Project-based learning to improve learning outcomes and 21st century skills of vocational high school students competency of light vehicle engineering skills

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Abstract. In Indonesia, hard skills are more developed by 90% and 21st century skills are only 10% while the world of work demands students has 21st century skills. Project-based learning is a learning model that makes the project to integrate and gather knowledge based on an experience that learners have in real life. This study used experiments because researchers wanted to find out the differences between the group of students who were taught using project-based learning and the method of lecturing students on the competency of light vehicle engineering skills. This study uses pseudo-experimental design using a 3 x 2 factorial design. The group of students used in the study is class X learners of SMKN Bali Mandara Light Vehicle Engineering competency. It consists one control class and one experiment class. Pretests for knowing the initial ability of high, medium, low and post tests are used to find out the learning outcomes of students. Hypothetical test of study results among the group of students taught using a project-based learning model using a lecture model with a coefficient value of F calculated at 4.174 and a signification value of 0.002, so that H0 in reject and H1 are accepted. Testing of the 21st century skills hypothesis between the group of students taught using the project-based learning model and using the lecture model showed an F coefficient value of 4.050 and a significant value of 0.003, resulting in H0 being rejected.

1. Introduction

The most dominant thing in determining success is not only technical skills or hard skills, but also the prowess of the 21st century skills [1]. 21st century skills are skills that combines creativity, innovation, communication and real experience in the context of learning [2]. In the educational process, students need to have an important role in learning activities [3]. The more being involved in the learning process, the better the achievement will be. The upside is that it happens in the world of education. Indonesia happens more developed hard skills by 90% and 21st century skills is only 10% while the world of work demands students has 21st century skills [4]. The learning model which is able to develop 21st century skills is project-based learning [5]. Project-based learning is a learning model which makes the project integrate and gather knowledge based on an experience that students have while doing activities in real time [6] and [7].
Based on the above problems and the importance of students in efforts to improve the competency skills of expertise that is offset by 21st century skills, it is necessary to conduct this research in an effort to develop the skills of students both from the competency of expertise and the skills of the 21st century skills reviewed from the implementation of project-based learning.

2. Method
This research used experiments because researchers wanted to find out if there were differences between the group of students who were taught using project-based learning and the method of lecture students on the competency of light vehicle engineering skills. Therefore, this research focuses on the learning outcomes and developing 21st century skills in students. This study uses pseudo-experimental design using a 3 x 2 factorial design. The study uses two classes. In this study, the group of students used in the research was students of class X competency skills of Light Vehicle Engineering SMKN Bali Mandara. It consists of one control class and one experiment class. Students requested to create learning video as the purpose of project-based learning. Pretests for knowing the prior knowledge of high, medium, low and post tests are used to find out the learning outcomes of students. The design of the study can be seen from Table 1.

| Prior Knowledge | Project-Based Learning (X1,1) | Lecture Learning (X1,2) |
|-----------------|-------------------------------|-------------------------|
| High (X2,1)     | Y1.Y2                         | Y1.Y2                   |
| Medium (X2,2)   | Y1.Y2                         | Y1.Y2                   |
| Low (X2,3)      | Y1.Y2                         | Y1.Y2                   |

3. Result and discussion
In this study, there are six hypotheses that need to be tested simultaneously using SPSS 22.0 for Windows with the Two Ways ANOVA analysis method. Data that has passed prerequisite tests such as normality tests and homogeneity tests is able to be continued for hypothesis tests. In the conclusion in the hypothesis test, if the significance value is < 0.05, then H0 is rejected. In the withdrawal of hypothetical conclusions by reading the signification value and F count listed in Table 2 and Table 3.
Table 2. Two Ways ANOVA Analysis Results from Learners’ Learning Outcomes

| Source                        | Type III Sum of Squares | df | Mean Square | F    | Sig. |
|-------------------------------|-------------------------|----|-------------|-----|------|
| Corrected Model               | 3700.267²               | 41 | 90.250      | 4.075| .001 |
| Intercept                     | 212206.849              | 1  | 212206.849  | 9581.246| .000 |
| Prior_Knowledge               | 1878.846                | 8  | 234.856     | 10.604| .000 |
| PjBL_Lecture                  | 1386.848                | 15 | 92.457      | 4.174 | .002 |
| Prior_Knowledge * PjBL_Lecture| 940.285                | 18 | 52.238      | 2.359 | .038 |
| Error                         | 398.667                 | 18 | 22.148      |      |      |
| Total                         | 364164.000              | 60 |             |      |      |
| Corrected Total               | 4098.933                | 59 |             |      |      |

a. R Squared = .903 (Adjusted R Squared = .681)

Source: Output SPSS 22.0 For Windows

Table 3. Two Ways ANOVA analysis of 21st Century Skills

| Source                        | Type III Sum of Squares | df | Mean Square | F    | Sig. |
|-------------------------------|-------------------------|----|-------------|-----|------|
| Corrected Model               | 1845.100²               | 29 | 63.624      | 3.311| .001 |
| Intercept                     | 665944.613              | 1  | 665944.613  | 34654.333| .000 |
| Prior_Knowledge               | 391.057                 | 7  | 55.865      | 2.907 | .019 |
| PjBL_Lecture                  | 544.845                 | 7  | 77.835      | 4.050 | .003 |
| Prior_Knowledge * PjBL_Lecture| 933.022                | 15 | 62.201      | 3.237 | .003 |
| Error                         | 576.500                 | 30 | 19.217      |      |      |
| Total                         | 1158348.000             | 60 |             |      |      |
| Corrected Total               | 2421.600                | 59 |             |      |      |

a. R Squared = .762 (Adjusted R Squared = .532)

Source: Output SPSS 22.0 For Windows

3.1. Learning outcomes between groups of students taught using project-based learning models and those using lecture models

Based on Table 2, the hypothesis test of study results between the group of students taught using the project-based learning model and those using the lecture model with a coefficient value of F calculates 4.174 and the signification value of 0.002 so that H₀ is rejected. Students learning outcomes of project-based learning shows a mean value of 79.27 and the lecture model shows a mean value of 76.83. Project-based learning has better learning results compared to the lecture model. Project-based learning which students are able to understand the materials is able to be based on the experience and cognitive of discussion friends so it is able to to improve the learning outcomes of students. Project-based learning activities can improve learning outcomes because students are able to exchange thoughts and add to the experience gained from other students [8] and [9].

3.2. Interaction between learning models and prior knowledge of student learning outcomes

Based on Table 2, the interaction between the learning model and the prior knowledge of the students’ learning results shows a coefficient value of F calculated at 2.359 and shows a signification value of 0.038 until H₀ is rejected. The interaction of project-based learning and prior knowledge of student
learning outcomes a mean value of 78.70 and the lecture model shows a mean value of 76.83. Project-based learning can improve the learning outcomes of students with different initial abilities. Understanding a material concept with different initial abilities is able to be shaped by the direct experience of students visually [10] and [11]. Project-based learning requires students to complete a material-related project so students are able to understand the material more deeply when working on a project with different initial capabilities.

3.3. 21st century skills among groups of students taught using project-based learning models and those using lecture models

Based on Table 3, the results of the 21st century skills hypothesis test between the group of students taught using the project-based learning model using the lecture model shows a coefficient value of F count 4.050 and a significant value of 0.003, so H0 is rejected. 21st century skills with the project-based learning shows a mean value of 139.97 and lecture model shows a mean value of 137.63. In project completion, students are able to channel their creativity, problem solving skills, teamwork, and thinking skills. After the students have finished the project, they are required to present their project in front of the class as a form of improve their communication skills. Project-based learning is more focused on students in planning, implementing, and evaluating projects that suit real-life students by working with other students [12]; [13]; [14]; and [15].

3.4. 21st century skills of students with high, medium, and low prior knowledge

Based on Table 3, the results of the 21st century skills hypothesis testing of a group of students with different prior knowledge shows the results of the F coefficient count at 2.907 and the significance value of 0.019 so it can be concluded that H0 is rejected. Project-based learning with high prior knowledge in 21st century skills shows a mean value of 139.25. medium shows a mean value of 140.80. low shows a mean value of 137.67. The lecture model with high prior knowledge in 21st century skills shows a mean value of 137.63. medium shows a mean value of 137.39. low showed a mean value of 138.75. Students who already have good prior knowledge are faster at understanding a concept in learning because students only need to delve into their prior knowledge and connect with new restraints in shaping a concept of 21st century skills. Students who have high and moderate prior knowledge get a higher average when compared to students who have low prior knowledge because students are easier to form if they already have good prior knowledge so it is easy to form a understanding of the concept of students [16].

3.5. Interaction between learning models and prior knowledge of 21st century skills

Based on Table 3, the results of hypothetical testing of the interaction between the learning model and the prior knowledge of 21st century skills show the results of the F coefficient of 3.237 and the significant value of 0.003, so it can be concluded that H0 is rejected. The interaction of project-based learning and prior knowledge of 21st century skills shows a mean value of 139.97. The lecture model shows a mean value of 137.63. Therefore, project-based learning is able to stimulate students to work together, bring up creative ideas, stimulate how to think in problem solving, and dare to perform and communicate in front of other students. Project-based learning can improve the skills of the 21st century with the prior knowledge of different students by encouraging students to think, work together to find ideas, seek information, exchange ideas, and present those ideas to others [17]; [18]; [19]; and [20].

4. Conclusion

Based on the research that has been done and discussed the results of the study, this study concludes that the application of project-based learning model is able to improve the 21st century skills of students with different prior knowledge and able to improve students' learning outcomes. The timing in
implementing project-based learning has a big effect on the results to be achieved. The longer the application of project-based learning, the better the results will be. The significance of teachers and schools is able to facilitate students in project-based learning to prepare students when going into the business world and industry.

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