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Evaluation of the practicality of project-based learning implementation plan in light vehicle engine maintenance using ADDIE approach

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ABSTRACT

Light vehicle engine maintenance is an important subject in automotive vocational education. However, several problems need to be overcome, such as the lack of student involvement in learning, which creates a gap between theoretical and practical learning. To overcome this problem, a project-based learning implementation plan (LIP) was developed which has been proposed as an approach capable of integrating theory and practice, as well as increasing student involvement in learning. This research aims to evaluate the practicality of product development in the form of a project-based LIP on light vehicle engine maintenance. This study uses an R&D approach as well as the ADDIE model procedure. The subjects in this study were 5 experts who came from productive teachers. The instruments used are interview sheets for observation activities and instruments in the form of response questionnaires to obtain product practicality data. The analysis technique at the practicality criteria level uses a practicality value formula in percentage form. The research results have found that the practicality of the product implementation plan for project-based learning in light vehicle engine maintenance learning is based on teacher responses which have been analyzed so that it is stated in the convenient category. This study concludes that the project-based lesson plan developed has high practicality in learning light vehicle engine maintenance. Further research can test the effectiveness of project-based learning implementation plans on a larger scale by involving more students and educational institutions and integrating modern technologies such as augmented reality or virtual reality into the learning implementation plans.

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INTRODUCTION

Developing a learning implementation plan (LIP) is an important aspect of designing an effective and efficient learning process. LIP acts as a guide for teachers in planning and organizing learning according to the needs and characteristics of students (Kaliisa et al., 2023). This concerns the professionalism of a teacher before teaching must-have tools and planning in the learning process

(Setiawan et al., 2020). Teachers are required to get ready learning instruments such as in planning lesson plans. LIP has various elements such as learning objectives, learning strategies, learning materials, assessments, and the steps that will be carried out in the learning process (Johnson et al., 2020).

The development of a good lesson plan involves a deep understanding of learning objectives, student needs, and appropriate learning approaches and strategies. Well-structured and organized lesson plans provide clear directions to teachers and ensure that all aspects of learning are covered systematically (Audina & Harahap, 2022). The importance of developing a good lesson plan lies in its ability to optimize the learning process and achieve the desired results (Masmin, 2020). Quality lesson plans will enable teachers to teach effectively, facilitate student understanding, and encourage the development of student's skills and understanding of concepts (Wibawa, 2019). In addition, lesson plans can also help teachers face challenges in learning, such as accommodating individual student differences, paying attention to student learning styles, and integrating technology into the learning process (Widiasih, 2021). LIP which is well developed can be an effective tool for achieving compatibility between learning objectives and student needs, as well as ensuring that learning takes place in a directed and meaningful way.

Based on the results of observations in the field, precisely at State Vocational School 1 Lahat (SMKN 1 Lahat), during an interview with the head of the light vehicle engineering department, it was found that the learning tools, especially lesson plans, had been used for a long time and this was certainly no longer suitable for the current characteristics of students. The LIP used in learning light vehicle engine maintenance has never been updated and still uses the old format with the learning methods used in the LIP in a conventional context. Even though this subject is one of the obligatory subjects that proceeds to develop.

Light vehicle engine maintenance is an important subject in automotive vocational education. The main problems often faced are the lack of student involvement and the gap between theory and practice in learning light vehicle engine maintenance at SMK Negeri 1 Lahat. Lack of student involvement is a significant obstacle (Farrow et al., 2024; Issa & Khataibeh, 2021). Many students feel bored or unmotivated because the teaching methods tend to be monotonous and do not involve direct activities. Learning that focuses on theory without giving students space to actively participate can reduce interest in learning (Almulla, 2020). To overcome this problem, a project-based lesson plan (LIP) has been proposed as an approach capable of integrating theory and practice, as well as increasing student involvement in learning.

Talking about the maintenance of light vehicle engines, with technological developments that are quite rapid, so special attention is needed to prepare plans in the learning process. An example of a case found is the use of this undeveloped lesson plan, learning activities that lack variety, are less creative, and are less innovative in the learning process. So, it was found that students were still less active, not focused, and lacked motivation to learn. LIP is very important to use and implement to motivate students and actively participate in the learning process (Solehuddin et al., 2022). In fact, for the current conditions of student characteristics, emphasis is needed so that learning is centered on students, not teachers anymore (Juniantari, 2017). With a paradigm shift like that, it is hoped that students will be more active, with motivation arising from the students themselves.

The development of project-based lesson plans in this subject is an innovative and relevant approach in the world of vocational education. In this era of rapid development of technology and the automotive industry, students need to have a strong theoretical understanding and relevant practical skills (Jalinus & Nabawi, 2017; Widawati, 2021). This approach also allows students to develop collaboration skills, problem-solving, and critical thinking (Hadi et al., 2017; Dewi et al., 2019). During project activities in this subject, students must work in teams, analyze problems, plan appropriate actions, and evaluate the work that has been done (Endrayanto et al., 2023; Huda et al., 2024; Utomo & Kurniawan, 2020). In addition, students will also be directly involved with light vehicle engine components, gaining a deeper understanding of the systems involved in maintenance (Ismael et al., 2024; Pane et al., 2022).

This research has a high urgency in improving the learning quality of light vehicle engine maintenance. By integrating theory and practice through project-based lesson plans, students will

have the opportunity to develop practical skills that are relevant to the real world (Muslim et al., 2020; Saputro & Rahayu, 2020). According to a report from the World Economic Forum (2023), industry requires a workforce that not only has theoretical understanding but is also able to apply knowledge in direct practice. UNESCO (2019) reported that countries with vocational education integrated with direct practice have a student success rate in transitioning to the world of work of 85%. In contrast, countries with a less integrated approach only reach 60%. In addition, this research can also overcome the gap that often occurs between theory and practice in light vehicle engine maintenance, so that students will be better prepared to face challenges in the automotive industry.

Previous research results have underscored the importance of student engagement in learning and the integration of theory and practice. According to Eliza et al, Laili et al and Marheni, it was found that the importance of involvement between students who are active in the learning process by using a learning model that is appropriate to the characteristics of students and is integrated both theoretically and practically (Eliza et al., 2019; Laili et al., 2019; Marheni, 2022). However, this research will provide a new contribution by focusing on the use of project-based LIPs. Looking at the practicality of project-based lesson plans, this study will complement previous research and provide more specific insight into the potential of project-based lesson plans in improving learning.

Based on the problems and solutions offered, the main aim of this research is to evaluate the level of practicality of project-based learning implementation plans (LIP) in the maintenance subjects described previously. This research will contribute to the novelty in automotive vocational education and provide new insights into the potential of project-based learning approaches that can be integrated into learning implementation plans.

METHOD

Practical activities for developing project-based learning implementation plans (LIP) with R&D research using the ADDIE model development procedure. The ADDIE model is a systematic framework or approach used to design, develop, and evaluate learning or training programs. The stage in the analysis phase involves identifying learning objectives, needs analysis, student characteristics, and challenges in learning as well as reviewing literature regarding project-based lesson plans. The design stage is designing the lesson plan by determining the competencies that will be achieved by students in this subject, preparing the structure of the lesson plan, and important elements such as learning objectives, learning activities, learning materials, assessments, and project activity steps. The development stage is the process of producing or creating learning materials, such as modules, videos, presentations, or other aids. All elements designed in the previous stage are realized in real form. The implementation stage involves the implementation of learning or training. The developed material is delivered to the target audience. The implementation process also includes ensuring that all resources are ready to use. The evaluation stage is carried out to assess the success of the learning program.

Before being implemented in the field, the product in the form of a lesson plan needs to undergo several stages of development. The development stage in question is product development (Rusmanto & Rukun, 2020). This research is at the practicality stage, where the product in the form of lesson plans will be evaluated and the level of practicality to be used will be sought. The understanding of this practical category is that the product being developed has a level of use. This is done by conducting direct trials on products that have been developed previously (Juniantari et al., 2020; Muslim et al., 2023; Suharti et al., 2020). LIP is said to be practical after the instrument that has been distributed is in the form of a teacher response questionnaire with a level of data interpretation in practical conditions or very practical to use.

The development stage has been carried out by developing the product with the previously designed design. This is done of course after evaluating at the previous stage. This is following the development procedure using the ADDIE model which can be seen in Figure 1. Revise and adjust the LIP based on feedback from experts who have provided validity values for this product. After getting the validity value and carrying out revisions, the stage that must be carried out is the implementation stage by distributing practical instruments in the form of teacher response questionnaires.

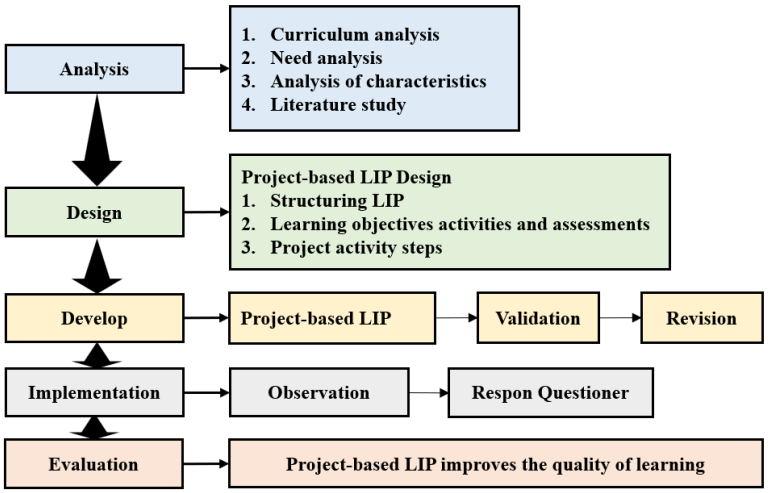


Figure 1. ADDIE Procedure

The implementation stage will also include conducting direct trials in the field to obtain effectiveness values. Limited trials were conducted at State Vocational School 1 Lahat in the odd semester of 2023/2024, while the sample for this study was 30 students majoring in light vehicle engineering at the vocational school. The sampling technique used was cluster sampling by randomly selecting 3 existing classes. This effectiveness value is viewed from classical completeness based on learning outcomes tests using one-shot case study analysis techniques and interpreted using the classical completeness criteria table (Syah, 2019). The evaluation stage is a series of evaluations used at each stage in the ADDIE model, which is the final result of the first stage and the beginning of the next stage. The stages in this model allow researchers to design, implement, and evaluate project-based lesson plans comprehensively and effectively.

This research uses a descriptive quantitative approach in presenting data and interpreting practical data on project-based LIPs. The instrument used in this research is a practicality questionnaire or response questionnaire. The response questionnaire has passed the eligibility test first and is declared valid as a practical instrument with an average validity value given by experts of 87.5%. The response questionnaire instrument grid can be seen in Table 1.

Table 1. Response Questionnaire Instrument Grid

No.	Aspect	Indicator
1.	Appearance	LIP Components Comply with Process Standards
		Identity is by Reference Standards
2.	Presentation	There is an Implementation Plan
		Planning in Classroom Management
		Planning the Use of Process Standards in Learning
		Assessment Plan for Learning Purposes

The subjects of this research were five light vehicle engine maintenance teachers who had teaching experience in this subject. The selection of teachers as research subjects aims to gain rich and varied insights into the practicalities of product development. After getting data from the instruments that have been distributed, carry out an analysis to get the overall percentage by applying the practicality value Formula 1 (Trianto, 2014).

$$P = \frac{R}{SM} \times 100\% \quad (1)$$

P is the practicality score, R is the total score obtained, SM is the maximum score. The average percentage will be interpreted into the data interpretation Table 2 (Purwanto, 2011) for the level of practicality to provide final results that can be concluded.

Table 2. Practicality Category

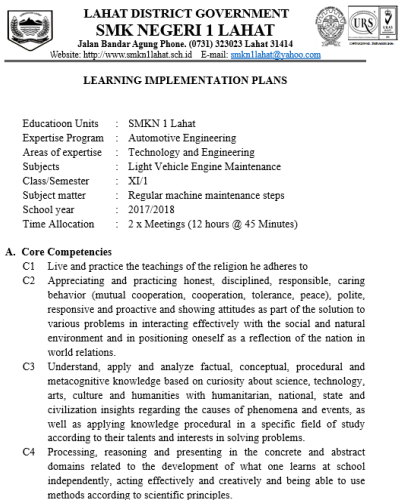
No.	P	Kategori
1	80% - 100%	Very Practical
2	60% - 79%	Practical
3	40% - 59%	Quite Practical
4	20% - 39%	Less Practical
5	0% - 19%	Not Practical

RESULTS AND DISCUSSION

Results

The results of the analysis phase after identifying learning objectives, student characteristics, and challenges and reviewing the literature, it is necessary to develop lesson plans with a learning approach that can encourage students to be more active in learning. Not only active learning but there is also collaboration with colleagues and being able to apply it to real conditions. Based on this, a project-based learning approach is used which has been integrated into the lesson plan design. The design phase is carried out after going through the analysis phase by evaluating the end of the analysis step. Based on the final results of the analysis phase, the next stage is to design a project-based LIP. This is done by determining the competencies achieved in the subjects, compiling the structure of lesson plans, and important elements such as learning objectives, learning activities, learning materials, assessment, and project activity steps.

The next stage is the development of a project-based LIP. At this stage, the product has been developed and passed the feasibility aspect commonly known as validity. After making revisions according to expert advice in the form of adding time allocation in each learning phase to the core activities and several reference sources that can be taken from the internet, the next stage is product implementation on research subjects. The appearance of the product that has been developed can be seen in Figure 2 and this has also been presented in Table 3 and Table 4. Figure 2, is the initial view of the product in the form of a project-based LIP that has been developed. This section explains the header display section according to the format used by the school where the research is conducted. This section also presents educational units, skills programs, areas of expertise, subjects, classes, main material, and time allocation and also presents the core competencies that students will complete later. Table 3 is a display of basic competencies and indicators that will be implemented later in class. Table 4 is the introductory, core, and concluding parts of an LIP that was developed. This section also describes the activities accompanied by the time allocation used. The core activities developed are by the phases of the project-based learning model, starting from the first phase to the sixth phase, which begins with basic questions and ends with an experience evaluation.



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LEARNING IMPLEMENTATION PLANS

Educatioon Units	:	SMKN 1 Lahat
Expertise Program	:	Automotive Engineering
Areas of expertise	:	Technology and Engineering
Subjects	:	Light Vehicle Engine Maintenance
Class/Semester	:	XI/1
Subject matter	:	Regular machine maintenance steps
School year	:	2017/2018
Time Allocation	:	2 x Meetings (12 hours @ 45 Minutes)

A. Core Competencies

C1 Live and practice the teachings of the religion he adheres to

C2 Appreciating and practicing honest, disciplined, responsible, caring behavior (mutual cooperation, cooperation, tolerance, peace), polite, responsive and proactive and showing attitudes as part of the solution to various problems in interacting effectively with the social and natural environment and in positioning oneself as a reflection of the nation in world relations.

C3 Understand, apply and analyze factual, conceptual, procedural and metacognitive knowledge based on curiosity about science, technology, arts, culture and humanities with humanitarian, national, state and civilization insights regarding the causes of phenomena and events, as well as applying knowledge procedural in a specific field of study according to their talents and interests in solving problems.

C4 Processing, reasoning and presenting in the concrete and abstract domains related to the development of what one learns at school independently, acting effectively and creatively and being able to use methods according to scientific principles.

Figure 2. Initial Appearance and Core Competencies of Project-Based LIP

Table 3. Display of Project-Based LIP Basic Competency

No.	Basic Competencies
1	1.1 The Environment and Natural Resources as Gifts from Almighty God must be Preserved and Preserved Forever
	1.2 The Development and use of Technology in Learning Activities must be in Harmony and not Damage and Pollute The Environment
2	2.1 Demonstrate a Caring Attitude Towards the Environment Through Activities Related to Light Vehicle Engine Maintenance
	2.2 Demonstrate a Careful and Thorough Attitude in Maintaining Light Vehicle Engines
	2.3 Demonstrate Discipline and Responsibility in Carrying Out Light Vehicle Engine Maintenance by SOP
	2.4 Demonstrate a Careful and Caring Attitude Towards Work Safety
	2.5 Demonstrate a Caring Attitude Towards the Environment Through Activities Related to Light Vehicle Engine Maintenance
3	3.1. Understand how to Maintain Machines Regularly
	Indicator
	1. Students can Explain the Meaning, Purpose, and Requirements for Periodic Maintenance or Servicing of Motor Vehicles
	2. Students can Prepare, use, and Maintain the Workplace and Carry Out Periodic Maintenance According to the Correct Procedures
	3. Students can Lift Various Types of Vehicles Safely and According to Correct Procedures
	4. Students can Clean the Outside and Inside of the Vehicle According to the Correct Procedures
4	4.1. Maintain the machine regularly
	Indicator
	1. How to Maintain the Machine Regularly
	2. How to Adjust the Timing Belt

Table 4. Displaying the Introduction, Core, and Closing Parts of the Lesson Plan

No.	Activity	Description (Indicator)	Allocation (minutes)
1	Introduction Step	1. Opening in Class	20
		2. Pray	
		3. Sing the National Anthem	
		4. Absence	
		5. Provide Motivation to Students in Learning	
		6. Provide Initial Problems	
2	Core Step	**Exploration**	
		Delivery of Objectives and Competencies Mastered	20
		Elaboration	
		Phase 1: Determining the Fundamental Questions	15
		Phase 2: Design Project planning	15
		Phase 3: Arranging a Schedule	15
		Phase 4: Student Monitoring	120
		Phase 5: Testing Results	15
		Phase 6: Evaluating Experience	30
3	Closing Step	Concluding, Evaluating, and Preparing to Go Home	20

Following the research method, where the research subjects for product trials in obtaining practicality criteria were 5 productive teachers majoring in automotive engineering. The response questionnaire that had been prepared was then distributed to 5 experts to obtain practical value for the product. The results of filling out this response questionnaire can be seen and understood in Figure 3. In this figure, it is explained that 2 aspects are assessed of the product that has been developed, namely the display aspect and the presentation aspect.

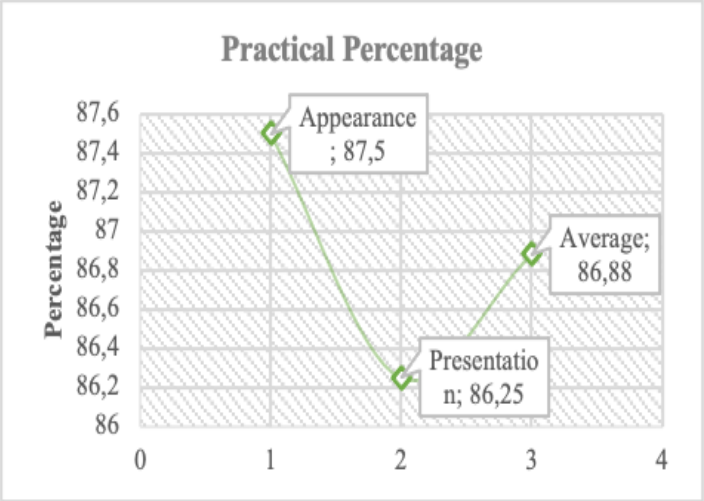

Figure 3. Percentage of Practicality from the Aspect of Appearance and Presentation of the Project-Based LIP

Based on the results of the practicality test on the product being developed, the data obtained for appearance obtained a value of 87.5%, and presentation of 86.25% so the average analysis percentage obtained was 86.8%. After obtaining the percentage value from the research instrument, the next step is to interpret the data in the product practicality interpretation table. The final result obtained is a product developed in the practical category.

Discussion

The results obtained from developing this project-based LIP are practical values. The results obtained are an in-depth understanding of product development. The product developed was implemented in one of the subjects in the light vehicle engineering department at SMKN 1 Lahat. The practicality of the product being developed is by product development principles in the form of project-based lesson plans on the subject of light vehicle engine maintenance.

The practicality test was carried out with the help of responses from productive teachers majoring in light vehicle engineering, resulting in a product in the very practical category with an average score of 86.88%. This means that this product is following what it is supposed to serve. In line with Brand (2020), Ko et al (2021), and Xu et al., (2022) stated that by developing a product if procedures or steps and methods are used in the right direction, the result that will be obtained is a practical product. According to Lindorff et al., (2020), Meika et al., (2019), and Rombout et al., (2021) stated that based on the appearance and presentation aspects taken from the response questionnaire instrument if it is developed using good correct procedures, it will produce a product that is practical to implement.

Hufri et al., (2019) stated the importance of presenting content that is easy to use and utilizes the product. In addition, teacher involvement in the product development process increases the practical value of the product (Panggabean et al., 2021). This has been done in this study which is a positive assessment to achieve a high practicality value. The high level of practicality in the appearance aspect shows that the product can attract the attention of students who are generally more responsive to visualization. Meanwhile, the high presentation value emphasizes that this product is not only attractive but also able to provide effective learning guidance.

The LIP developed is oriented towards active learning that allows students to be directly involved in projects that are relevant to real conditions. This approach motivates students to learn more deeply which can connect theoretical concepts with practical applications directly. Practicality testing by directly involving teachers in providing an overview of this product can be applied in class. This shows that the project-based approach is acceptable to teachers and students so that it is easy to adopt in learning activities.

Products developed in the form of lesson plans also have a significant impact on student involvement in learning light vehicle engine maintenance. These results or findings are in line with

research activities that have been completed previously, which show that the integration of project-based learning in lesson plans or learning tools that are developed will increase student involvement, students are motivated and there is interest in solving problems given by the teacher so that they can find solutions on real projects (Lin, 2018; Lin et al., 2021; Syamsuri et al., 2017). Student involvement in real projects provides additional motivation and provides opportunities to develop collaboration and problem-solving skills (Jiang, 2021; Muslim et al., 2021; Sugiarto et al., 2023).

Through project-based LIP, students can apply theoretical knowledge in light vehicle engine maintenance in a real context. The results showed that student's understanding of concepts increased through implementing the concepts in projects. These findings support previous research which shows that project-based learning can increase the level of understanding of learning concepts by connecting theoretical and application learning activities through practical activities (Almulla, 2020; Baghoussi & El Ouchdi, 2019).

The findings of this research support the view that active, contextual, and practice-integrated learning provides a more meaningful and in-depth learning experience for students. According to Veza (2021), active learning will become a benchmark so that learning abilities increase. The benchmark for students' abilities can be seen from the learning process, learning innovation, and the teacher's ability to organize the learning process (Anwar et al., 2022; Hidayat et al., 2020; Syahril et al., 2022).

These findings provide a strong theoretical and pedagogical foundation for applying a project-based learning approach to light vehicle engine maintenance subjects at State Vocational School 1 Lahat. The findings of this research provide clear direction for automotive vocational education in improving the quality of learning and preparing students with relevant skills to face the challenges of the world of work. This is in line with Penuel et al., (2011), the development and testing of innovations in implementing learning implementation plans will improve the quality of learning.

Project-based lesson plans provide students with the opportunity to develop relevant practical skills in this subject. The research results show that students can apply practical skills, such as problem-solving, conducting analysis, and planning appropriate actions in maintenance projects. These findings support previous research which shows that project-based learning can increase students' practicum scores in the skill level category in applying theoretical knowledge (Aydın et al., 2018; Eliza et al., 2017; Marten et al., 2019).

Through the use of project-based lesson plans, students are actively involved in learning, develop relevant practical skills, and deepen their understanding of concepts. With the involvement of students in real projects, they can develop practical skills needed in the world of work (Mali, 2016; Gerhana et al., 2017). This helps students prepare for success in their careers in the automotive industry.

Students become active in problem-solving, collaboration in teams, and analysis of problems (Adawiah et al., 2014; Jalinus et al., 2022; Sukmasari & Rosana, 2017). With high involvement, students can build a strong interest in the subject and feel more involved in the learning process (Dwiyanti & Rosana, 2020; Saputra et al., 2021). Students can apply theoretical knowledge in the context of real light vehicle engine maintenance. This helps students deepen their understanding of basic concepts and develop relevant practical skills (Hidayati et al., 2017).

Based on the results of this research, it can be interpreted that the development of this product has a positive impact on increasing student engagement, conceptual understanding, and practical skills. Project-based lesson plans provide contextual and real-world relevant learning experiences, which help students effectively connect theory with practice. The practical implication is the importance of implementing a project-based learning approach in light vehicle engine maintenance, especially in the light vehicle engineering department at State Vocational School 1 Lahat to improve the quality of learning and prepare students with relevant skills to enter the automotive industry.

There are several limitations in this study, one of which is regarding the time and condition of the curriculum that continues to change. Project-based learning requires a longer time in the application process in the field. The dense curriculum conditions will create difficulties in implementing previously planned projects. Other limitations are limited trials and the number of teachers at State Vocational School 1 Lahat. In addition, this study emphasizes more on the practical

aspects of the products developed. The direct impact and involvement of students and their practical improvements have not been studied directly. Further research is needed on the advantages and disadvantages of presenting this project-based lesson plan so that application in the field can be carried out optimally.

CONCLUSION

The conclusion that can be presented regarding the results of this research is that the development of a project-based learning implementation plan (LIP) on the subject of light vehicle engine maintenance has high practicality. The teacher's role as an instructor provides a positive response to the application of the product being developed. The results of LIP development are still focused on the practical level of productive lecturers and teachers at the secondary education level. Further research can be conducted by evaluating the effectiveness of the project-based learning implementation plan on a larger scale involving more students or other educational institutions. In addition, in-depth research can be conducted by integrating interactive learning technologies such as the use of augmented reality or virtual reality to increase student engagement.

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