Physics mobile learning with scaffolding approach in simple harmonic motion to improve student learning independence

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Abstract. A study has been conducted that applies physics mobile learning with a scaffolding approach. The purpose of this study was to determine the level of student learning independence as the effect of the use of physics mobile learning with the scaffolding approach. This research uses pre- experimental with one group Pretest-Postest design. The research subjects used were students of MAN 3 Yogyakarta class X IPA 1 as a modeling class of 32 people and X IPA 4 as an implementation class as many as 30 people. Subjects were selected by purposive sampling technique. Data for learning independence obtained through questionnaires and observation. Quantitative and qualitative analysis techniques are used to evaluate research data. The results showed that (1) The use of physics mobile learning with the scaffolding approach can improve student learning independence. (2) Student learning independence is in high and very high categories for modeling class and implementation class.
Keyword: *physics mobile learning, scaffolding approach, learning independence*

1. Introduction

Industrial Revolution 4.0 is known as the era of technological disruption and the digital revolution. One of the movements launched by the government in responding to industry 4.0 is the new literacy movement. The literacy movement is focused on three main literacies namely, 1) digital literacy, 2) technological literacy, and 3) human literacy [1]. The perceived ease of digital technology is efficiency in terms of service as well as the use of online systems allowing a wider range of connections [2]. Technology-based learning is also a recommended learning method [3]. Several studies have also shown the advantages of using technology in learning such as being able to develop positive attitudes towards technology based learning [4], improving critical thinking skills and divergent thinking skills of students [5].

Students experience dependence on others, especially teachers because they assume that teachers are the only source of knowledge so that learning independence is not properly trained. Lack of independence of learning among students is related to unfavorable study habits that are not durable and only learn after approaching the exam, ditching, cheating, and looking for leaked exam questions. Learning independence will be realized if students have control over personal awareness, motivation, competence, and skills that will be achieved [6]. Students who can learn independently have greater potential to achieve high academic achievement because they can identify and choose their problems, plan activities, and submit results at the end of the activity [7]. Learning independence that is owned by students makes it able to make decisions in the learning process so that it can account for the decisions taken [8].

Simple harmonious motion is one of physics material that is closely related to daily life but is often considered difficult by students. One of them is that students still experience confusion about the relationship between the mass, the length of the rope and the pendulum period [9]. The majority of students do not relate concepts that have been learned in simple harmonic motion to the problem presented. Students find it difficult to identify the parameters needed to solve simple harmonic motion problems [10].

How to convey physics learning in class affects the quality of learning. Teacher involvement in creating participatory culture during learning plays an important role in conceptual interpretations of students', analyzing problem-solving abilities and abilities and in the reconstruction of thinking [11]. The teacher needs to be aware of the difficulties and mistakes faced by students and take the right approach. One approach that can be used is scaffolding. In learning activities, scaffolding provides temporary assistance from the teacher to students then reduces it little by little. The goal is that students can achieve higher abilities and skills. Assistance will be removed when students have achieved these abilities independently without assistance [12]. Scaffolding requires problem-solving skills in solving problems, can be done in discussions, providing teaching materials and designing assignments [13]. The approach scaffolding can also increase motivation student thus encouraging student learning independence [14].

The use of appropriate learning media is highly recommended in the learning process. The concept of science is difficult to understand when explained verbally so that the use of media to provide a concrete picture and visualize concepts is important [15]. One effort to improve the quality of the learning process in class is by developing learning media [16]. The main function of learning media is as a tool that also influences the learning climate, conditions, and environment that are arranged and created by the teacher [17]. The use of computer-based media and associated with mobile devices can improve the understanding abilities of students and teachers [18].

Mobile learning produces educational methods that are far more diverse and innovative. The integration of mobile learning media with Scaffolding can overcome the problems faced by students in the learning process. Scaffolding combined with mobile learning emphasizes the importance of supporting interaction in the learning process. The combination of learning media and the scaffolding approach produces physics mobile learning using the scaffolding approach. Therefore, this study aims to look at the effect of physics mobile learning with a scaffolding approach to simple harmonious motion materials to improve learning independence. The material was chosen because it is closely related to daily life but the majority of students cannot associate the concepts that have been learned with the problems presented.

2. Research method

This type of research is an pre-experiment. The purpose is to find out the effect of physics mobile learning with a scaffolding approach in simple harmonious motion materials to improve student learning independence. The subject were students of class X MAN 3 Yogyakarta in the 2018/2019 school year. The sampling technique used in the study was purposive sampling. Students selected as research subjects have not yet studied simple harmonious motion. The subjects consisted of 32 students of class X IPA 1 as a modeling class and 30 students of Class X IPA 4 as an implementation class. The modeling class is conducted by researcher using physics mobile learning with scaffolding approach. The implementation class is conducted by teacher of physics subject using the same device like modelling class. The form of research is pre-experimental with one group pretest-posttest research design as shown in table 1.

Table 1. Research design

O_1	X	O_2

Explanation:
O_1 : Pretest questionnaire of learning independence
O_2 : Posttest questionnaire of learning independence
X : Using physics mobile learning with a scaffolding approach

The study began with: (1) pre-research (observation of learning in class); (2) formulating research problems obtained from pre-research results; (3) making learning tools in the form of lesson plans (RPP), student worksheets, and physics mobile learning media on simple harmonic motion; (4) making research instruments; (5) validating learning tools and research instruments; and (6) revising learning tools and research instruments. The learning implementation plan is developed by integrating three levels of scaffolding, namely 1) environmental provisions, 2) explaining, reviewing, and restructuring and 3) developing conceptual thinking [19]. Indicators of learning independence that will be used in this study are shown in table 2 [20].

Table 2. Indicators of learning independence

No	Indicators
1	Convidence
2	Problem Solving
3	Responsible
4	Initiative
5	Discipline

Environmental provisions are carried out by conditioning the class consisting of asking students for readiness in learning, providing motivation and apperception, and arranging student seats based on each group. The level of explaining, reviewing, and restructuring in the form of activities to explain the basic concepts of simple harmonious motion using the media physics mobile learning. In the media, there are instructions for use, basic competencies, material, example questions, student worksheet, and practice questions so that students understand more. In the next stage, students are given the task of working on student worksheet. Student worksheet contains experimental video observation activities contained in physics mobile learning and answers discussion questions. The teacher's role is to provide assistance and guidance so students can complete the given task. Then, the last stage is developing conceptual thinking. At this level, the teacher together with students concludes simple harmonious motion.

Learning tools and instruments that have been developed are then tested for validity. Validity testing uses the opinion of experts (expert judgment). Validity was tested by two expert lecturers. The results of the validity testing show that the learning tools and research instruments are feasible to be used in the excellent category. The next stage is the implementation of research that includes pretest activities, implementation of learning using physics mobile learning with the approach scaffolding to simple harmonic motion material and provide a post-test. The study ended with analyzing the research data, drawing conclusions, and compiling articles. Data is collected by using a questionnaire for pretest and posttest and observation sheets during learning activities take place. Learning independence questionnaire data were analyzed with descriptive statistics and test t-paired using SPSS. The data using the learning independence observation sheet is calculated by calculating the scores obtained by students and then determining the criteria for learning independence based on the values obtained. Determination of the criteria of student learning independence using a scale of 4 is shown in table 3 [21]. With the X value is the score obtained by students, X_i is the ideal average value that can be determined by adding up the maximum score and ideal minimum score then divided by two. Whereas SB_i is the ideal standard deviation value which can be determined by the difference from the ideal maximum score with the ideal minimum score then divided by six.

Table 3. Level of criteria for student learning independence

Intervals of learning independence	Category
$X \geq X_i + 1.0$ SDi	Very High
$X_i + 1.0$ SDi $> X \geq X_i$	High
$X_i > X \geq X_i - 1.0$ SDi	Low
$X_i < X_i - 1.0$ SDi	Very Low

3. Results and Discussion

3.1 Result in Modeling Class

Modeling class is done in class X IPA 1 where the implementation of learning tools used by researcher is using physics mobile learning with the scaffolding approach. The results of measuring students' learning independence in the modeling class that grades obtained from the pretest and posttest using a questionnaire which then obtained an average value for each test as descriptive analysis material. The results of the descriptive statistical analysis are shown in table 4.

Table 4. Descriptive statistics of student learning independence

	N	Mean	Std. Deviation	Min.	Max.
pre_test	32	67.91	5.687	59	82
post_test	32	75.81	6.473	65	90

Descriptive statistics show the average value of the pre-test students' learning independence of 67.91, while the average value for the posttest of 75.81. These results indicate that there is an increase in student learning independence, but to be more certain that the data will be analyzed using the t-paired test. The frequency distribution of answers shows 1 student whose posttest questionnaire value is smaller than pretest. A total of 29 students have higher posttest scores than pretest, and 2 students have the same posttest and pretest scores. Normality test is carried out to find out data normally distributed. The results are shown in table 5.

Tabel 5. Tests of Normality Shapiro-Wilk

	Statistic	df	Sig.
Pretest	0.957	32	0.229
Posttest	0.978	32	0.727

The results of the normality test using SPSS assistance in the pretest obtained a significance value of 0.229 and a posttest of 0.727. This shows that the significance value of the pretest and posttest student learning independence > 0.05, so the data is normally distributed. T-Paired test results are shown in table 6.

Table 6. Paired t - test result

		t	df	Sig. (2-tailed)
Learning Independence	Pretest - PostTest	-7.360	31	0.000

Statistical tests using t-paired showed that α was 0.00. The relative error used is 5% or 0.05. Because the significance value of the T-Paired is smaller than the relative error, or it can be written that 0.00

<0.05 so that it can be concluded that there is a significant increase in the learning independence of the modeling class before and after using physics mobile learning with the scaffolding approach on simple harmonic motion material.

3.2 Results in implementation class

Implementation class is carried out by physics subject teachers in class X IPA 4 using the same tools as the modeling class. Before implementing the teacher first observes how to use media and learning tools carried out by students in the modeling class. The results of measuring students' learning independence in the Implementation class obtained from the pretest and posttest using a questionnaire are shown in table 7.

Table 7. Descriptive statistics of student learning independence

	N	Mean	Std. Deviation	Min.	Max.
Pretest	30	66.63	4.930	58	78
Posttest	30	75.80	7.425	63	97

Descriptive statistics show the average value of the pre-test student learning independence of 66.63, while the average value for the posttest was 75.80. These results indicate that there is an increase in student learning independence, but to be more certain that the data will be analyzed using the t-paired test. The frequency of independence of student learning shows that all students have posttest scores higher than pretest. Normality test is carried out to find out data normally distributed. The results are shown in table 8.

Table 8. Tests of Normality Shapiro Wilk

	Statistic	Df	Sig.
Pre_test	0.950	30	0.168
Post_test	0.940	30	0.089

The results of the normality test using the help of SPSS on the pretest obtained a significance value of 0.168 and a posttest of 0.089. This shows that the significance value of the pretest and posttest student learning independence > 0.05, so the data is normally distributed. T-paired test can be done because the data has a normal distribution. T-paired test results are shown in table 9.

Table 9. Paired t-test result

		t	df	Sig. (2-tailed)
Learning Independence	Pre_test - Post-Test	-8.086	29	0.000

Statistical tests using t-paired showed that α was 0.00. The relative error used is 5% or 0.05. Because the significance value of the t-paired is smaller than the relative error, or it can be written that 0.00 < 0.05 so that it can be concluded that there is a significant increase in the independence of student learning in the implementation class before and after learning using physics mobile learning with the scaffolding approach on simple harmonic motion.

3.3 Observation result

The observation was carried out to determine the level of student learning independence in the modeling and implementation class when learning activities took place using physics mobile learning with a scaffolding approach. The results of observations in both classes are shown in figure 1.

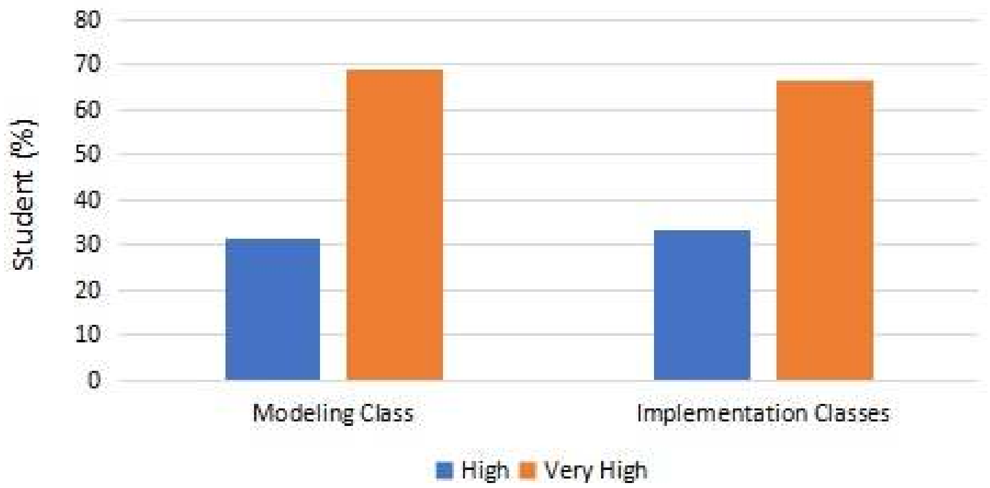

Figure 1. Observation results of student learning independence

Student learning independence in the modeling class is in line with the results obtained from the t-paired test results in which 31.25% of students have a high level and 68.75% have a very high level of learning independence. The implementation class has results that are not much different from the modeling class where 33.33% of students have a high level and 66.67% have a very high level of learning independence.

3.4 Discussion

The results showed that the use of physics mobile learning with scaffolding approach in-modeling class and implementation class can improve student learning independence. From the results of data analysis and observation, the level of student learning independence is almost the same. Increased learning independence can occur because both classes use the same learning device. In terms of the frequency of independence of student learning for the implementation class, it looks better than the modeling class. This is evidenced by the results of data analysis that all students of the implementation class have higher posttest results than pretest. In contrast to the modeling class where 2 students have the same pretest and posttest scores and 1 student has a pretest score higher than the posttest. This difference can occur because in modeling classes that do teaching our students where students are not familiar with new teachers and the introduction is only done in a day. This is inversely proportional to the implementation class where students are taught directly by the physics subject teacher who usually teaches in this class. The teacher knows the character and character of the students so that it is easier to organize learning. The teacher's understanding of student character influences the way of learning so that it is easier to understand [22].

In the use of Physics Mobile Learning with the Scaffolding approach, students are given the task to work on student worksheet in groups and carried out independently, then discussed in class and presented. The teacher will assist (scaffolding) and reduce it slowly so students can be more active in implementing problem-solving and foster an attitude of initiative in students in solving problems. In the scaffolding approach students are encouraged to learn through their active involvement [23]. Giving this task fosters a sense of responsibility to the group to complete the task. Students are also required to be disciplined in the presence of assignments like this. This treatment raises curiosity and questions in students' minds, so they try to find answers to what they think. They feel the need to learn without being told to learn so that students' confidence will grow. Scaffolding supports various teachings, one of which is independent learning [24]. Scaffolding helps students engage in decision making, manage investigations, problem-solving processes, and encourage students to articulate their thoughts and reflect on their learning [25].

The use of physics mobile learning learning media influences student learning independence. In the media, some videos and animations help students understand concepts better. There are examples of questions and discussions arranged to facilitate students in understanding the questions given. The question exercises are also prepared in the media created to give more opportunities for students to practice their understanding of the concept of simple harmonious motion. So that students' dependence on teachers can be reduced, and students can be more active in solving the problems faced. Assignments of learning assignments to be carried out independently, interesting learning and support from the design of learning activities that allow students to arrange their learning sequences can improve student learning independence [26]. The use of instructional media can increase student learning independence [27]. This is in line with research Sidin [23] learning material in the form of multimedia can provide benefits, which makes it easier to capture information. Multimedia technology can be able to develop students' imagination, creativity, and emotions in a better direction.

4. Conclusion

This research presents the implementation of physics mobile learning with a scaffolding approach to simple harmonic motion to improve student learning independence. Based on the results of research that has been done shows that (1) The use of physics mobile learning with the scaffolding approach can improve student learning independence. (2) Student learning independence is in high and very high categories for modeling class and implementation class. These results prove that physic mobile learning with scaffolding approach is effectively used to improve student learning independence.

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