

Project-Based Teaching Materials in Increasing the Knowledge and Skills of Vocational High School Students

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ARTICLE INFO

Article history:

Received July 21, 2023

Revised July 27, 2023

Accepted November 30, 2023

Available online December 25, 2023

Kata Kunci:

Pengembangan Bahan Ajar,
Project-based Learning, Analisis
Efektivitas

Keywords:

Teaching Material Development,
Project-based Learning,
Effectiveness Analysis



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ABSTRAK

Banyaknya siswa yang lulus dengan pengetahuan dan keterampilan yang kurang memadai sehingga diperlukan metode pembelajaran yang lebih efektif. Agar kompetensi siswa dapat meningkat, perlu dikembangkan modul pembelajaran berbasis proyek. Adapun tujuan dari studi ini adalah untuk mengukur efektivitas bahan ajar berbasis proyek dalam mata pelajaran pemeliharaan mesin kendaraan ringan. Jenis penelitian yang digunakan adalah berupa penelitian eksperimen dengan pendekatan kuantitatif. Subjek dalam penelitian ini adalah 30 orang siswa digunakan untuk menguji efektivitas bahan ajar yang dikembangkan. Uji coba dilakukan untuk mengumpulkan data kuantitatif berupa tes hasil belajar dan tes keterampilan dalam rangka mendapatkan nilai efektivitas produk. Teknik analisis data menggunakan one shot case study ditinjau dari ketuntasan klasikal nilai hasil belajar pengetahuan dan keterampilan. Hasil penelitian menunjukkan bahwa penggunaan bahan ajar berbasis proyek yang dikembangkan efektif digunakan. Hal ini didasarkan terjadinya peningkatan pengetahuan dan keterampilan siswa setelah menggunakan bahan ajar tersebut. Kesimpulannya, uji efektivitas yang telah dilakukan dalam pengembangan bahan ajar pemeliharaan mesin kendaraan ringan yang digunakan oleh siswa dapat meningkatkan pengetahuan serta keterampilan dalam proses pembelajaran. Hal ini dapat membantu siswa dalam memahami konsep pemeliharaan mesin kendaraan ringan secara praktis dan terintegrasi dengan pengetahuan yang telah dipelajari sebelumnya.

ABSTRACT

Many students graduate with inadequate knowledge and skills, so more effective learning methods are needed. So that student competency can increase, project-based learning modules must be developed. This study aims to measure the effectiveness of project-based teaching materials on light vehicle engine maintenance. The type of research used is experimental research with a quantitative approach. The subjects in this research were 30 students used to test the effectiveness of the teaching materials developed. Trials are collected to collect quantitative data in the form of learning outcomes tests and skills tests to obtain product effectiveness scores. The data analysis technique uses a one-shot case study regarding the classical completeness of the value of knowledge and skills learning outcomes. The research results show that the use of project-based teaching materials is effective. This is based on increased students' knowledge and skills after using these teaching materials. In conclusion, the effectiveness test in developing teaching materials for light vehicle engine maintenance used by students can increase knowledge and skills in the learning process. This can help students practically understand the concept of light vehicle engine maintenance and integrate it with previously learned knowledge.

1. INTRODUCTION

Teaching materials are all forms of materials that contain learning materials that are used by teachers in the learning process during the learning and teaching process in class. Teaching materials can be in the form of written or non-written. Teaching materials are also learning materials that have been arranged systematically and are used by teachers and students in the learning process (Acosta, 2017; Ningrum et al., 2021; Xie & Derakhshan, 2021). Teaching materials that are prepared can display the full conditions of the competencies that will be mastered by students in learning activities. Using teaching

materials will enable students to learn competencies as a whole (Rahmayani et al., 2022; Silvana et al., 2021). Therefore skills are needed in developing teaching materials so that students have learning activities that are quite good in increasing their competence (Fonna et al., 2022; Meika et al., 2019). The positive impact caused by teaching materials for teachers is that they will have a lot of time in guiding students in the learning process and assisting students in providing knowledge from various kinds of reference sources because so far people have assumed that the source of knowledge is the teacher himself. Teaching materials are an external factor that is very useful for students in developing their knowledge (Farida et al., 2022; Hung et al., 2017). This teaching material can also strengthen student learning outcomes. Teaching materials must be present in the learning process because teaching materials are one of the complementary components of learning tools that must be prepared by teachers as educators (Khalil & Elkhider, 2016; Stockwell et al., 2015). Teaching materials must be designed completely in the sense that there are elements and learning resources that are following the characteristics of students so that they will affect the learning atmosphere which results in learning being more optimal (Risnawaty et al., 2021; Stockwell et al., 2015; Vahlia, 2017). Teaching materials are equipped with illustrations that can attract and produce a stimulus for students to use teaching materials as a source of learning.

On the other hand, there is a gap in the curriculum used in Vocational Schools and the existing needs in the industry related to light vehicle engine maintenance subjects. The large number of students who graduate with inadequate knowledge and skills so that a more effective learning method is needed in preparing students to become a reliable workforce, especially in the field of automotive engineering. This method is very useful in increasing student interest so that they can study well and can focus on digesting the material provided. Based on previous research, it was found that the use of project-based teaching materials can increase students' understanding of the material packaged in these teaching materials. However, it was found that there were differences in learning outcomes between students who were able to follow the material provided well and students who had difficulty understanding the material. Several studies that have been conducted found an increase in student motivation and interest in applying teaching materials, but it is necessary to pay more attention to the advantages and disadvantages of the approach used in applying these teaching materials. This can be found by analyzing student characteristics, especially in the light vehicle engine maintenance subject.

Based on the problems that have been stated, it is necessary to develop project-based teaching materials. The developed teaching materials are expected to improve student's learning skills in addition to increasing students' cognitive knowledge. The use of project-based teaching materials can help students improve and develop practical skills through activities with the direct experience provided (Rokhim et al., 2020; Santos et al., 2023). Students will be encouraged to be more active in learning with challenging project activities based on teaching materials that have integrated project-based learning (Dwi Saputra et al., 2022; Lasamahu et al., 2021). Students can make relevant decisions and can measure the level of student involvement based on the extent to which teaching materials increase student participation in learning. The fields studied in this course are very relevant to conditions in the world of work, especially in the automotive industry, for this reason providing teaching materials that have been developed can prepare students with the skills and knowledge by industry demands (Kusumawardani et al., 2018; Muslim et al., 2020). This means that this research activity can measure the extent to which the use of project-based teaching materials increases student readiness to face competition in the world of work later.

The application of technology and innovation provided in the process of developing teaching materials can improve students' experience in learning. This research activity will explore the potential of technology and innovation in learning, especially in the subject of maintenance of light vehicle engines. Innovations that arise in harmony will emerge with teaching materials that have been integrated with problem-based learning so that it encourages improvement in learning methods that are relevant to needs according to student characteristics and industry needs (Ariningsih et al., 2021; Hadi et al., 2017). Based on the problems that have been stated, it is necessary to develop project-based teaching materials. Project-based learning was chosen because it is to the characteristics of students and can make it easier for students to understand learning material. Project-based learning is learning that links the use of technology and implements it in everyday life problems in the form of assignments in the form of projects that lead to interactions between students and teachers (Sudiana & Sukmayasa, 2021; Wurdinger et al., 2020). This learning is innovative learning with the learning center being the students themselves (Baghoussi & Zoubida El Ouchdi, 2019; Zhang et al., 2022).

The function of the teacher or education in this learning activity is as a facilitator who will provide opportunities for students to construct learning activities (Mite et al., 2021; Rusmanto & Rukun, 2020). Aside from being a facilitator, educators such as teachers and lecturers must have good and professional competence, so that the learning process can be carried out optimally (Setiawan et al., 2020; Zancul et al., 2017). In the process of developing these teaching materials, it is necessary to pay attention to the

curriculum and industry needs related to the competencies learned by students and pay attention to the responses of students to the learning methods applied. It is hoped that the development of project-based teaching materials at SMKN 1 Lahat can be more effective in providing even better learning outcomes for students.

The development of project-based light vehicle engine maintenance teaching materials will provide a direct experience for students in the learning process, resulting in better and more innovative skills and knowledge. However, in the development of teaching materials, it is necessary to test the validity, practicality, and effectiveness tests. Validity testing serves to ensure that the product being developed is suitable for use (Abadi et al., 2017; Chen & Wei, 2022; Ko et al., 2021). The next step is a practicality test, in this step, the aim is that the products developed are practical for use by both teachers and students as well as practical use for educational institutions in need. The test carried out in the last section is an effectiveness test, the effectiveness test functions to find out whether the use of teaching materials that have been developed can increase students' insight into better material (N. P. W. P. Dewi & Agustika, 2020; Mexdadoris & Jama, 2020). This effectiveness test is a very important activity after conducting validity tests and practicality tests on the products being developed. The effectiveness test activity was carried out on the level of understanding of students who were given before and after being given treatment or learning with teaching materials that had been distributed (Cahyani et al., 2020; Paputungan et al., 2022). With this effectiveness test activity, it is hoped that more accurate data will be obtained in deciding to use appropriate learning methods in the realm of vocational high schools, especially the light vehicle engineering department at SMKN 1 Lahat.

The purpose of this research activity was to measure the value of the effectiveness of project-based teaching materials developed for the light vehicle engine maintenance subject at SMKN 1 Lahat. This effective test activity can contribute to the development of teaching materials in the future. The teaching materials in the form of developed modules are expected to be applied to the learning process, especially in the subject of maintenance of light vehicle engines and generally in each vocational school.

2. METHOD

This research used a quantitative approach in the form of experimental research. Experimental research aims to test ideas, both practices and procedures to determine whether the idea influences the results or dependent variable (Thyer, 2012). The research design used was a pretest posttest group design (Creswell, 2012). The research design is presented in Table 1.

Table 1. Pretest Posttest Group Design

Experimental Group	Pretest (O ₁)	Giving Treatment (X ₁)	Posttest 1 (O ₂)
Description: O ₁ : Preliminary measurements before intervention/Pretest; X ₁ : Treatment of transactional analysis counseling techniques to improve intercultural communication; O ₂ : Measurements after intervention			

This experimental research consists of two variables, namely Transactional analysis counseling as the independent variable, intercultural communication as the dependent variable. The sampling technique in this research is purposive sampling, namely sampling based on the researcher's judgment. Intercultural communication instrument data is analyzed descriptively and expressed by qualification levels. Qualification levels are categorized based on average scores, ideal mean (Mi), and ideal standard deviation (SDi). Qualification levels are categorized according to the guidelines listed in Table 2.

Table 2. Scoring Guidelines

No.	Scoring Category	Category
1	$Mi + 1,5 SD_i$	Very Good/Very High
2	$Mi + 0,5 \leq \bar{X} < Mi + 1,5 SD_i$	Good/High
3	$Mi - 0,5 \leq \bar{X} < Mi + 0,5 SD_i$	Enough
4	$Mi - 1,5 \leq \bar{X} < Mi - 0,5 SD_i$	Poor/Low
5	$< Mi - 1,5 SD_i$	Very Poor/Very Low

3. RESULT AND DISCUSSION

Result

The effectiveness test in development research using the ADDIE model aims to make the products that have been developed effectively in improving students' abilities both in terms of knowledge and skills. The effectiveness value is obtained during the implementation phase, where the implementation phase is carried out if the product has been declared valid and practical. The validity value is obtained from the value given by experts or experts who have experience in evaluating products in the form of modules. Input from the validator will be used to revise the product that has been developed before entering the trial phase to obtain practicality and product effectiveness values. The validity value that has been obtained in this product development is based on the results of validity tests from experts with a total average value of 86.56%, and after being interpreted, the product developed is in the valid category. The revision results obtained are in the form of adding coloring to the appearance of the module to make it more attractive and adding formative test answer keys which aim to get feedback for students in using the module.

The practicality test was obtained from teachers who teach in the light vehicle engineering department. For this to be realized, the teacher's response questionnaire was distributed during the implementation phase. The practicality value is the value used as the usability level of the product developed for teachers in the light vehicle engine maintenance subject. This practicality test was carried out by giving a practicality questionnaire or response questionnaire to the module given to the light vehicle engineering eye teacher at SMK N 1 Lahat. The practicality value of the teaching materials that have been developed is based on the teacher's response with an average value of 88.75% so it is declared very practical after the average percentage is interpreted in the practicality table.

After getting the validity and practicality values, the next step is to analyze the learning achievement test data to get cognitive values and student skills which aim to get the effectiveness of the product being developed. The activity carried out was a limited trial of 30 students majoring in light vehicle engineering at SMKN 1 Lahat. The value of effectiveness in terms of classical completeness tests of cognitive learning outcomes and skills using the one-shot case study analysis technique. Cognitive learning results are taken from the average value of students while doing 3 times the posttest after being given treatment. Student test results are compared with the KKM score that has been set, which is around 74 on a scale of 100. The tabulation results can be seen in [Table 3](#) regarding the average student post-test score.

Table 3. Posttest Average Scores Using the One Shot Case Study Design

Activity	N	Average	Standard Deviation
Post-test 1	30	74.56	6.34
Post-test 2		78.22	6.17
Post-test 3		82.56	9.70

Based on [Table 3](#), the results of the posttest using the one-shot case study analysis have increased, this can be seen clearly in [Figure 1](#) regarding the diagram of learning outcomes obtained from 3 posttest activities.



Figure 1. Posttest Results Diagram Using the One Shot Case Study Design

Based on [Figure 1](#), it can be seen that the average value of 3 times the posttest of students using the one-shot case study design has increased from posttest 1 to posttest 3. From the results of the final analysis, it is known that the average student learning outcome is 82.56. The results of the analysis of student learning outcomes tests obtained the lowest score was 56.67, the highest ranged from 93.33 so the average student learning outcomes test score on the cognitive aspect was 82.56 with a standard deviation of 9.70. The percentage of classical completeness in the limited test of 30 students was 86.67% with very high criteria. The results of the analysis of student learning outcomes tests on the skill aspect obtained data on learning outcomes with the lowest score of 70.28, and the highest score of 85.74 so the average obtained is 80.50 with a standard deviation of 4.47. The percentage of classical skills test completeness is 86.67% with very high criteria. It can be concluded that the value of the effectiveness of cognitive aspects and skills in products developed based on classical completeness criteria with very high criteria so that the products developed are effective for use.

Discussion

Based on the results of the research, it was found that the modules or project-based teaching materials developed were in the category of valid, practical, and effective. Instructional materials that have been integrated using a project-based learning approach are proven to be able to improve student learning outcomes both in terms of cognitive and in terms of students' learning skills. Active and collaborative learning can help students develop critical, creative thinking skills and be able to think reflectively ([N. L. E. K. Dewi et al., 2018](#); [Saad & Zainudin, 2022](#); [Syafri et al., 2022](#)). In addition, project-based teaching materials assist students in developing social skills such as collaboration with teams, communication activities, and being able to negotiate in the learning process ([Kataria et al., 2020](#); [Teresa et al., 2014](#)).

The findings contained in this study are that developing teaching materials using a project-based approach that is integrated into these teaching materials, will increase students' understanding of the light vehicle engine maintenance material as a whole because it is treated with more interesting content. The teaching materials developed are modules on the subject of maintenance of light vehicle engines which have been conducted in limited trials on students majoring in light vehicle engineering at SMKN 1 Lahat. Teaching materials developed with this project-based approach will make students more active in learning, and motivated to do new things because they are directly dealing with real conditions. Many studies have shown more positive results using this learning method. Previous research conducted shows that the use of project-based teaching materials will significantly improve student learning outcomes ([Aditama et al., 2022](#); [Albana, 2020](#); [Kokotsaki et al., 2016](#)), besides that according to previous studies shows that the use of project-based teaching materials will improve students' critical thinking skills ([Allanta & Puspita, 2021](#); [Kim & Tawfik, 2021](#); [Triningsih & Mawardi, 2020](#)). By using teaching materials that have been integrated with project-based learning can help students develop social skills. Research conducted shows that students will develop social and emotional skills in learning to use teaching materials that have been developed with a project-based learning approach ([Triningsih & Mawardi, 2020](#); [Zhylykybay et al., 2014](#)).

In line with research says that teaching materials that are well developed using a fairly good approach method, students will be active so that increased understanding of knowledge and skills possessed because the problems given are directly related to the conditions in the field ([Natalia & Jalinus, 2021](#); [Putra et al., 2022](#); [Syah et al., 2019](#)). In line with research, regarding the effectiveness of developing teaching materials, it was found that the development of innovative teaching materials will make students more open and creative in learning ([Hsin & Wu, 2023](#); [Mirah Setia Dewi et al., 2019](#); [Pursitasari et al., 2022](#)). On the other hand, there is a collaborative attitude found, of course, this is very meaningful for students. It is necessary to pay attention to other factors that might be able to develop teaching materials more optimally such as the availability of resources or support from the family to increase student success in learning. The involvement of parents in helping learning activities will also increase students' motivation to learning.

Overall, the study shows that developing project-based teaching materials is considered a learning method that will improve student learning outcomes. The use of these teaching materials can also assist students in gaining their understanding of social and emotional skills and being able to gain a better understanding of the learning material that has been provided. In addition, collaborative learning can help students develop critical thinking skills, and creative and social skills such as collaboration, communication, and negotiation activities ([Bergvall & Dyrvold, 2021](#); [Hendriana et al., 2019](#)). In skills or practicum activities, the use of project-based teaching materials must be prepared more intensively by the teacher including in the planning of the assignments given, the topics taken, and the selection of methods according to student characteristics.

However, the development of project-based teaching materials will provide benefits that are commensurate with the efforts that have been given by the teacher. The results of the effectiveness test can

provide insight into the strengths and weaknesses of the teaching materials that have been developed, as well as which parts need to be improved in increasing the effectiveness of these products. In addition to measuring the effectiveness of the use of teaching materials, this study can also deepen understanding of factors that can influence implementation such as administrative support, training activities for teachers, and the availability of resources that must be explored in understanding challenges and opportunities related to the use of teaching materials. Project-based teaching materials can also be integrated into other learning materials so that it will help students see the relationship between different concepts in the application of knowledge as a whole. Effectiveness testing can also provide benefits by providing evidence to stakeholders such as teachers, and policy makers by providing supporting information on the use of products as effective teaching materials. On the other hand, the results of this effectiveness test can be a source of information, especially for researchers and educational practitioners in developing learning strategies that are appropriate to the characteristics of students. It is recommended to be able to study the long-term effects of using the developed teaching materials.

This research activity implies that using project-based teaching materials will promote more effective learning. The results of the effectiveness test can provide empirical evidence that this test activity is effective in improving student learning outcomes. The results of this study can be used by teachers or educators who are relevant to the activities of this study in designing project-based teaching materials so that they can be used for students. Disclosure of effectiveness in the use of teaching materials can encourage the application of a more active and participatory learning approach, teachers can implement practical projects to improve students' critical thinking, collaborate, and can apply knowledge in real life. These findings will provide important input and form the basis for integrating project-based learning into the curriculum and can influence learning as a whole. This study will provide strength between educators and the world of work or industry so that students will be better prepared to face demands and competition after taking the education. Teachers and policymakers should consider the use of these teaching materials as an effective method of improving the quality of education.

The limitations in this research activity are due to the focus of the study on the subject of light vehicle engine maintenance in one school, it is necessary to have further research activities to explore other factors that might affect the results of the effectiveness of teaching materials developed in various learning contexts. Even more incentive attention must be given to the planning activities of the tasks given, the topics taken and the methods used to match the characteristics of students in learning activities.

4. CONCLUSION

The conclusion that can be drawn based on the results of the research that has been done is that project-based teaching materials about light vehicle engine maintenance are in the effective category. This is evidenced by the increased value of students' knowledge and skills based on the percentage of classical completeness that has been done after using these teaching materials. Project-based teaching materials developed can be used in the learning process to improve student learning outcomes. Students feel helped by the teaching materials that have been developed so that learning becomes more enjoyable. The existence of student characteristics analysis activities can determine the right approach so that it can be applied to optimal learning.

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