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# The Effectiveness of Using Smartphone-Based Phyphox in Field Practice Tilt to Improve Students' Creative Thinking Skills

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**Abstract.** The use of technology is a solution to overcome problems in physics learning. This study aims to determine the effectiveness of using Smartphone-based Phyphox in improving students' creative thinking skills. The design used in this research is a nonequivalent pre-test and post-test control group design. This study used a purposive sampling technique to get two groups. The statistical analysis used was independent sample t-test. The results of the analysis showed that there was an effect of using Smartphone-based Phyphox in improving students' creative thinking skills, so it was effective in the learning process. In general, this research can contribute to the field of education, especially physics learning, to optimize the use of technology as a learning medium. This learning strategy allows students to participate directly in proving the concept of the material. In addition, this model can be an alternative to active learning in improving students' creative thinking.

*Keywords: effectiveness, smartphone-based Phypox, creative thinking skills*

## 1. Introduction

Technological advancements in the 21st century affect everything, such as the field of Education. The use of information technology in the context of education is tools that can be used to support the teaching and learning process. This process requires collaboration between various parties, including educators, teachers, prospective teachers and leaders [1]. Practice-based learning is needed to provide opportunities for students to discover and Applying concepts through observationm [2]. Practicum prepares participants education to face real-world conditions in the industrial world, especially in Current industry Revolution 4.0 [3].

Today's society is facing increasingly complex world challenges and Students are required to develop skills and ability as initial capital before entering the community [4]. According to TIMSS (Trends in Mathematics and Science Study), participants' creative thinking skills Indonesia's education is low [5]. To answer these demands, learning must increasing the importance of creative thinking skills. Learners The ability to think creatively when learning can have an influence on learning outcomes. Achieving learning goals will largely depend on on one's capacity to think originally [6] Creative learning it is necessary for students to feel happy and at home to Participating in classroom learning [7]. There are many efforts that can be made to help Students achieve creative thinking skills, one of which is by utilizing technology.

Creative thinking skills are crucial to current generations dealing with 21st-century challenges. Creative thinking skills can be easily empowered if students have good metacognitive abilities [8]. Creativity in thinking about a problem will present easily if the person has good metacognitive abilities.

Metacognitive development is one of the dimensions of knowledge that must be achieved, that is, how individuals can plan, monitor, and evaluate the learning process [9]. The ability to think creatively is able to give birth to something with originality, novelty, and uniqueness that is visible from the previous version. Efforts to improve creative thinking abilities can be applied in all fields of science [10]. Creative thinking skills are specific mental abilities that enable the generation of unique and valuable ideas to solveproblems through imagination.

The main factors comprising creative thinking skills include several approaches [11]: a) Fluency; b) Flexibility; c) Originality; d) Elaboration. To foster creative thinking, studentscan participate in practices such as brainstorming, using mind maps, discussions, and participating in problem-solving exercises. Embracing diverse perspectives and ideas is crucial for fostering a more creative mindset [12].

Information and communication technology (ICT) has the potential to provide a variety of benefits for teachers and students, including the field of joint learning, Interactive, cooperative, and collaborative learning opportunities [13]. Smartphones is a modern communication tool that is flexible, convenient, and popular. Learners are perceived to favor learning through mobile apps and video content over traditional forms, so they tend to emulate their teachers who integrate modern technology into their curriculum and use it outside of class hours for learning [11]. Smartphones also provide many applications that help Experiments in physics learning [12]. Smartphones have a lot of applications that can help teachers in the teaching and learning process, such as measurement, linear accelerometer, gyroscope, barometer, roller coaster, ruler, magnetometer, compass, global positioning system/GPS, stroboscope (beta), inclinometer, light meter, color detector, sound meter, Tone generator and spectrum analyzer spectrogram (audio) [14].

The learning of basic physics practicum based on virtual mobile observatory gets a good response by students, this can be seen from the enthusiasm of students following the practicum of determining the earth's gravity. In addition, learning activities can be done online or offline [15]. Whereas, according to Permana et al that Phyphox can be utilized in learning and has a good impact [16]. This is in accordance with the results of research from Nurfadilah ddk who applied Phyhox in developing media for use in learning [17].

Smartphone is a modern communication tool that is flexible, convenient and widely popular. Smartphones also provide many applications that help experiments in learning physics [12]. This application integrates various sensors on smartphones and laptops as the basis for experimental measurements. The Phyphox app can facilitate data recording and analysis of physics practicum required and obtained based on sensors [18]. In the work of Pierratos et al, making an interesting combination of Atwood machines and inclined planes to study quantitative kinematics with smart phones and phyphox applications. The choice of using the phyphox app has several advantages for presenting kinematics concepts to secondary school learners, as it directly and wirelessly provides the analyzed data to a laptop or desktop computer screen. Thus, eliminating the need to export raw data and requiring heavy data processing steps by learners [19].

The development and use of Phyphox in learning can have a good impact on students [16]. Virtual Mobile Observatory-Based Basic Physics Practicum Good response by students, this can be seen from the enthusiasm of students. Participating in the earth gravity determination practice. In addition, activities Learning can be done online or offline [15]. Application Phyphox is an application program that is being developed rapidly in its use as a tool during physics experiments. Although it has presented promising prospects, in the use of Digital practicum tools in the educational environment have limitations. Thing It emphasizes the need for further research in a variety of environments education to validate these findings and explore the long-term impact The length of the integration of technology in education. The aim of this research is to explore the effectiveness of using smartphone-based Phyphox in improving creative thinking skills in understanding the concept of inclined planes in physics practicum, as well as its contribution to a better learning experience for students.

## 2. Methods

### 2.1. *Research Model*

This study uses a quasi experimental design consisting of nonequivalent (pre test-post test) control group design, where there are control classes and experimental classes that are given different treatments. The procedure of this study is a test of questions in a class that has previously studied the material, then in the sample class a pretest is conducted to determine the initial ability of students, treatment, and the last is a posttest to determine the creative thinking ability of students after treatment.

**Table 1.** Research design.

| Groups | Pretest | Treatment | Postest |
|---|---|---|---|
| Experiment | $R_1$ | X | $R_2$ |
| Control | $R_1$ | Y | $R_2$ |

### 2.2. *Research Sample*

This study was conducted among eighth-grade students of a junior high school in Sikka, East Nusa Tenggara, Indonesia. The sampling technique used was purposive sampling to determine the experimental and control classes where each class amounted to 25 students as samples.

### 2.3. *Research Instruments*

In this study, the instrument used was a descriptive test question to measure the effectiveness of using the smartphone-based Phyphox application on improving students' creative thinking skills. The questions in this test are related to physical phenomena observed through experiments, and in the test there are indicators of creative thinking skills including: a) Fluency; b) Flexibility; c) Originality; d) Elaboration; e) Sensitivity to issues.

### 2.4. *Analysis Tecniques*

In the study, the prerequisite test was first carried out in the form of a normality test and homogeneity test using the chi square. After the prerequisite test is complete, then hypothesis testing is carried out using independent sample t- test.

## 3. Results and Discussion

Before starting the practicum using Phyphox, it is first necessary to explain the basic concept of an inclined plane to students. After understanding the basic concepts of inclined planes, students use the Phyphox application to measure phenomena that occur on inclined planes directly. The use of Phyphox in inclined plane practicum provides opportunities for students to think creatively, by conducting interactive experiments, solving problems, using technology. After the practicum is finished, students can reflect on the experimental process that has been carried out, and the teacher can evaluate the extent to which students have mastered physics concepts related to inclined planes.

The results of descriptive analysis of critical thinking ability data before and after treatment show that the average value of the experimental class is higher than the control class, as shown in Table 2.

**Table 2.** Descriptive analysis.

| Groups | N | Pretest | | | Postest | | |
|---|---|---|---|---|---|---|---|
| | | Average | Min | Max | Average | Min | Max |
| Experiment | 25 | 17,32 | 1 | 45 | 43,68 | 23 | 72 |
| Control | 25 | 12,24 | 5 | 34 | 27,81 | 15 | 42 |

After calculating the pre-test data for the experimental class, $X^2$count is 4.402 If consulted with the chi square table at the significance level $\alpha = 0.05$, $X^2$tabel = 11.07 is obtained. Thus it can be said that the experimental class pre-test data is normally distributed because $X^2$count = 4.402 < 11.07 = $X^2$table. As for the experimental class post-test data after calculating $X^2$count of 1.66, with the chi square table

at the significance level α = 0.05 obtained $X^2$table = 11.07. Thus it can be said that the experimental class post-test data is normally distributed because $X^2$count = 1.66 < 11.07 = $X^2$ table. Furthermore, for the control class pre-test data obtained $X^2$count of 2.64 If consulted with the chi square table at the significance level α = 0.05 obtained $X^2$ table = 11.07. Thus it can be said that the control class pre-test data is normally distributed because $X^2$count = 2.64 < 11.07 = $X^2$table. As for the control class post-test data after calculating $X^2$count of 2.81, with the chi square table at the significance level α = 0.05 obtained $X^2$table = 11.07. Thus it can be said that the control class post-test data is normally distributed because $X^2$count = 2.81 < 11.07 = $X^2$table. Table 3 below are the results of the calculation of the normality test of pre-test and post-test data on creative thinking skills.

**Table 3.** Results of the normality test calculation.

| Groups | | Pre-test | Post-test |
|---|---|---|---|
| Experiment | $X^2_{hitung}$ | 4.402 | 1.663 |
| | $X^2_{tabel}$ | 11.07 | 11.07 |
| Control | $X^2_{hitung}$ | 2.643 | 2.811 |
| | $X^2_{tabel}$ | 11.07 | 11.07 |

This hypothesis test was conducted to determine the effect of treatment on different samples in the experimental and control classes. different experimental and control classes. The display of independent sample t-test results can be can be seen in Table 4.

**Table 4.** Independent sample t-test results.

| | Experiment | Control |
|---|---|---|
| Mean | 43.68 | 27.81 |
| Df | 48 | |
| Significance Value | 0.000026 | |
| t-Table | 2.01 | |

Table 4 shows that the average post-test of the experimental class was 43.68, while the average post-test of the control class was 27.81. The average results of the two classes show that the average of the experimental class is higher than the control class with a difference of 15.87. While the results of the calculation of the tcount obtained a tcount price of 3.727 and a ttable price of 2.01 at α of 0.05 with a degree of freedom of 48. The results of the calculation of the significance value, obtained a significance value of 0.000026 at a significance level of 0.05. Because the significance value is smaller than the significance level (0.000026 <0.05), it can be said that there is an effect of using Smartphone-Based Phyphox on Practicum in improving students' creative thinking skills.

The test for improving learning outcomes was reviewed from the N-gain difference between pretest scores and posttest scores in experimental and control classes. Pretest data was taken before treatment while posttest data was taken after treatment. N-Gain Score After calculating the N-Gain score test, it was found that the average percentage value of N-Gain Score for the experimental class (using Smartphone-Based Phyphox in Practicum) was 61.62%, including in the moderately effective category. While the average percentage value of N-Gain Score for the control class (without using Smartphone-Based Phyphox in Practicum) is 40.81%, including in the less effective category. Ngain result data for both classes can be seen in Table 5.

**Table 5.** N-gain data

| Groups | N | N-gain Pesrcent | Classification |
|---|---|---|---|
| Experiment | 25 | 61.62% | Effective enough |
| Control | 25 | 40.81% | Less effective |

Effect size analysis is carried out to obtain information about the magnitude of the effect of a variable on other variables, the magnitude of the difference or relationship that is free from the influence of sample size. data on the results of the effect size calculation can be seen in Table 6.

**Table 6.** The results of the effect size analysis.

| Groups | Average | Standard deviation | Effect size | Interpretation |
|---|---|---|---|---|
| Experiment | 43.68 | 7.6 | 1.4 | Large |
| Control | 27.81 | 10.9 | | |

Society today faces increasingly complex world challenges and learners are required to develop proficiency, skills and abilities as initial capital before plunging into society [4]. Information and communication technology (ICT) has the potential to provide various benefits for teachers and learners, including areas of shared learning, interactive, cooperative and collaborative learning opportunities [8]. Analysis after testing using the independent sample t-test test to determine the effect of treatment on different samples in the experimental and control classes obtained the price of tcount> ttable (3.727> 2.01), so it can be said that there is an effect of the use of Smartphone-Based Phyphox on Practicum in improving students' creative thinking skills. This is in line with research conducted by Andre Valerius et al, who said that the application of the use of the Phyphox application can have a good effect in physics learning [20]. Diperkuat oleh penelitian Ghazanfar yang menyatakan bahwa penggunaan yang berhubungan dengan belajar memiliki efek positif pada kinerja akademik [21].

The effectiveness of using smartphone-based Phyphox can be seen from the Ngain test. The results of the analysis showed that the experimental class Ngain percentage of 61.62% was included in the moderately effective category higher than the control class of 40.81% which was included in the less effective category. This is in accordance with research conducted by Kauwo et. al., which says that the Phyphox application is effectively used in free fall experiments as a learning medium [22].

## 4. Conclusion

Based on the results of hypothesis testing, it is concluded that the use of Smartphone-based Phyphox has an effect on improving students' creative thinking skills, so it can be used in the learning process.

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