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THE EFFECT OF PHYPHOX APPLICATION ASSISTANT GUIDED INQUIRIES ON ABILITY STUDENT CREATIVE THINKING

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Abstract

This study aims to determine the effect of using a guided inquiry-based phyphox smartphone sensor application on creative thinking skills and improvement. The sample of this research is the students of class X IPA 3 SMA N 1 Kotabumi. The research design used was One Group Pretest-Posttest. The treatment is in the form of partially elastic collision learning assisted by a guided inquiry-based phyphox application that can be processed using Microsoft Excel. Data on students' creative thinking skills were obtained using a description test instrument. The technique of analyzing student learning outcomes data is using Paired Sample T-Test. Based on the results of the study, the average score of creative thinking skills increased by 35%, the average N-gain was 0.52 sig. (2-tailed) the value was less than 0.05. The results of partially elastic collision learning using a phyphox smartphone sensor based on guided inquiry have a significant effect on increasing students' creative thinking skills.

Keywords**:** *creative thinking ability's, online, phyphox application, guided inquiry, smartphone sensor*

INTRODUCTION

Science and technology is one of the factors that can support the quality of education. The development of this technology gave birth to a digital generation or so-called digital native. This generation is very familiar with the internet and various digital technologies such as computers, laptops, tablets, smartphones and others (Sudarsiman, 2015).

The Cambridge International Organization, which was attended by 502 students and 637 teachers in Indonesia, released research results through the Global Education Census (2018) which stated that Indonesian students are among the highest

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technology users. The development of technology, especially software that is free and open source designed specifically for learning (Afrianti, 2012).

Utilizing technological developments is expected to make it easier for students to carry out practicals. Utilization of technological developments in learning will produce a generation that has good thinking skills as well. With the emergence of the Covid-19 *(Corona Virus Disease)* outbreak, the Indonesian government issued a Work From Home *(WFH)* policy which requires people to study from home, work from home, and worship at home. Learning during the WFH period needs to strengthen online learning *(e-learning)* in order to maximize online learning.

Online learning has become a guide in the world of education since the last few years (He et al., 2014). During the pandemic, better learning facilities are needed with the use of information technology (Panigrah et al., 2018). Bensalem (2018) explains that various platforms can be used to support online learning.

E-learning provides learning through digital devices such as computers, laptops, tablets or smartphones. Smartphones are equipped with features that support various sensors in them that can be used as experimental tools. Smartphones will be a good solution in the modern era (Kuhn & Vogt, 2013).

Chia-Yu et al. (2017) describes the results of using a trial of data acquisition tools on pendulum experiments, free fall motion, inclined planes, and projectile motion using smartphones and digital video (DV). students compared to the old model practicum.

Learning physics that is centered on solving problems using creativity will help in solving problems from various points of view. According to (Wahyudi & Supardi, 2011) creative thinking is the ability to understand problems and find solutions with varied (divergent) strategies or logical methods. In line with Ekasari & Sahidu (2016) which stated "Creativity is a matter of coming up with new ideas that are also useful".

21st century learning demands quality in all aspects and results of human work, Wijaya et al. (2016). The world changes all the time, regarding revolution, engineering, modern economics, social systems and technology undergoing changes which of course also experience a shift in the paradigm and practice of Syahid's education (2016). Guided inquiry is learning that focuses or emphasizes the process of inquiry Parmin et al. (2014).

This result was also stated by the Ministry of Education and Culture of the Republic of Indonesia, suggesting the use of a learning model that is in accordance with the 2013 curriculum which is centered on logical thinking, critical thinking, creative, and innovative to solve problems. The appropriate learning model is the guided inquiry learning model (Matsun & Widha, 2016).

The guided inquiry learning model is a teacher's strategy to encourage students to learn actively, and to encourage students to have their own experiences in finding solutions to every problem (Kunandar, 2010).

This method can also improve learning achievement and develop

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students' thinking because the learning process goes through stages like scientists (Novitaningrum et al., 2016). In line with Santos et al. (2019), students' activities during practicum resulted in good performance

One of the advantages of using a virtual lab in physics experiments is that it has a relative error of 0%, while physics experiments directly involve a scientific process which has a relative error. One of the factors is limited human observation to observe the tracks or events directly.Based on the above problems, one of the technologies that can be used to facilitate learning activities is the smartphone sensor application (Nazruddin, 2012).

The development of smartphone sensor technology has begun to be developed in Indonesia, one of which is phyphox *(*Physical Phone Experiments*)*. Through the guidance given at the initial stage, students are given the opportunity to explore and then the guidance is gradually reduced according to the student's development (Kuhlthau, 2010). This media can help students during the pandemic for activities in practicum where the results of the experiment can be stored until they can be analyzed further.

The use of smartphone technology is expected to facilitate learning and practical activities on physics material so as to create innovative and fun learning and not an obstacle in the learning or research process, but as a good learning medium and in accordance with the global demands of the 21st century. Therefore, the researcher examines the research entitled "The Effect of Smartphone Sensor Applications on Elastic Collision Learning (Collision) Based on Guided Inquiry on the Improvement of Students' Creative Thinking Ability".

METHODS

In this study, there are three forms of variables, namely the independent variable is phyphox, the dependent variable is the ability to think creatively and the moderator variable is the guided inquiry learning model. The design of this study only uses one class, namely the experimental class, the selection of the experimental class uses purposive sampling technique. This study used a group design of one group pretest-posttest design.

Implementation of research at SMA Negeri 1 Kotabumi in the even semester of 2020 online. Data collection was carried out before and after the learning activities were carried out. The population in this study were all students of class X MIPA at SMA N 1 Kotabumi, totaling 4 classes with a total of 133 students and X MIPA 3 was obtained as the experimental class. The sample class was selected using purposive sampling technique.

The instrument used in this research is the test of the validity of the questions and the test of the reliability of the questions. 6 items about the description of creative thinking skills with a Pearson correlation value > 0.361 and a *Cronbach alpha* value of 0.465. The data analysis technique used in this study is the normality test of creative thinking skills and the *N-Gain* test. Samples that have been normally distributed are used to see the effect of learning treatment using paired sample T-test.

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RESULTS AND DISCUSSION

Research on the effect of using smartphone sensor applications on guided inquiry-based collision learning on students' creative thinking skills began on Monday, April 13, 2020 at SMA Negeri 1 Kotabumi. The learning process takes place three times face-to-face with an allocation of 3 hours of lessons

Table 1. Average student pretest-posttest results

Parameter	Pretest	Postest
Lowest	11,00	50,00
Highesti	48,61	81,94
Average	17,07	67,93

Based on Table 1, the posttest value was greater than the pretest value because students experienced an increase after being given treatment in the form of guided inquiry-based learning assisted by Phyphox applications. The average increase in each indicator of creative thinking ability can be seen in Figure 1.

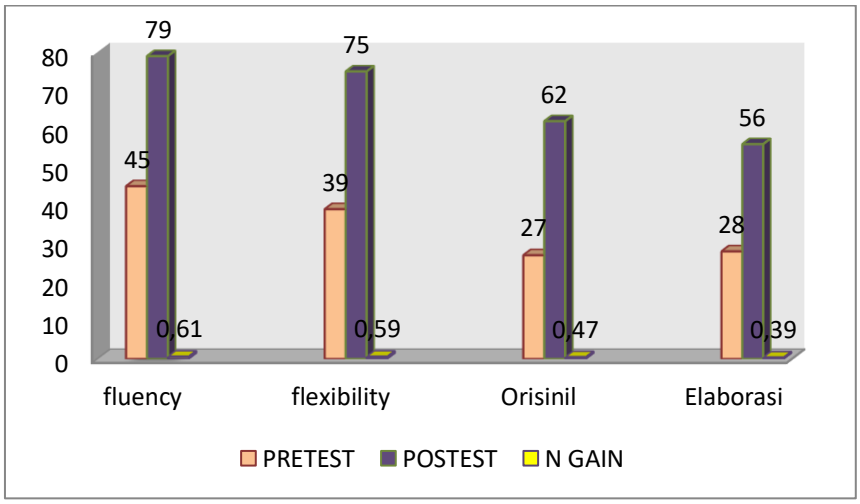

Figure 1. Average of each indicator on creative thinking ability

The highest indicator mastered by students is the ability to think fluency or the ability to think fluently in terms of Graph 2. Hypothesis testing is carried out using students' *N-gain* data. The average *N-gain* pretest and posttest data can be seen in Table 2.

Table 2. *N-gain* creative thinking ability

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Acquisition Score	*Pretest*	*Posttest*	*N-Gain*	*Increment %*	Category N-gain average
Highest Score	47	82	0,16	54%	Moderate
Lowest Score	11	49	0,69	10%	Low
Average	33	68	0,52	35%	Moderate

Based on Table 2 . The average N-gain results of students' creative thinking abilities are in the medium category with the average increase in students' creative thinking abilities at the posttest higher than in the pretest. Hypothesis testing using pretest and posttest N-gain data. Before testing the hypothesis, the data were normally distributed. The next step is to test the hypothesis using a paired sample T-test, the results of the hypothesis test can be seen in Table 3.

Table 3. Result *paired sample t-test*

Pair	T	df	Sig.(2-tailed)
Pretest-Postest	-22,201	33	.000

Based on Table 3, it can be seen that the values of *Sig. (2-tailed)* is smaller than 0.05, meaning that there is a difference in the average creative thinking ability of students before and after being given learning treatment using the phyphox smartphone sensor application with a guided inquiry model.

Sesen & Tarhan (2013) said that inquiry-based learning with laboratory activities is an effective combination in learning activities. The use of tools related to everyday life will increase students' interest in learning physics. Practical activities can foster student curiosity and answer problems based on a series of experiments that have been carried out by students.

The partially elastic collision experiment is one of the most difficult practicums to observe directly. Changes in reflection that are almost simultaneously during the elastic impact practicum are partly difficult to do manually because of limited human observations. Based on observations from several schools, the partially elastic collision practicum conducted in schools still uses simple tools so that the results are less accurate. Therefore, it is necessary to assist with sensors capable of recording objects at a more accurate height such as the phyphox application.

Practical activities can foster student curiosity and answer problems based on a series of experiments that have been carried out. The results of this study were also stated by Sukariasih et al. (2019) stating that phyphox can also practice as support in laboratory work which contributes to helping train creative thinking skills through student activities in real time.

Based on the results of the Paired Sample T-test, it shows that there is a difference in the average creative thinking ability of students before and after learning using the Phyphox

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application. The average results of the partially elastic collision investigations carried out by 5 groups obtained an average relative error of 0.34% with a decision-making tolerance of 5%. In line with the research of Staacks et al. (2018) said using the phyphox application produces more accurate data because it is able to see in real-time on the experiment.

Using a guided inquiry model assisted by the phyphox smartphone sensor application can require students to solve problems with various solutions in their own way, so as to encourage the improvement of students' creative thinking skills. According to (Wahyudi & Supardi, 2011) creative thinking is the ability to understand problems and find solutions with varied (divergent) strategies or logical methods. The guided inquiry model requires students to be independent in doing assignments so that students can explore their abilities to find answers to the problems given.

(Underbakke et al., 1993) found in science learning, that learning that involves students' activities in problem solving through posing problems, presenting hypotheses, and testing hypotheses can train students' higher order thinking skills. The sources of increasing creative thinking skills are found in each stage of learning.

Online learning does not prevent students from interacting and finding their own creativity, this is in line with the results of research (Fatmala et al., 2020) which states that the learning process that occurs in small groups in online learning does not prevent students from communicating to achieve common goals. The use of tools related to everyday life will increase students' interest in learning physics.

According to Wenning (2010), each stage of levels of inquiry involves students' intellectual and scientific process skills. The first stage in this study is orientation (problem identification), this stage can trigger students' thinking skills in the cognitive domains of C2 (understanding) and C3 (problem solving).). Baer (1993) found a learning process that trains students to solve problems (problem solving) can improve students' creative thinking skills. Identify phenomena, find and formulate problems in their own way. In this process students are faced with phenomena related to partially elastic collisions, this is where the ability to think flexible and the ability to think fluently (fluency) students are trained. The activity of analyzing images and videos presented within 5 minutes to find problems with new solving abilities, issue many ideas, ideas or alternative answers smoothly and train students in creative thinking.

The stage of formulating problems (asking questions) can trigger students' thinking skills in the C4 cognitive domain (analysis). This step challenges students to think to find and analyze answers to problems regarding the phenomena presented, this is where students' fluent thinking skills are trained. The stage of formulating a hypothesis (planning an investigation) can trigger C4 cognitive (formulating) thinking skills. Through this stage students are trained in original thinking skills and fluency. The process of formulating a hypothesis will usually encounter incompatibility between the formulation of the hypothesis and the

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results of the experiment. Students will get used to connecting various problems to find answers that do not fit.

The stage of collecting data (carrying out an investigation) can trigger students' thinking skills in the cognitive domains of C5 (proving) and C6 (designing and creating). Students and their groups conduct independent investigations, starting from preparing tools and materials available at home, using the phyphox smartphone sensor application and independently exploring their findings. Usually students will start having difficulties at the stage of conducting the experiment due to several factors, for example, the noise of the room used, and the lack of accuracy of students regarding the weaknesses of their own smartphones, this is where students are trained to think flexibly and in detail. At this stage students will be accustomed to expressing ideas to solve a problem in the core process and expressing ideas as a solution to solving problems, as well as maximizing their ability to act as the party that controls learning according to the provisions. An example of the design of the group design tool can be seen in Figure 2 as follows.

Figure 2. A Series of collision experiments and designs by the phyphox app

The stage of analyzing data (testing hypotheses) can trigger students' thinking skills in the C5 cognitive domain (find). Students with their groups discuss and analyze data, this is where the ability to think flexible, original and detailed is trained. The ability to process data results from the phyphox application and use Microsoft Excel can familiarize students with analyzing various different ways to solve a problem. In the process of analyzing data, students will usually have difficulty connecting the speed and height of a partially elastic collision to find the mathematical equation. Students will be accustomed to using ideas to compare various opinions with problems faced by students. The teacher's role in this process is to guide students so that they do not get out of the learning concept. The activities of students who practice flexible thinking skills, originality and elaboration can be seen in Figure 3 as follows.

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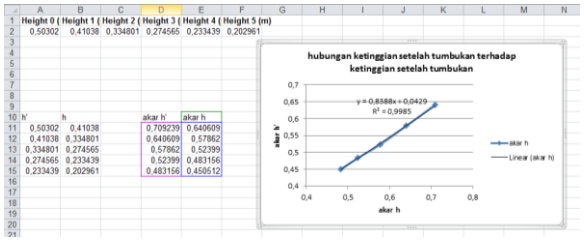

Figure 3. The Process of tabulating the data of the results of the investigation assisted by the phyphox application

The stage of making conclusions and communicating results can trigger students' thinking skills in the C5 cognitive domain (conclude and argue). Students and their groups make conclusions based on the results of the investigation activities and present the results of the activities that have been carried out. At this stage the ability to think fluently, original and elaboration is trained. Students are trained to analyze experimental data to find the equation of the coefficient of restitution. After tabulating the data and converting it into a graph, it will be obtained from the comparison of the velocity before the collision to the velocity after the collision which is obtained on the graph and then analyzed in detail using the free fall equation of motion to find out what quantities affect the coefficient of restitution. The results of the detailed analysis will get the equation for the relative error of the average restitution coefficient based on the data obtained. The process that trains detailed thinking can be seen in Figure 4 as follows:

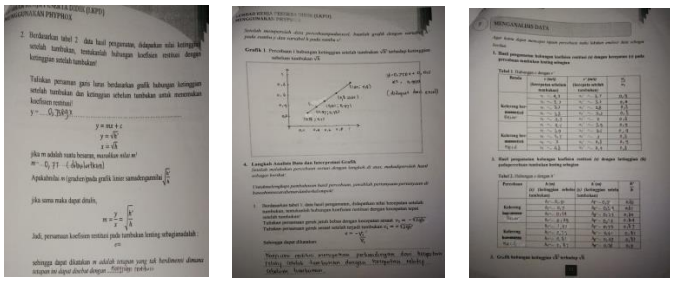

Figure 4. Student activities in the process of processing and communicating results

Inquiry learning is a learning designed to invite students directly into the scientific process. Students who actively ask questions and express opinions during learning will help practice their creative thinking skills. The ability to think creatively on the indicator of fluent thinking or fluency obtained an average value of 78.7. This indicator is in the first position of the four indicators of creative thinking that have been mastered by students. This result is because students are able to analyze answers and ideas correctly to a problem. These students have extensive knowledge so that they are able to provide ideas fluently. According to Marlani (2015) the ability to think creatively on the indicator of fluent thinking is the

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ability of students to express their ideas by answering a number of answers about a problem.

The ability to think creatively on the flexible thinking indicator gets an average value of 75. This indicator is in the second position of the four indicators of creative thinking that have been mastered by students. These results indicate that students are still often confused in the process of selecting data in Microsoft Excel to be grouped according to the height before and after the collision. If students can master flexible thinking skills well then this will affect original thinking skills. The ability to deal with various problems with the right analysis will certainly produce a more interesting answer.

The ability to think creatively on the indicator of original thinking or originality obtained an average value of 61.7. This indicator is in the third position of the four creative thinking indicators that have been mastered by students. This result is because students are required to give answers that are unusual or rarely given by most people, while the majority of students answer with the same answer. If students can master original thinking skills well, this activity will affect the increase in elaboration thinking indicators. The ability to think in more detail and depth will certainly result in a better understanding of concepts.

The ability to think creatively on the elaboration thinking indicator gets an average score of 56.2. This indicator is in the last position of the four indicators of creative thinking that have been mastered by students. This result is caused by students who have to look for a deeper meaning to the answers or problem solving by taking detailed steps, while students answer problems only according to what is taught and according to the book without enriching existing ideas. Husen (2015) said that the ability to think creatively is one of the basic assets that students must have to face competition in the global era.

Based on the results of the study, it is known that partially elastic collision learning assisted by smartphone sensor applications using a guided inquiry model has increased. This means that the more interesting the physics learning that is packaged well, the higher the creativity of students when learning physics. Based on the researcher's observations, students who have high enough creative thinking abilities can find or solve a problem in their own way or find ideas in a different way from the others. This is in line with the opinion of Ekasari et al. (2016) which states that creativity is a person's ability to produce a new product or a combination of things that already exist, which are useful, and understandable. It can be concluded that in this study there was a significant increase in creative thinking skills assisted by the inquiry-based phyhpox smartphone sensor application for class X MIPA 3 at SMA N 1 Kotabumi.

CONCLUSION AND RECOMMENDATION

Based on the results of research and discussion that the N-gain value and the results of the paired simple T-test analysis in partially elastic collision learning using a guided inquiry model assisted by the phyphox smartphone sensor application, students' creative thinking skills

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increased. Therefore, the application of learning assisted by the phyphox smartphone sensor application using a guided inquiry model can be used as an alternative for teachers as an effort to improve students' creative thinking skills.

Based on the results of the study, the author suggests that if teachers or other researchers want to use the phyphox application in the (in) elastic collision experiment, it is necessary to pay attention to the type of smartphone and the noise of the room to be used because the motion analysis of the phyphox smartphone sensor has a high sensitivity so that it affects each experiment.

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