The Effectiveness of the Problem-Based Learning Model Using Android-Based Learning Application

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Abstract. The development of industry 4.0 era demands that education for 21st-century skills is not enough, but must consider management of learning in social aspects and virtual learning. Smartphones can be used as mobile learning in learning to support the industry 4.0 era. This research explains the effectiveness of the problem-based learning model using an android-based learning application on EFI service subjects. This type of research is quasi-experimental with a population of students of class XI TKR SMK Perindustrian Yogyakarta totaling 54 students. Samples were taken randomly with each class amounting to 27 students and found in the XI TKR A class as the student control class and XI TKR B class as the experimental class. The data collection instrument used is a multiple-choice test. The data analysis technique uses descriptive, prerequisite tests using the normality test and homogeneity test, while the hypothetical test uses the t-test. The results showed that the problem-based learning model using an android-based learning application was effectively applied to EFI service subjects. Therefore, this learning model needs to be applied to a similar subject or other schools

Keywords: *PBL Model, Android-Based Learning Application, EFI Service*

1 Introduction

Vocational school is one of the formal secondary education institutions that aim to increase intelligence, knowledge, personality, noble character, and students' skills to be independent, so that they can improve their quality of life [1]. Vocational schools are basically as providers of skilled workers for the needs of the industrial and business world. The development of skilled workers must be balanced with the current alignment of technological developments.

Indonesia has experienced the impact of the development of industry 4.0 where this era was born officially in Germany in 2011. The development of industry 4.0 was marked by the occurrence of online integration to increase productivity. The development of the industry 4.0 demands that education for 21st-century skills alone is not enough, but must consider learning management in social aspects and virtual learning [2].

Although Industry 4.0 has been started since 2015, Indonesia, especially in the field of education, is still far behind in its application. As an illustration, in the SMK Perindustrian Yogyakarta in learning activities is still found with the application of conventional learning models, especially in EFI Service subjects. The conventional learning model is teacher-centered learning in the form of lectures and demonstrations. With conventional learning,

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students are placed as learning objects that act as passive recipients of information, so that it seems one-way [3]. The impact of the use of conventional learning models is the low student learning outcomes in EFI service subjects, namely from 56 students there are 30 students who score below the minimum completeness criteria.

The learning process in Vocational Schools should consider learning experiences. Learning experience gained is related to the application of work competencies in daily life (real word). In the selection of learning models for Vocational Schools, they can integrate with the principles of a scientific approach by using the PBL model [4]. By using the PBL model, students will be confronted with a problem then followed by a student-centered search for information. This learning model is very potential to develop students' independence through meaningful problem-solving.

As supporting industry 4.0, in the learning process in addition to using PBL, smartphones can be used as android mobile learning [5] [6]. The Android-Based Learning Application as a learning resource or reference in solving problems. This is based on consideration because it can be accessed anywhere and anytime provided the internet network is available. The utilization of internet technology is expected to prepare students in facing industry 4.0 challenges.

1.1. Problem-Based Learning (PBL) Model

The PBL model requires students to think critically in solving problems independently. The process of problem-solving is done collaboratively and adapted to life with various alternative solutions [7] [8] [9]. PBL model is an innovation in learning because with this learning model students' abilities are truly optimized through systematic group or teamwork processes, so students can empower their students to hone, test, and develop their thinking skills on an ongoing basis. The using of the PBL model at SMK Muhammadiyah Prambanan Sleman was more effective than the using of the direct teaching model [10].

The PBL model is a learning model in which there is a series of activities carried out either in groups or individually in solving problems related to the real world that require students to think, communicate, seek and solve problems by thinking scientifically, and involving students to play an active role in the problem-solving process. The use of the PBL model combined with information media literacy can be used to enhance students' conceptual comprehension [11].

The syntax PBL model consists of 5 stages: (1) Orienting students to the problem, (2) Organizing students to research, (3) Assisting independent and group investigations, (4) Developing and presenting the work, and (5) analyze and evaluate the problem-solving process [12].

1.2. Android-Based Learning Application

Android is an operating system for gadget devices that very popular in the community, it is friendly and easy to use [13]. Android users in Indonesia accounted for 93.22%, the remaining 5.52% IOS users and 0.12% Windows users [14]. Android is distributed in two ways, first, which gets full support from Google or Google Mail Service (GMS) and second, that distributed without direct support from Google or Open Handset Distribution [15].

The application used in running the Android operating system is in the form of an APK format that is installed on a gadget device [16]. The application is useful for running gadget devices. The application used in research is aimed at finding material information via the internet.

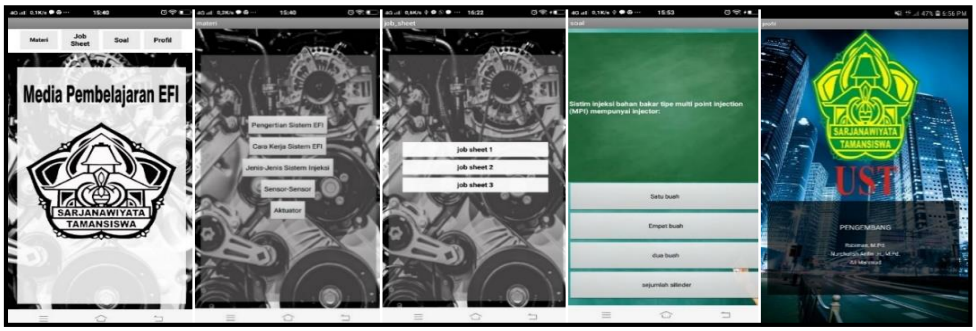

Fig.1. Android-Based Learning Application used in EFI service subjects

Figure 1 is an android application display that is used in learning PBL. The display includes product start design, screen title, screen material, screen job sheet, screen problem, and screen profile. This android application is integrated with the internet so students can easily access it anywhere and anytime.

Android-Based Learning Application can be used as mobile learning which is part of electronic learning or called e-learning. This application as a combination of cloud computing and e-learning becomes a source that can be accessed anytime and anywhere, making it easier to find information and interactions, so that it supports effective learning without the limitations of space and time [17] [18]. Technically mobile learning is personal learning that connects students with the internet using gadgets [19].

2 Method

This type of research uses a quasi-experimental design with Nonequivalent Control Group Design as follows:

Table 1. Research design

Classes	*Pre-test*	Treatment	*Post-test*
Experiment	O_1	X	O_2
Control	O_3	-	O_4

Information:

X : treatment using the PBL model

\- : without treatment or treatment with conventional models

O_1 : Pre-Test Results of the experimental class

O_2 : Post-Test Results of the experimental class

O_3 : Pre-Test Results of the control class

O_4 : Post-Test Results of the control class

The research was conducted at the SMK Perindustrian Yogyakarta with the population being class XI TKR students in the 2018/2019 school year, totaling 54 students. Cluster Random Sampling is used to determine the sample found students XI TKR A as a control class and students XI TKR B as an experimental class with each class totaling 27 students.

Data collection uses a pre-test conducted at the beginning to find out the balance of the ability of students. While the post-test is a test conducted at the end to measure learning outcomes in the experimental class and the control class.

The Validation was conducted, and the pre-test instrument results from 22 valid items with the reliability of 0.789 (high category), while the validation results of the post-test instrument obtained 22 valid items with the reliability 0.768 (high category).

Internal validity control is used to anticipate the possibilities that affect the learning outcomes so that learning outcomes in this study are really influenced by the results of the study as follows: 1). History; 2) Maturity; 3) Statistical regression; 4) Pre-test; 5). Lost in Experiments; and 6). Measuring Instrument.

Descriptive data analysis techniques used to determine the differences of student learning outcomes in class XI TKR SMK Perindustrian Yogyakarta EFI Service Subjects through the t-test results of the pre-test and post-test. Test requirements for the analysis are measured using tests of normality and homogeneity.

3 Result and Discussion

The Balance Test is conducted to determine the students' initial abilities before the treatment is applied. The balance test data description can be seen as follows:

Table 2. Pre-test description results

No	Classes	Students	Me	Mo	Var	Min	Max	Mean	SD
1	Experiment	27	68,2	68,2	130,85	50	86,4	68,7	11,44
2	Control	27	68,2	72,7	129,5	50	86,4	68,4	11,38

After the description of the pre-test results is then performed prerequisite test data analysis. The analysis of prerequisite test results can be seen as follows:

Table 3. Prerequisite test results of pre-test data

No	Normality Test			Homogeneity Test		
	Classes	Sig	Conclusion	Data	Sig	Information
1	Experiment	0,200	Normal	Pre-test	0,674	Homogen
2	Control	0,097	Normal			

Normality test from the pre-test achievement of the control class and the experimental class resulted in sig value> 0.05, it can be concluded that members of the group are normally distributed. The homogeneity test of the pre-test achievement of this study is known to be a significant value of 0.674 greater than 0.05 (sig> 0.05) that concluded if the data in this study have a homogeneous variance. After the data analysis requirements are fulfilled, it can be done an analysis of the balance test. Table 4 showing the balance test data analysis results can be seen as follows:

Table 4. Balance test results of pre-test data

Classes	Average	t_{count}	P
Pre-Test Experiment Class	68,688	0,109	0,914
Pre-Test Control Class	68,350		

The learning outcomes average of the experiment class was 68.668 and the Learning outcomes average of the control class was 68.350. Table 4 shown that t_{count} was 0.109 with a significance of 0.914 and while ttable was 1.675 at the significance level of 0.914. Then the $t_{count} < t_{table}$ (0.109 <1.675) and the significance value is more than 0.05 (P = 0.914> 0.05).

Finally Based on data at table 4 can be concluded that in EFI service subjects of class XI TKR SMK Perindustrian Yogyakarta, the prior knowledge of the control group and the experiment group students are equal. Furthermore, experiments will be carried out by being given a different teaching model, the experimental group will be taught using the PBL model using an android-based learning application while the control class taught using conventional learning models. Table 5 shows the results of the treatment.

Table 5. Post-test description results

No	Classes	Students	Me	Mo	Var	Min	Max	Mean	SD
1	Experiment	27	77,3	77,3	94,71	63,6	95,5	78,5	9,73
2	Control	27	72,7	72,7	100,89	54,5	90,9	72,6	10,04

After the description of the post-test results is then performed prerequisite test data analysis. The analysis of prerequisite test results can be seen in table 6.

Table 6. Prerequisite test results of post-test data

No	Normality Test			Homogeneity Test		
	Classes	Sig		Data	Sig	Information
1	Eksperimen	0,200	Normal	Post-Test	0,782	Homogen
2	Kontrol	0,155	Normal			

Based on the result of the normality test from the post-test achievement of the control class and the experimental class resulted in sig value> 0.05, it can be concluded that members of the group are normally distributed. The homogeneity test of the post-test achievement of this study is known to be a significant value of 0.782 greater than 0.05 (sig> 0.05) that concluded if the members in this study have a homogeneous variance. After the data analysis requirements are fulfilled, the hypothesis test can be performed, the results of the hypothesis test can be seen as follows:

Table 7. Hypothesis test results

Classes	Average	t_{count}	P
Post-Test Experiment Class	78,45	2,189	0,02
Post-Test Control Class	72,56		

The achievement average of the control class is 72.56 and the experiment class is 78.45, so it can be concluded that the average learning outcomes of the experimental group are 5.89 more than the control class from the table, it is known that t_{count} is 2,189 with a significance of 0.02 and a table of 1.674 at a significance level of 0.02. So the value of $t_{count} > t_{table}$ (2.189> 1.674) and the significance value is less than 0.05 (P = 0.02 <0.05).

Based on the upper description can be concluded that the learning outcomes of students taught using the PBL model are more effective if compared to classes taught with conventional learning models. Using the PBL model, the teacher presents real problems in daily life (real word) according to the competencies and the material being taught. Students

formulate hypotheses and solve problems that have been given by teachers in groups. In the process of learning as a group, there will be mutually supportive interactions between students of each of their respective groups, thereby fostering motivation to learn in students [20]. The use of PBL model can help students develop thinking skills to solve through a variety of real or simulated conditions and becoming independent and autonomous students.

The results also show that by using the PBL model students actively conduct questions or respond to questions in the context of critical thinking and work together to solve the problems given by the teacher. PBL model has several advantages, namely: 1) relate to situations with student-centered so that learning is more meaningful; 2) Encourage students to learn actively; 3) Encourage other students as an interdisciplinary learning approach; 4) Provide opportunities for students to choose what to learn and how to study it; 5) Encourage the achievement of collaborative learning; and 6). Believed to be able to improve the quality of education [9].

The use of Android-Based Learning Applications as mobile learning which is part of e-learning learning adjusts students' interests, intelligence, and learning styles [21] [22]. Along with the development of industrial technology 4.0 demands that 21st-century skills alone are not enough, but must consider management of learning in social aspects and virtual learning [2]. With Android-Based Learning Application students are given the freedom to search for sources of information or problem-solving material related to the material. The use of this application is expected to familiarize students to maximize internet technology in learning so that it is not only used as entertainment.

In contrast to using conventional learning models consisting of lectures and demonstrations, student learning outcomes are lower because in these learning activities are usually more active to the teacher. The use of lectures has several weaknesses, namely: 1) Easy to be verbalism (understanding words); 2) The visual becomes a loss, the big auditive (hears) accepts it; 3) When always used and too long, boring; 4) The teacher concludes that students understand and are interested in the lecture, this is very difficult; and 5) Causing students to be passive [23]. While the weaknesses of the demonstration model are: 1) Teacher skills are required specifically for the implementation of demonstrations to be effective; 2) Good facilities are needed; and 3) Good planning preparation is needed so that sufficient time is available [24].

Based on the weaknesses of conventional learning models that have been revealed, it can be concluded that this learning model is not recommended to be applied. Teachers should apply the PBL model because this learning model is part of curriculum development and teaching systems that simultaneously solve problem strategies and the basics of knowledge and skills by placing students in an active role as solving everyday problems that are not well structured [25]. That is, the PBL model is a learning model that is suitable for the industry 4.0 era.

4 Conclusion

Based on the results of the discussion it can be concluded that the PBL model by using the Android-Based Learning Application is effectively applied in EFI service subjects for class XI TKR students in SMK Perindustrian Yogyakarta. By applying PBL model students become actively learning to solve problems related to the material in the learning process. With Android-Based Learning Application, students can learn to use technology and internet

networks to find sources of information in order to solve problems related to the material in the learning process.

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