Project Based Learning Model on Basic Competencies of Light Vehicle Front Suspension System Maintenance at SMK

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Abstract: Vocational High School (SMK) is an educational institution that offers learning to acquire specific skills. After students graduate from school, they must be able to interact effectively and professionally and have competence. Project-based learning is applied to increase student involvement in order to achieve competence. The approach used in this study is a descriptive qualitative method to describe what PjBL is. Qualitative research aims to understand social phenomena through student involvement in the learning process. Techniques for collecting data include surveys, project assignments, student observations of the learning process to have a positive impact i.e. students become competent. The results of the research were from 10 groups of students, 8 groups were competent, 1 was quite competent, and 1 was very competent. Other research shows how using PjBL in the classroom can help students become more committed.

Keywords: Competencies, PjBL, Vocational.

INTRODUCTION

At this time, the Industrial Revolution 4.0 has impacted many facets of human life. Humanity in this time. They must stay current with a variety of quickly evolving technology innovations. The industrial revolution 4.0 has an impact on education in a way that makes it impossible for anybody active in the field of education to remain indifferent or mute about this change. Passive education's components will deteriorate or become stagnant. Education is merely a way of conveying knowledge that does not help the development of abilities to tackle the difficulties of the times without advancements or innovations that can stay up with these advancements (Andrian, Wahyuni, & Ramadhan, 2022).

Education may ease the transition to worthwhile and useful activities that will help to develop the workforce and social control systems necessary for society to prosper sustainably (Pramesti, Probosari, & Indiyanti, 2022). Vocational high schools (SMK) are educational institutions that offer instruction in acquiring specialized skills. Students are allowed to enhance their talents based on their interests. They should also be able to use information and skills pertinent to their line of employment. After students leave school, they should be able to interact effectively and professionally in their native tongue. Additionally, students are ready to take on the global economy's problems. In other words, they need soft skills to compete globally (Susanti, 2021)

Indonesian vocational high schools (SMK) offer a wide range of options for competencies in the business management and technology sectors. Automotive light-vehicle engineering competence is one of the competency options available at vocational high schools (SMK), with the main goal being to provide students with knowledge, attitudes, behaviours, and abilities (Hendi Firdaus, Cucu Atikah, 2021). Motorized or automotive light vehicles are frequently employed for one-on-one or small-group transportation. This car, which can carry a maximum of around 3,500 kg, is typically used for highway and city driving. There are many kinds of automotive light vehicles, such as electric automobiles, sports cars, and passenger cars (Kemenhub, 2019)

The goal of automotive light vehicle engineering competency is to prepare students to become mechanics who can manage businesses, particularly in automotive light vehicle repair shops, and be proficient mechanics in the maintenance and repair of motors, chassis, and power transfer systems (Khosmas, 2021)

Light Vehicle Engineering (TKR) is one of SMK's specialized skills in advancing automotive technology. Students are taught competencies in electricity, engines, chassis, and power transmission in gasoline- or diesel-powered vehicles as part of the TKR major. Students are taught how to operate in the field of maintenance and repair services in the automobile industry through light vehicle engineering skills proficiency (Wilantara, Kurniawan, Fitriyanto, & Tegar, 2022). Depending on their passions, skills, and abilities, students in SMK (Vocational High Schools) might have a wide range of potential. Individuals at SMK get vocational education combining theory and practice in specific sectors, allowing the school to categorize individuals' potential according to their chosen vocational path.

In order to mould students' brains, education must be able to keep and increase information. It takes collaboration between instructors and students to accomplish these educational objectives. The instructor continues to be at the core of the learning process thus far. The lecture technique is an alternative for lecturers who need more creativity, which results in bored and generally quiet students (Rizky, Kanza, Lesmono, & Mulyo, 2020). Beyond being proficient in the fundamentals of specific fields, the modern work market requires students to possess some talents, sometimes called "21st-century skills." Project management, administering them, and resolving complicated issues are becoming vital lifelong skills (Zaroukula, 2020)

According to Suryani, Niasari, & Mei (2023) There is a need for a learning model that considers children's innate interests and has simple instructions that make teaching it to students easier. With the project-based learning approach, students engage in designing, problem-solving, decision-making, and investigative activities that allow them to work independently for extended periods and produce natural products or presentations. Authentic problems should be faced before any preparation, problems should be used to achieve the necessary knowledge, and learning should be directed to acquire new knowledge. These qualities should be present in the project-based learning approach (Khandakar et al., 2020)

Students who are learning the Project Based Learning model must be engaged in their education by working together to engage in the scientific and technical practice (such as researching issues, offering explanations, and challenging others' ideas), and they must produce some actual products and joint products that are accessible to the public through external representation (Sormunen, 2020)

PjBL is a learning approach that enables students to pick up new information and perspectives based on their own experience with their end products. PjBL places a strong emphasis on students working autonomously in their groups and gathering data in the form of physical goods. PjBL allows students to practice addressing actual issues (Setyarini & Jannah, 2020). By emphasizing a student-centred approach rather than a teacher-centred approach and allowing students to obtain information via project work and hands-on experience, the PjBL model can improve teaching and learning (Belwal & Badi, 2020)

Project-based learning is implemented to increase student engagement, knowledge and skill acquisition, and project-based problem-solving skills. In developing and enhancing students' abilities to manage resources or equipment to perform tasks, promoting student collaboration, and addressing complicated project challenges with tangible consequences (Baharullah, Sri Satriani, Fathrul Arriah, 2022)

The suspension system is a system that functions for comfort in driving by reducing shocks resulting from uneven road conditions (Ebrahimi-nejad, Kheybari, Vahid, & Borujerd, 2020). The three basic categories of car suspension systems are passive, semi-active, and activation systems. The springs and other suspension system components are positioned between the wheels of the automobile body in passive suspension. This makes driving and braking comfortable. The chassis's characteristics constrain the suspension's comfort to certain values. When the suspension drift exceeds specific, defined values, driving comfort declines (Ahmed, 2020)

In four-wheeled cars, the suspension system is a component of the chassis system. As part of the suspension system maintenance competency, students are expected to comprehend how the suspension system operates and how to maintain it so that it continues to perform as intended. Research on suspension systems can also help in the future creation of better and more effective suspension technologies.

In addition to preventing wheel wobble, excessive movement to the front, back, and sides, or changing the wheel's tilt, suspension works to absorb forces from uneven road surfaces so that the vehicle travels in the correct direction. The suspension system of a car serves a variety of purposes, such as (1) increasing comfort and stability, (2) transmitting braking force and body motion, (3) supporting the body on the axle, and (4) keeping the body and wheels in their proper geometric relationships (Sayit Anwar, 2020)

The suspension system, sandwiched between the car's body and its wheels, is intended to lessen the impact of bumps in the road while enhancing the car's comfort and stability and the wheels' traction. Spring, shock, stabilizer, ball joint, lower arms, and strut bars comprise the front suspension. The suspension system employed in this study is an independent model suspension system for a front-mounted light four-wheeled vehicle. An independent suspension system is one in which there is no direct connection between the left and right wheels and one axle. The two wheels rotate independently of one another (New Step 1 Toyota, 1994). A telescopic damper's top is the upper steering shaft in a car suspension system known as a Macpherson-type suspension. In the front suspension of contemporary automobiles, it is frequently employed. The front wheels are often equipped with this kind of suspension. This design's architecture comprises struts, stabilizer bars, and lower arms (Heri S, 2020). This study aims to analyze the use of the Project Based Learning learning model for students' mastery of competence in productive subjects of suspension system maintenance.

METHODS

A total of 30 students from class XI TKRO 1 at SMK Negeri 4 Kota Serang participated in this study on the fundamental competency of suspension system maintenance. The descriptive qualitative approach was employed in this study to describe what a PjBL notion meant to different people in the context of their shared experiences. Qualitative research aims to comprehend social phenomena via dialogue and engagement (Putri Dewi Anggraini, 2021). Techniques for gathering data include surveys, project assignments, student observation of the learning process while they are already working in groups, and documentation, specifically in the form of learning outcomes. Ten groups of three students each served as the research subjects (Retno, 2022). The instrument for evaluating student activities is shown in Table 1 the following:

Table.1. Student Activity Instruments

PjBL Steps	Indicators
Planning Activities	Contains objectives, topics, reasons, planning, time and place of implementation, tools and materials
Preparation of tools and materials	Ability to prepare job sheets, tools and materials
Schedule creation	Clarity of task division in designing activities
PjBL implementation process	Work processing in accordance with SOPs, result criteria, and work safety
Valuation	Systematics of PjBL
	PjBL work attitude
	PjBL Results
Evaluation and reports	Ability to present project results and reporting

In this study, performance or appearance are typically examined to assess the psychomotor domain. Researchers can utilize simulations, performance tests, or identification tests to measure it. Each answer is given a score in the form of a number so that each question item in this study may be examined. The following are the answer item scores: Very competent candidates receive scores of 4, competent candidates receive scores of 3, quite competent candidates receive scores of 2, and less competent candidates receive scores of 1 (Elis Ratna Wulan, 2014)

Since rating scales are more flexible and can be used to gauge respondents' perceptions of other phenomena, such as socioeconomic status, institutions, knowledge, abilities, activity processes, and others, they should be used to process data from performance assessment questionnaires (Sugiyono, 2013).

Table 2. Data processing criteria

No	Attainment rate	Information
1	76-100 %	Very competent
2	51-75 %	Competent
3	26-50 %	Quite competent
4	0-25 %	Less of competence

Kriteria :

1. If the results of the analysis obtain criterion A (76-100%) then the qualifications are very competent
2. If the results of the analysis obtain criterion B (51-75%) then the qualifications are competent
3. If the results of the analysis obtain criterion C (26-50%) then the qualifications are quite competent
4. If the results of the analysis obtain criterion D (0-25%) then the qualifications are less competent

The formula used to calculate the percentage of each subject is

Formula 1. Percentage calculation

$$Persentase = \frac{\Sigma(Answer\ x\ Each\ Selection\ Weight)}{n\ x\ each\ highest\ weight}\ x\ 100\ \% \quad (1)$$

Information:

Σ = Sum
n = Number of respondents

Sumber : (Abduh, 2019)

FINDINGS AND DISCUSSION

Model Project Based Learning

Project-based learning (PjBL) is a learning paradigm that describes inquiry-based teaching strategies that include students in building knowledge by having them complete significant projects and produce valuable outputs (Guo, Saab, Post, & Admiraal, 2020). According to (Kurniawati & Agustin, 2020) With this model the PjBL learning steps can be developed in several indicators in figure 1 as follows:
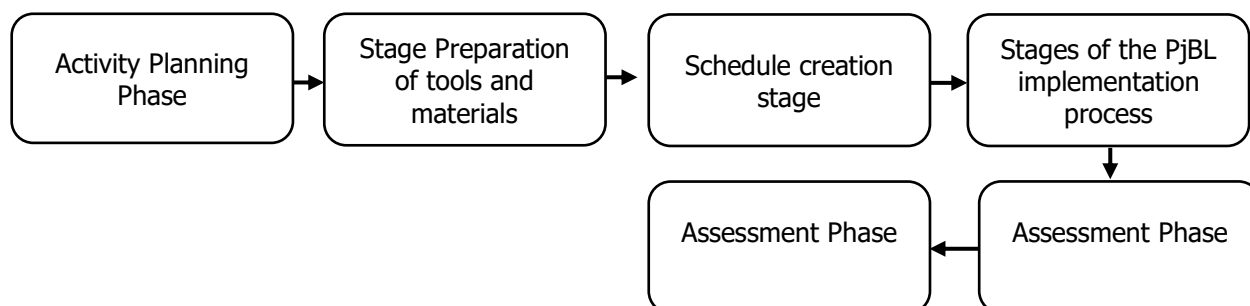

Figure.1. PjBL model steps

Productive learning of chassis subjects basic competence of suspension system maintenance, which uses the PjBL learning model with six steps as follows:

1. Activity Planning Phase
   At this stage, students discuss in groups by being given basic questions or identifying problems related to how to explain the maintenance function of the suspension system, how to determine how to maintain the suspension system, how to perform suspension system maintenance, and how to check the results of suspension system maintenance.
2. Stage Preparation of tools and materials

At this stage, students and teachers collaboratively design, collect data and explore information about suspension system maintenance procedures and techniques through internet media and books, resulting in a job sheet that is used to prepare tools and materials and steps to work on suspension system maintenance projects.

3. Schedule creation stage
   At this stage, students compile a schedule of task distribution activities and design activities related to the stages of project completion from the beginning to evaluation. The agreed schedule must be mutually agreed so that teachers can monitor learning progress and work on projects outside the classroom

4. Stages of the PjBL implementation process
   At this stage, the Master is responsible for monitoring student activities during the completion of the project. Monitoring is carried out by facilitating students in each process. In other words, the teacher acts as a mentor for student activities. In order to facilitate the monitoring process, a rubric was created that can record all important activities. And students in groups carry out the task of PjBL suspension system maintenance
5. Assessment Phase
   At this stage, the teacher measures the achievement of competency standards related to systematics, work attitudes and results, and evaluates the progress of each student, and gives feedback on the level of understanding that has been achieved by students

6. Evaluation Phase and report
   At this stage, teachers and students reflect on the activities and results of projects that have been carried out. The reflection process is carried out both individually and in groups. At this stage students are asked to express their feelings and experiences during the completion of the project. Teachers and students develop discussions in order to improve performance during the learning process, so that in the end a new finding is found (new inquiry) to answer the problems posed in the first stage of learning.

   Based on the steps of the PjBL model that have been implemented by students, data on the results of the suspension system maintenance competency performance assessment using the PjBL model are obtained, seen in table 3, below:

Table.3. Results of Performance Assessment of Student Groups at Each Step of PjBL

PjBL Steps	Indicators	Very Competent	Competent	Quite Competent	Less Competent
Event Planning	Contains objectives, topics, reasons, planning, time and place of implementation, tools and materials		57,50%		
Preparation of tools and materials	Ability to prepare job sheets, tools and materials		70,00%		
Schedule planning	Clarity of task division in designing activities		55,50%		
PjBL implementation process	Work processing in accordance with SOPs, result criteria, and work safety		70,00%		
Valuation	Systematics of PjBL		67,50%		
	PjBL work attitude		72,50%		
	PjBL Results		60,00%		
Evaluasi dan laporan	Ability to present project results and reporting		57,50%		

Based on the data in Table 3, related to the results of the performance assessment of ten groups of students on the implementation of PjBL activities on suspension system maintenance. Results are obtained with the competent category, meaning that the entire group is able to follow the steps according to what has been given by the teacher or instructor. And students have a creative, critical attitude, and students are able to collaborate to complete projects, share ideas, solve problems together, and support each other. This can increase students' intrinsic motivation, sense of ownership of learning, and independence in managing their tasks. Furthermore, with the data obtained in table 3, teachers can apply the PjBL model to all teaching and learning activities in the classroom

to be able to improve student competence in the automotive department.

Table 4. Performance Appraisal Results of Each Group of Students

| Group | Assessment Results | | | |
	Very Competent	Competent	Quite Competent	Less Competent
One		59.38%		
Two		65.63%		
Three		71.88%		
Four			40.63%	
Five		68.75%		
Six		75.00%		
Seven		50.00%		
Eight	78.13%			
Nine		68.75%		
Ten		59.38%		

Based on the data in Table 4, there is one group in the category that is quite competent, this is because the group lacks in planning steps and preparing tools and materials and planning practice schedules. So that it affects the results of work on project activities. Furthermore, the group that obtains the category of competent enough will be accompanied by teachers to improve the steps in PjBL activities that still have less categories. For one group that is included in the category of very competent, based on the data in the assessment analysis the group has a good level of creativity and teamwork, so it has a superior value compared to other groups. Furthermore, the group that is included in the category of very competent will become a role model for other groups in the next project activities.

Other studies Demonstrates how using PjBL in the classroom may help students become more proficient in skills, creativity, and critical thinking. The findings of this study suggest that PjBL can be a proper teaching strategy for preparing SMK students to meet the demands of a workplace that is becoming more complicated.

Three groups of PjBL learning models will be created due to implementing PjBL learning features in SMK. The first group is a project-based learning model where students use projects to practice technical skills and where the instructor plays a significant role in project completion. The second is the project-based learning model, which uses the project to bring contextual learning and practical workshops closer together. In this setup, the instructor still plays a significant part in learning. The third approach, called project-based learning, uses project work to integrate theoretical and practical learning, contextual learning, and collaborative problem-solving. Students also take a more significant lead in completing project assignments (Rizki, Nisa, & Yuliawati, 2021)

The analysis's findings demonstrate that the PjBL model helps students develop their critical and analytical thinking skills, creativity, independence, and responsibility. Naturally, this technique adapts to the learning materials and the maturity level of the students (Fahrezi & Taufiq, 2020). The PjBL paradigm also provides benefits, including (1) Teaching students to think more broadly about issues in life that must be acknowledged;(2) Giving students direct training by introducing and acquainting them with critical thinking and skills in everyday life; and (3) Modern concepts must be adjusted, and their implementation requires students to develop their talents via practice, theory, and application (Anggraini & Wulandari, 2021).

There are two factors why PjBL is considered an effective instructional approach in learning activities in vocational schools: (1) Current learning patterns and student learning interests, do not encourage teachers to use conventional learning. (2) Graduate competence emphasizes students' ability to solve complex problems, which are very difficult to achieve when only through theoretical delivery and traditional education(Kaushik, 2020). However, keep in mind that the success of PjBL in improving the mastery of vocational students' competencies depends on factors such as project management, student involvement, and the use of technology. Therefore, good PjBL development and effective implementation are indispensable to ensure that students can get maximum benefit from the PjBL learning approach.

CONCLUSION

The use of the Project Based Learning learning model at the vocational high school level is very suitable for application in learning, especially in the chassis subject of the basic competence of suspension system maintenance. With this model students can carry out project learning activities starting from problem formulation, designing projects, making project completion schedules, monitoring project implementation progress, assessing project results to evaluating project activities so that students have competence in the field of chassis lessons. This is a unit that can form students into graduates who have creativity, responsibility, independence, confidence and critical thinking. By having these competencies, students are expected to become excellent human beings and achievers when they continue their studies at tertiary level or enter the world of work. It is hoped that this research can become a reference for vocational schools or for vocational teachers to apply project-based learning models in the implementation of learning in vocational high schools.

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