideas verbally and in writing, 10). Complete and neat in describing the results of group work. As for the results of the analysis of the assessment of creativity of students based on the achievement of creativity indicators.

![Figure 1. Student creativity achievement per indicator.](image)

Figure 1 shows the value of achievement per indicator of creativity that was carried out at the time of the assessment of students namely there are about six indicators which are at a value of ≥70%. These results can be said to represent that the creativity of students in implementing creative physics experiments is good enough when reviewed and seen based on the results of achievement per creativity indicator. This shows that students are able to develop ideas, ideas and creative mindsets when they are in a work group to carry out creative physics experiment activities with the knowledge and abilities they previously had from the results of the teaching and learning process. In assessing the creativity of students can be seen and assessed from the results of observations and tests. This is like the study of [19] the results of students' creativity can be seen and assessed by a holistic and analytic assessment. Analytical assessment is an assessment carried out with an observation sheet of creativity while for a holistic assessment is an assessment can be seen from the results of reports and products created by students. This is supported by [20] assessments that can be measured for the creative or creativity of students in working on drawing tasks, guessing tasks and alternative use tasks of the creative indicators themselves in the form of fluency, flexibility, authenticity and elaboration.

As for other assessments the creativity of students in work groups can be seen or measured from the work / products and reports that have been successful in each of the work groups created. In this case, it can represent that it actually shows the success of creating a work or product through the implementation of creative physics experiments for students in the working group individually having a pretty good creativity, because based on the results of the assessment of the achievement indicators show that the success of an average above ≥70%. This is supported by research by [21] which states that creative experiments can implement students' creativity in understanding the visual language of images into drawing lessons. [22] for assessing the level of creative thinking ability of students can be done with a test in the form of Torrance which aims to evaluate students' thinking abilities. The test can be done at the beginning or end of learning. Supported by [23] Students' creative thinking skills are measured before and after learning by using tests in the form of essays. The ability of creativity that exists in a person can be measured through four process approaches namely creative, adaptation,
synthesis and genesis. For students, it can later increase metacognitive awareness and develop ideas of creativity from literacy activities [24].

![Figure 2](image-url)

**Figure 2.** The score of the participants creativity per work group.

Figure 2 explains that the creative physics experiment activities are divided based on the working group of students according to the principle of task-based learning to create a work or product. Student creativity can be measured through two separate methods with individuals and groups [25]. The results of the analysis in Figure 2 show that each work group has a high average of creativity that can be seen that has a value of ≥70% and only one work group has a value of ≤70%. It can be said that the creativity of students in creating and developing creative thought patterns or ideas in a work group into a work / product is very good. These results are supported by his research [19] said that the creativity of students can be seen based on the creativity of the working group formed. Experimental learning in group activities can influence pedagogical abilities and the development of students' creative thinking [26].

The learning process activities in the form of creative physics experiments, educators as facilitators aim to guide/direct students when there are difficulties and problems in carrying out the activities of implementing creative physics experiments. Students in these activities become centers of learning which will be more active, often ask questions and communicate in developing/combining ideas and creative ideas that they have. The process of students doing it is to produce and create a work/product that is desired and expected according to the mindset and creativity of each student each per group in implementing the objectives of learning in the form of creative physics experiments. These results are also supported by research [19] states that simple experimental-based learning is able to be a medium to see students' creativity. [27] that learning with experimental methods is proven to foster interest and talent in arousing the creativity of students towards science learning, so that unconsciously learning outcomes will also increase.

Based on observations when the process of implementing creative physics experiments there are a number of working groups that have succeeded in creating a work that is good and true but there are some working groups that still have problems or difficulties in creating a work. The problem in this case turns out to be a number of factors including: students in the working group who have poor communication with other students and there are also students who still do not understand the goals of the working group. Although in this case the creativity of individual students is quite good but when implementing creative physics experiments in working groups requires good communication and cooperation to realize a work or product that is in accordance with ideas, ideas and innovations that are owned by all members of the work group. In the case of creativity groups can create cooperation, good communication between fellow students [28].

4. Conclusion

Based on the results of research that has been done in this study the following conclusions include:

Student creativity based on the achievement of the indicator that is equal to ≥70%. Where there are six indicators that have a value of ≥70% and four indicators ≤70%. These results can be said to represent that the creativity of students in implementing creative physics experiments is good enough when reviewed and seen based on the results of achievement per creativity indicator. Student creativity
based on work groups has a high average of creativity that can be seen that has a value of ≥70%. It can be said that the creativity of students in creating and developing creative thought patterns or ideas in a working group in implementing creative physics experiments into the form of works / products is very good.

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