Project-based learning model with real object in vocational school learning

Nurcholish Arifin Handoyono¹, Suparmin², Samidjo³ and Arif Bintoro Johan⁴, Suyitno⁵
⁴¹²³ Mechanical Engineering Education Vocational Study Program, Faculty of Teacher Training and Education, Universitas Sarjanawiyata Tamansiswa Yogyakarta, Indonesia
⁵³ Department of Automotive Engineering Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Purworejo, Indonesia

Correspondence Author email: arifin@ustjogja.ac.id

Abstract. Learning in vocational schools is not enough just teacher-centered because the material presented does not only cover cognitive aspects, but also the affective and psychomotor aspects. In fact, there are still many teachers who use conventional modes, including learning technical drawings, so that student learning outcomes are low. The purpose of this research was to determine the learning outcomes of the PjBL model using real object media better than conventional methods in technical drawing subjects. A quasi-experiment was used in research with a nonequivalent control group design. The study population was 42 students of class X TP. The sampling technique uses cluster sampling. Class X TP1 as a control class with 23 students and Class X TP2 as an experimental class with 19 students. Data collection techniques using test techniques. The research instrument was a test sheet. The data analysis used t-test analysis with prerequisite tests, namely the normality test and homogeneity test. Based on testing the hypothesis test, it was concluded that the PjBL model with real objects gives better learning outcomes compared to conventional methods of learning outcomes of technical drawings.

1. Introduction

Education has an important role in creating a reliable and skilled generation of the nation. To overcome the low quality of education can be done using formal education, namely Vocational Schools. Vocational schools, is an educational institution prepared to improve the quality of human resources. The vocational school aims to produce professional workers in both the business and industrial world by providing formal education with special training patterns [1].

The goals of vocational schools can be achieved if the learning process is carried out well. One indicator of the success of learning in vocational schools is seen in student learning outcomes. Learning outcomes can be interpreted as the final results of students as decision-making levels of students' knowledge during the learning process which is expressed in terms of values [2]. Learning outcomes are a success of the learning process and the education system has developed that students can master and understand the subject matter described by the teacher during the learning process.

Based on observations and interviews with technical drawing subject teachers, there are several reasons for the low learning outcomes of class X TP SMK Muhammadiyah 3 Yogyakarta. This is
evidenced by some students who have not met the learning completeness standards set by the school, which is 63.6%. The minimum completeness criteria for productive subjects is 75. This problem is caused by ineffective and less attractive learning media applied to students during the lesson. Teachers convey subject matter still using conventional learning media, such as using a blackboard and still using the lecture method even though they have used visual media but student motivation and learning are still quite low.

In learning using the lecture method, there are weaknesses, namely that the material controlled by students is limited and it is difficult to ensure that all students understand the material described by the teacher [3]. If the learning process is still teacher-centered, then some students don’t pay attention to the teacher, chat by themselves, and even play cellphones. This kind of learning process is more appropriate for subjects that require a lot of theory, such as mathematics or Indonesian, while technical drawing requires more practice than theory. To meet learning outcomes according to the cognitive, affective, and psychomotor domains, the teacher’s role should be as a guide, motivator, and facilitator. There are many solutions so that teachers can improve student learning outcomes, including in the selection of learning models and learning media [4].

In developing a learning model, teachers are required to use a model that is by the student’s condition [5]. The use of learning models is expected to facilitate the learning process. As a learning model that requires students to be more active, it is hoped that it can help students to be creative in understanding and reading pictures. The teacher must consider the model used so that it gives good results. To improve student learning outcomes can be done by applying the Project-Based Learning (PjBL) model. PjBL is a learning model in the form of presenting the subject matter to students from a project which is then reviewed from various relevant views so that students get comprehensive and meaningful problem-solving. The use of the PjBL model is a concept of production-based education developed in vocational schools so that it can equip graduates’ competencies according to standards in their respective fields. The advantages of the PjBL model in learning are that students are motivated to do work, students are more active in solving complex problems [6] [7].

Learning media is a very important factor in improving the quality and effectiveness of learning. The use of instructional media is intended to facilitate teachers in the learning process. Each media has different effectiveness. Therefore, the teacher must consider the suitability of the media used. Teachers must select and develop media so that it produces good and relevant results. The teacher’s efforts to improve student learning outcomes can be done in various ways, one of which is by using real object learning media. Real objects as a medium for conveying information in the form of objects or objects that are real or original and have not undergone significant changes [8].

The use of real objects in the application of the PjBL model in learning engineering drawings can help students’ imagination with the perception of 3D space into 2D. As a learning model that activates the sense of sight, of course in learning students will be helped in being creative to be able to understand and read cut images. It is expected that the application of the PjBL model with real objects will be effective in solving the problem of low student learning outcomes of technical drawing. Real objects are more effective as media because they relate to the original objects that will be projected for project creation. Real objects do not have to be held in the classroom, but students can see objects directly. The advantage of real objects is that students get real experience to solve their problems related to the subject matter [9]. This statement is consistent with conditions in the field that vocational school graduates in industry measure and draw more real objects.

1.1. Project-based learning (PjBL)

PjBL is part of a learning model that aims to provide students with experiences in learning to be involved in project work. In learning, students will be involved in learning knowledge and skills through the development of a product. The result of PjBL learning is that students produce products. The project-based learning process refers to the activities of students in designing, planning, and implementing a project that results in something in the form of a product, publication, and or presentation that can be exhibited [10].
The main components in the PjBL model are (1) project design, (2) project implementation, and (3) project evaluation [11]. Project design is the basic project design that is determined by the teacher as content in learning. Project implementation is the process of teachers carrying out learning with students which consist of important stages, namely: (1) project introduction, (2) subproject implementation, and (3) subproject integration. Project evaluation is an assessment of the learning process and student learning outcomes.

The steps in implementing the PPA model are: (1) Get An Idea, (2) Design The Project, (3) Tune The Project, (4) Do The Project, and (5) Exhibit The Project (Patton, 2012). Some of the advantages of the teacher apply the PjBL model, namely: (1) Building student communication skills and eliminating cultural boundaries and obtaining a consensus, (2) Building student inquiry skills and fostering student curiosity about surrounding phenomena, (3) Students learn to adjust the time of the assignment obtained because students know their work is related to their group of friends within a certain deadline, and (4) Build a complete student understanding of how something happens and not only around the student environment [12].

1.2. Real object
Media is an intermediary or messenger in a communication. In learning, media is a physical tool that presents useful messages to stimulate students to learn. With the media, the objectives of learning can be achieved by students [13]. Media plays a very important role in learning to provide experience and meaning for student learning, this will make it easier for teachers to encourage students to achieve their learning goals. Media classification is classified into 4 groups, namely audio media, visual media, audiovisual media, and various media [14].

Realia media is the media of real objects or living things as the conveyor of information [15]. Realia media can be in the form of real objects as a tool that is easy to use in learning because no preparation is needed other than to use it immediately. Real objects are widely used in learning in introducing new subjects to students. With real objects, it can provide a real picture to students who previously were only presented abstractly in the form of words or only visually.

The use of real objects in learning has several advantages, namely: students are allowed to study material and experiences in real situations, and students can practice their skills using sensory organs [16]. Real objects can provide direct experience to students. Real objects in their use do not require much preparation. Real objects can attract students' motivation and enthusiasm for learning.

1.3. Results of learning technical drawings
Learning outcomes are assessments that aim to determine the achievement of learning targets as a measure of how far students can reach their learning goals [17]. Learning outcomes are the abilities possessed by students after going through the learning process [18]. Learning outcomes are student abilities obtained after participating in learning which is used as benchmarks for learning targets. Learning outcomes, in this case, are the students' abilities obtained from learning technical drawings.

Image is a communication tool to convey one's intentions and goals. As a forwarder of information, images must contain information accurately and objectively. Image information that cannot be conveyed by verbal language must be adequately represented with symbols. The quality of an image depends on the talent of the image designer. The important objectives in making a drawing have the following criteria: (1) accuracy, (2) speed, (3) legibility, (4) neatness, (5) accuracy, (6) validity, (7) truth, (8) equality, (9) alignment, and (10) straightness, to achieve predetermined competency values and provide a general picture to students [19]. Based on the syllabus of SMK Muhammadiyah 3 Yogyakarta, the competencies that must be achieved in learning technical drawings are pictorial and orthogonal projections.
2. Method

This type of research is quasi-experimental where the control class uses conventional methods and the experimental class uses the PjBL model with real object media. The experimental design used is nonequivalent control are as follows:

| Class     | Pretest | Treatment | Postest |
|-----------|---------|-----------|---------|
| Experiment| O₁      | X         | O₂      |
| Control   | O₃      | -         | O₄      |

Keterangan:
O₁: pretest scores  
O₂: posttest scores  
X: treatment of the PjBL model with real objects  
O₃: pretest scores  
O₄: posttest scores  
-: Treatment using conventional methods

The population in the study were students of class X TP SMK Muhammadiyah 3 Yogyakarta, namely class X TP 1 and X TP 2, the total number of which was 42 students. Sampling was based on a predetermined population area from 2 classes, namely class X TP1 (control class) and class X TP2 (experimental class) with a total of 42 students. The research instrument used a test to measure the results of learning engineering drawings. The validity of the instrument used face validity with expert judgment involving two drawing technique experts, namely Ir. Drs. Suparmin M.T., (lecturer at PVTM FKIP UST) and Irman Tri Buana, M.Eng (teacher of SMK Muhammadiyah 3 Yogyakarta). The data analysis technique used descriptive analysis and the prerequisite analysis test (normality test and homogeneity test). Hypothesis testing using the t-test.

3. Result and discussion

The pretest was carried out to test the balance, namely to ensure that the initial abilities of the experimental and control class students were the same. Description of the pretest data are as follows:

| No | Class  | total | Me  | Mo  | Var  | Min | Max  | Mean | SD   |
|----|--------|-------|-----|-----|------|-----|------|------|------|
| 1  | Experiment | 19    | 68  | 63  | 26.91| 60  | 80   | 68.157| 5.188|
| 2  | Control   | 23    | 65  | 68  | 25.17| 60  | 77   | 66.087| 5.017|

After the data description is carried out, the prerequisite test is carried out. The prerequisite test results are as follows:

| No | Class     | Normality test | Homogeneity Test |
|----|-----------|----------------|------------------|
|    | Class     | Sig  | Conclusion | Data | Sig  | Conclusion |
| 1  | Experiment| 0.200| Normal     | Pre-test | 0.815| Homogenous |
| 2  | Control   | 0.058| Normal     |       |      |            |

The normality test of the two classes has a sig> 0.05, meaning that the pretest data is normally distributed. The homogeneity test has a significant result of 0.815> 0.05, meaning that the variance of the pretest data is homogeneous. After the test requirements are met, a balance test is carried out. The
balance test using the t-test obtained tcount of 1.311 < ttable of 2.021 and a significance level of 0.197 > 0.05. These results give the conclusion that student learning outcomes in both classes are the same. This means that it can be assumed that the abilities of the two classes are the same so that the results of the posttest later are purely the impact of different treatments and not the result of the conditions of the students who were previously different.

Based on the results of the balance test, experiments can be carried out by being given different treatments. The control class uses conventional learning methods while the experimental class uses the PjBL model with real objects. The description of the posttest data is as follows:

| No | Class    | Total | Me  | Mo  | Var    | Min | Max   | Mean  | SD   |
|----|----------|-------|-----|-----|--------|-----|-------|-------|------|
| 1  | Experiment | 19    | 80  | 82  | 16,69  | 74  | 95,5  | 90    | 4,085|
| 2  | Control   | 23    | 76  | 75  | 10,13  | 70  | 90,9  | 84    | 3,182|

After the data description is carried out, the prerequisite test is carried out. The results of the data analysis prerequisite test are as follows:

| No | Class    | Normality test | Homogeneity Test |
|----|----------|----------------|------------------|
|    |          | Sig            | Conclusion      | Data | Sig | Conclusion |
| 1  | Experiment | 0,200          | Normal          | Pre-test | 0,246 | Homogenous |
| 2  | Control   | 0,183          | Normal          |       |     |            |

Both classes have normality test results of Sig> 0.05, meaning that the posttest data is normally distributed. The homogeneity test has a significant result of 0.246 > 0.05, meaning that the variance of the posttest data is homogeneous. After the test requirements are met, then the hypothesis test is carried out. Hypothesis testing using a t-test obtained tcount of 2.618 > 1.683 and a significance level of 0.006 < 0.05. These results conclude that the student learning outcomes in the experimental class are better than the control class.

These results prove that using the PjBL model with real object media will get better learning outcomes when compared to conventional methods such as using lectures. This result is consistent with other relevant research, namely the PjBL model can improve motivation and learning outcomes in advanced welding courses [20]. Then the results of other studies state that there has been an increase in learning outcomes using the PjBL model in PDTO subjects [21]. Then the results of other research also state that learning with real objects will be more effective when compared to conventional learning [22].

The delivery of material delivered using the PjBL model is more effective than delivery using conventional methods such as lectures and demonstrations. This is because the PjBL model can adapt to conditions in the Mechanical Engineering Department in class X SMK Muhammadiyah 3 Yogyakarta. Providing projects related to life that is close to students, it can train students to be able to think critically. The learning step begins by asking essential questions about the American projection. Students are given assignments by the teacher to carry out learning activities by taking topics according to the realities of daily life, namely the hammer as a daily tooling tool according to the student's field as well as a learning medium.

Planning is done collaboratively between teachers and students. Planning contains rules related to project work and knowing the tools and materials that help complete the project. Teachers and students jointly arrange a schedule for completing the project. This process consists of the completion of a scheduled project, the teacher guiding students during the completion of the project. The teacher's main task is to monitor students while the project is completed. Monitoring is done by facilitating students in each process, in other words, the teacher acts as a mentor. At the end of the lesson, reflect on the results
of the project that has been implemented. In this process, students are asked to express their feelings during the completion of the project for the teacher to evaluate the project-based learning process which is carried out by discussing between teachers and students, so that new findings are found in completion.

The use of the PjBL model provides benefits to improve learning outcomes by the results of the data processing above. Some of the advantages of PjBL are increasing: (1) motivation; (2) problem-solving skills; (3) collaboration; (4) ability to manage resources; and (5) management [23]. Then the use of real objects provides the maximum possible opportunity for students to study material in real situations and provides experiences to maximize their respective sensory tools [24]. With the advantages of the PjBL Model and real object media, it can be applied to learning by engaging with each other. Learning media can make it easier for students to access information due to limited senses, space, and time [25]. The use of real object media in PjBL learning will help students' imagination with the perception of three-dimensional space into two dimensions which will then be applied to the project.

The use of the PjBL model with real object media is very appropriate to be applied to learning technical drawings by the concept of production-based education developed in vocational schools. In contrast to the use of conventional methods which are not appropriate for learning in vocational schools, especially in technical drawing learning because this method is only suitable as a transfer of cognitive aspects, whereas in vocational school learning there are 3 aspects of knowledge transfer that need to be mastered, namely cognitive, respective, and psychomotor. Learning using the lecture and demonstration method does not provide opportunities for students to optimize their abilities. Based on the post-test results obtained, it shows that the control class is lower than the experimental class, and there are only a few students who are active in the class. Meanwhile, other students are not used to actively asking questions or responding to questions. This is because the way the teacher teaches and the delivery of material in the control group seems boring and unattractive so that the enthusiasm of students to pay attention to what is explained by the teacher is also reduced. Conventional methods are not recommended to be used for learning because they have several weaknesses: (1) limited material; (2) less attractive presentation; (3) Difficulty knowing students who already understand or not after being explained; and (4) tedious methods [26]. This is by the research results, namely with conventional methods the learning outcomes will be lower than using active learning models such as using the PjBL model.

The choice of learning model is a very important factor in determining the achievement of learning objectives. The considerations that must be considered in choosing a learning model are: (1) the learning objectives to be achieved; (2) Availability of teaching materials and materials; (3) Students' abilities; and; (4) Others are non-technical [27]. Therefore, learning in the 21st century is more suitable to use student-oriented active learning [28]. The results recommend using the PjBL model with project-oriented learning objectives.

4. Conclusion
Learning outcomes using the PjBL model with Real Objects are higher than conventional learning methods in the subject of technical drawing for class X students of SMK Muhammadiyah 3 Yogyakarta. The PjBL model can be applied to 21st-century learning as a student-oriented active learning model with project-oriented learning objectives.

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