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The Use of Direct Instruction Learning Model Assisted by Phyphox Application Media on Simple Harmonic Vibration Material Experiments

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Abstract

This study was designed to analyze the effect of using direct instruction model learning with the assistance of the Phyphox application media on simple harmonic vibration material experiments based on students' learning outcomes in terms of factual, conceptual, and procedural knowledge. This research method was a pre-experimental design using the one-group pretest-posttest design type. The samples for this research were the students of class X MIPA Al-Mustaqim who were studying for the 2021–2022 academic year. A saturated sampling technique was used to perform the sampling. The data collection technique for this study was a test consisting of thirteen multiple-choice questions and three essays. The data analysis technique used in this study was the Paired Sample T-Test. The data analysis findings showed that before being given treatment, the average score of factual knowledge was 39.20, conceptual knowledge was 47.60, and procedural knowledge was 44.00. After the treatment, the average score for factual knowledge was 68.80, conceptual knowledge was 67.97, and procedural knowledge was 67.00. The results of hypothesis testing using the paired sample t-test showed differences in the average learning outcomes before and after using the direct instruction learning model assisted by the Phyphox application media in terms of factual, conceptual, and procedural knowledge. Based on these findings, it was determined that the direct instruction learning model with the assistance of the Phyphox application was effective in learning to provide students with opportunities for the successful learning process, with a Cohen's effect size of 1.94 (classified as very high). The direct instruction model of learning with the assistance of the Phyphox application media can be used as input and a reference for teachers who struggle with low student achievement.

Keywords: Direct Instruction Model; Phyphox Application; Simple Harmonic Vibration

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INTRODUCTION

Learning physics is learning about numbers, mathematical theories, concepts, and the material that can be applied in real-world situations (Dani et al., 2017). In the study of physics, practical experience is emphasized (Windrayani et al., 2019). Therefore,

students must be provided with the opportunity to learn directly to develop their skills through the use of instructional media in order to comprehend the subject matter better.

Physics learning in the teaching and learning process is still dominated by the lecture method. The absence of adequate physics laboratory equipment, both in terms of quality and quantity, is one of the contributing factors. Inadequate laboratory equipment generates inaccurate data, so research cannot be conducted to develop new theories or concepts (Sarini, 2015). It is expected that using technology-based media-assisted learning strategies can improve factual, conceptual, and procedural learning outcomes while increasing student involvement in learning. One of the technology-based learning media is the Phyphox application.

Phyphox is one of the applications that utilizes multiple smartphone and laptop sensors as a basis for experimental observations (Bura et al., 2022; Kristiyani et al., 2020). The advantages of this application are that it is free, and the sensor output can generate or store data from previously conducted studies. Some Phyphox simulations are possible if the smartphone has the required sensors (Julianingsih et al., 2019). According to prior research, using this Phyphox application to process experimental data of calculating spring constants is considered effective and accurate (Julianingsih et al., 2019). However, the study's measurement results were flawed, so repeated experiments were carried out to ensure the accuracy of the data collected. This occurs when the smartphone "wobbles" on the other axis, altering the data obtained. Since the sensor detects all acceleration, it is advised to begin the experiment without rotating the smartphone (Staacks, 2017). The experiment to calculate the spring constant is nearly identical to the pendulum swing experiment, except that the experiment uses simpler equipment. Consequently, in this study, researchers conducted a simple pendulum swing experiment using the pendulum sensors available in the Phyphox application. The Phyphox application can also facilitate the recording and analysis of data required after the data has been collected, allowing students to focus more on doing the practicum without considering how to analyze the obtained data (Yasmini et al., 2021).

The direct instruction model is suitable and works effectively for teaching in this study. The direct instruction learning model was developed primarily to provide learning benefits that focus on systematic declarative and procedural knowledge and can be guided step by step (Kamsinah et al., 2016; Majid, 2013; Wicaksono et al., 2017). Declarative knowledge consists of comprehending facts, concepts, principles, and generalizations. By using this direct instruction model, physics learning for simple harmonic vibration material will be taught sequentially or systematically, starting from explaining simple harmonic vibration material and using the Phyphox application in conducting experiments on harmonic vibration material, followed by providing exercises instructions, monitoring progress, guiding students, providing personal instruction and independent practice. According to Majid (2013), the benefits of the direct instruction model include, among others: (1) Teachers can help students focus on what needs to be done using the material and information that has been provided to them; (2) Effective in large and small groups; (3) the most efficient method for providing specific knowledge and skills to students who have low learning outcomes; (4) Emphasizes the listening process in learning to assist those who fits this teaching method; (5) The difficulty of considering the gap between theory and actual observations of what is happening

may be prevalent in learning using the direct instruction model. Thus, this model allows students to focus on the task outcome rather than the process or procedure used to produce it.

The research on using direct instruction model learning supported by Phyphox application media is conducted based on the description explained. The variability observed in this study differs from that of previous studies. Previous research has used characteristics such as using experiential learning methodology to enhance the problem-solving skill and learning motivation of students. Using the direct instruction learning model, the researcher is interested in determining learning outcomes for students regarding factual, conceptual, and procedural knowledge.

METHOD

Pre-experimental design with a quantitative approach was used in this study. One type of research methodology used is the one group pretest-posttest design. This pretest and posttest research type is conducted in one group without a comparison group. This is done so that researchers can compare the effectiveness of the learning outcomes before and after treatment since learning outcomes can be compared with conditions before treatment and can be determined more accurately (Sugiyono, 2012). The learning outcomes of students in class X MIPA MAS Al-Mustaqim were examined in this study.

This study's sampling method is referred to as "saturated sampling." The saturated sampling technique employs every population member as a sample (Sugiyono, 2018). As research samples, 25 students were included in the total. The research data collection technique was a test with 13 multiple-choice questions and three essay questions representing factual, conceptual, and procedural knowledge. The processing of data for each aspect of knowledge was dependent on the results of the test given. The procedure is as follows:

1. Assessment of test results
   a. Scoring each aspect of knowledge in each student's test answer
   b. Converting the answer into a score
   c. Calculating the mean score for each aspect of knowledge
   d. Calculating the standard deviation
2. Prerequisite tests were initially conducted using the Kolmogorov-Smirnov test for normality, and the Levene Statistic test for homogeneity to compare learning outcomes before and after the treatment was given from the perspective of factual, conceptual, and procedural knowledge. After the prerequisite tests were met, the Paired Sample T-Test, with the assistance of SPSS, was used in hypothesis testing.
3. Using the effect size formula, the effectiveness of learning with the direct instruction model assisted by Phyphox application media in a simple harmonic vibration material experiment on students' learning outcomes in each area of knowledge was evaluated and classified as one of four different intensity levels: low, medium, high, or very high.

RESULT AND DISCUSSION

The research was conducted using a direct instruction learning model assisted by Phyphox application media. The learning syntax of this research is as follows:

1) Phase 1: Orientation

The teacher begins the learning process by outlining the lesson objectives, background information, and important subject matter. In this situation, the teacher explains the specific educational objectives before imparting knowledge to the students.

2) Phase 2: Presentation

The teacher progressively explains the material and displays a video demonstration of the skill. At this stage, students observe the demonstration of material about simple harmonic

vibrations carried out by the teacher using the Phyphox application media, recognize the characteristics, and identify the problems presented. Phyphox application display is shown in Figure 1.

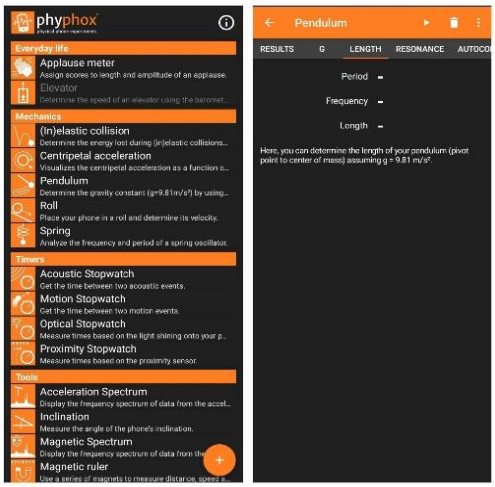

Figure 1 The display of Phyphox application

3) Phase 3: Structured practice

The teacher starts guiding the initial exercises by asking students to imitate the experiments conducted previously by the teacher. In this third stage, the teacher instructs students to attempt the initial simulation with guidance from the teacher.

4) Phase 4: Guided practice

The teacher observes the process of students' activities to determine the accuracy of their work while providing feedback. At this stage, the teacher instructs students to discuss and conduct experiments in groups while providing direction.

5) Phase 5: Independent practice

Teachers offer students strategies to practice independently so that they can be independent in everyday life, such as in the form of assignments or homework. In this phase, the teacher assigns students problem-solving assignments as further exercises.

Students learning outcomes before and after learning using the Direct Instruction model assisted by Phyphox application media are assessed in terms of factual, conceptual, and procedural knowledge

The learning outcomes achieved by students are listed in Table 1.

Table 1 The students learning outcomes

Knowledge	Before Treatment				After Treatment			
	Mean	SD	Min. Score	Max. Score	Mean	SD	Min. Score	Max. Score
Factual	39.20	13.52	20	80	68.80	13.01	60.00	100.00
Conceptual	47.60	13.56	10	78	67.97	9.81	49.00	84.00
Procedural	44.00	19.47	0	75	67.00	15.68	50.00	100.00
TOTAL	**43.60**	**15.52**	**10**	**78**	**67.92**	**12.84**	**53.00**	**94.67**

Based on Table 1, the average learning outcome score before learning on factual knowledge was 39.20, on conceptual knowledge it was 47.60, and on procedural knowledge, it was 44.00. Overall, the average score of learning outcomes was 43.60 before learning. Meanwhile, after the learning activity, the average score of the learning outcomes on factual knowledge was 68.80, conceptual knowledge was 67.97, and procedural knowledge was 67.00. The average score for learning outcomes was 67.92 overall.

The average difference in learning outcomes before and after learning using the Direct Instruction model assisted by Phyphox application media in terms of factual, conceptual, and procedural knowledge

Before conducting hypothesis testing, a normality test and homogeneity test were conducted. A normality test is conducted to determine whether the data spread is normal. The results of the normality test are listed in Table 2.

Table 2 Normality test result

One-Sample Kolmogorov-Smirnov Test			
		Before	**After**
N		25	25
Normal Parameters a,b	Mean	43.64	67.96
	Std. Deviation	12.533	9.418
Most Extreme Differences	Absolute	.151	.109
	Positive	.143	.109
	Negative	-.151	-.098
Test Statistic		.151	.109
Asymp. Sig. (2-tailed)		.142c	.200c

The significance value of using the direct instruction learning model with Phyphox application media is 0.142 > 0.05 before use and 0.200 > 0.05 after use, according to the normality test results. It can be concluded that the data on learning outcomes before and after learning using the direct instruction model assisted by Phyphox application media is normally distributed.

The homogeneity test is used to determine the similarity of the sample, i.e., whether or not the samples collected from the same population are uniform. The homogeneity test results are presented in Table 3.

Table 3 Homogeneity test result

Test of Homogeneity of Variances			
Levene Statistic	df1	df2	Sig.
1.432	1	48	0.237

The significance value of the homogeneity test is 0.237 > 0.05, so it can be concluded that the research sample is homogeneous. After conducting the necessary tests, hypothesis testing was then carried out. The hypothesis of this study was tested using the Paired Sample T-Test test formula. The hypothesis test results can be seen in Table 4.

Table 4 Hypothesis Testing Result

Paired Samples Test						
		Paired Differences		t	df	Sig. (2-tailed)
		Mean	Std. Deviation			
Factual Knowledge						
Pair 1	Before – After	29.60	14.28	10.36	24	.000
Conceptual Knowledge						
Pair 2	Before – After	20.32	10.95	9.28	24	.000
Procedural Knowledge						
Pair 3	Before – After	23.00	16.01	7.18	24	.000
TOTAL (Before – After)		**24.31**	**13.75**	**8.94**	**24**	**.000**

Based on Table 4, it was determined that there was a difference between the average learning outcomes from the perspective of factual, conceptual, and procedural knowledge before and after using the direct instruction learning model with Phyphox application media with the Sig. (2-tailed) value of 0.000 <

0.05, meaning that H0 is rejected and Ha is accepted.

The effectiveness of the Direct Instruction model assisted by Phyphox application media on students' learning outcomes in terms of factual, conceptual, and procedural knowledge

The effect of using the direct instruction learning model assisted by Phyphox application media on students' learning outcomes in terms of factual, conceptual, and procedural knowledge is determined using Cohen's effect size formula. The results of the effect size calculation are presented in Table 5.

Table 5 Effect size calculation result

Knowledge	Y_1	Y_2	S	ES
Factual	39.20	68.80	13.01	2.28
Conceptual	47.60	67.97	9.81	2.07
Procedural	44.00	67.00	15.68	1.47
TOTAL	**43.60**	**67.92**	**12.84**	**1.94**

The result of the Cohen's effect size calculation on factual knowledge is 2.28, conceptual knowledge is 2.07, and procedural knowledge is 1.47. Overall, the effect size value is 1.94. it can be concluded that the use of the direct instruction learning model with the assistance of Phyphox application media on simple harmonic vibration material experiments has a great influence that is classified as very high and effective for efficiently achieving learning objectives and enhancing student learning outcomes.

The first issue examines learning outcomes in terms of factual, conceptual, and procedural knowledge before using direct instruction model learning with the assistance of Phyphox application media and after using direct instruction model learning assisted by Phyphox application media. Based on the results of the student's answers, the initial ability (pretest) of students for simple harmonic vibration material is still relatively low before learning, as evidenced by a total average score of 43.60 out of the total ideal maximum average score of 100. This is because students do not completely comprehend the lesson in terms of factual, conceptual, and procedural knowledge, given their perception that physics lessons are challenging. After using the direct instruction learning model with the help of Phyphox application media, a posttest was administered to determine whether students' learning outcomes had improved. Since the average score on the posttest is 67.92, it can be stated that the average score has increased in comparison to the score on the pretest. Students are better able to learn when they are assisted in acquiring well-structured, progressive, and procedural declarative knowledge. Therefore, the increase between pretest and posttest scores is related to the theory associated with the use of direct learning models (Trianto, 2015).

The average score of learning outcomes shows that the use of direct instruction model learning assisted by Phyphox application media is very beneficial for enhancing learning outcomes. This is due to the fact that implementing the model and media has enabled students to achieve better learning outcomes when compared to other methods. Improved learning outcomes are closely related to learning using the direct instruction model with the aid of Phyphox application media as a media tool that can make learning conditions interesting in order to produce positive learning outcomes. Although it is teacher-centered, the direct instruction learning model assisted by Phyphox application media can cover more material and facilitate learning because it

emphasises teacher instructions more, making it easier for students to comprehend simple harmonic vibration material in terms of factual, conceptual, and procedural knowledge. In addition, the use of media in the classroom can trigger new desires and interests, inspire learning activities, and even psychologically impact students, all of which will significantly increase the effectiveness of the teaching and learning process today (Supardi et al., 2015). According to research cited in Sofiyah (2010), using direct instruction models in the learning process positively impacts students' learning outcomes.

The average difference in learning outcomes before and after using the Direct Instruction learning model assisted by Phyphox application media in terms of factual, conceptual, and procedural knowledge

In this study, the researchers discovered differences in learning outcomes in terms of factual, conceptual, and procedural knowledge before and after treatment with direct instruction model learning assisted by Phyphox application media. This data is derived from the Paired Sample T-Test results, which have a significance level of less than 0.05.

The application of the direct instruction learning model with the aid of Phyphox application media, which plays a role in students comprehending the concepts and skills of the subject being studied, causes a significant difference in learning outcomes. The application media called Phyphox promotes improved learning through simulation activities, encouraging students who are focused and convinced that learning is interesting and beneficial. When media are used in the classroom, students' comprehension can be enhanced, their motivation and interest in learning can be stimulated, and the learning process more engaging (Hade & Aswirna, 2019; Yasaroh et al., 2021). Utilizing Android applications to enhance student learning outcomes positively influences students' accomplishments (Putra et al., 2017).

The inseparability of each stage of the direct instruction learning model facilitated by Phyphox application media is the factor that causes learning outcomes improvement. The five phases of this learning process can help students become more effective learners. The various stages and phases include the following:

a. Orientation
   In this orientation phase, the teacher explains the learning objectives and the importance of learning simple harmonic vibration material while preparing students to participate in learning. This is intended to concentrate their attention on the teacher's explanation to achieve learning objectives. Achievement of learning objectives is one of the determinants of teaching and learning success (Emda, 2018).
b. Presentation
   In the second phase, the teacher presents information on simple harmonic vibrations and introduces students to Phyphox application media. Students can be captivated by the demonstrations that are performed. In this case, the demonstration in question is a teaching method that shows how the process of something happens in order to provide students with experience through seeing, hearing, and being able to imitate the material provided (Nur, 2014).
c. Structure Practice
   In the third phase, the teacher distributes the student worksheet and gives students time and space to experiment with the Phyphox application. Afterwards, students conduct learning exercises under the direction of the teacher so that every student can comprehend the use of simulation more thoroughly and

effectively. This activity aims to enhance students' theoretical knowledge and practical skills while motivating them to attain the learning objectives (Suprihanto, 2001).

d. Guided Practice
   In the fourth phase, the teacher evaluates the performance of the student's work and provides feedback in the form of specific directions. With the aid of this activity, the teacher can determine the success level of the students and identify areas for improvement. The process of giving feedback provides benefits to both the teacher and the students. Feedback can aid in correcting or enhancing the achievement of learning outcomes (Silverius, 1991).
e. Independent Practice
   In the last phase, the teacher instructs the students to conduct further exercises on the Phyphox application and gives tasks as independent exercises to find three topics related to simple harmonic vibration material in terms of factual, conceptual, and procedural knowledge and answer these questions. This helps the students improve their learning outcomes because they are more likely to use simulations related to the material being studied and they will understand how to use the Phyphox application better. Since the students perform exercises while completing the tasks, the purpose of the tasks is to increase the student's learning outcomes. As a result, students experience in learning existing subjects can be more thoroughly integrated (Roestiyah, 2012).

The effectiveness of learning using the Direct Instruction model with the aid of Phyphox application media on student learning outcomes in terms of factual, conceptual, and procedural knowledge

In this study, learning using the direct instruction model helped the students become more familiar with simple harmonic vibration experimental material in class X MIPA Al-Mustaqim. This is related to research conducted by Arianti et al. (2016), which reveals that a direct learning model with virtual simulations can assist students in gaining a deeper understanding of concepts.

According to Sofiana (2021), the direct learning model is better than indirect learning (online) because it enables students to gain a more active understanding of physics topics, enhancing their motivation, interest, and learning outcomes. The direct instruction model can be utilized effectively to rapidly disseminate a large amount of knowledge to all students while teaching specific ideas, concepts, and skills to students who have not yet attained the minimum completeness criteria. These and other advantages contribute to the effectiveness of this learning model (Lefudin, 2017).

CONCLUSION

The results of research findings and data analysis show that before using direct instruction model learning with the assistance of Phyphox application media, students obtained learning outcomes with an overall average value of 43.60. Meanwhile, after the use of direct instruction model learning assisted by Phyphox application media, students obtained learning outcomes with an aggregate mean value of 67.92. Based on the overall total value of learning outcomes, it can be concluded that the learning outcomes of students in terms of factual, conceptual, and procedural knowledge have increased after the use of learning with direct instruction models assisted by Phyphox application media.

The research findings also show a difference in the average learning outcomes before and after the use of direct instruction model learning with the

assistance of Phyphox application media with a significance value of 0.000 <0.05 in terms of factual, conceptual, and procedural knowledge. Moreover, it is also found that using direct instruction model learning with the aid of Phyphox application media is effective in providing students with opportunities for success in the learning process, with the overall effect size value of 1.94 (classified as very high).

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