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Application of Experiential Learning-Based Problem-Based Learning Model to Improve the Ability of Grade XII Students in Light Vehicle Engineering

Penerapan Model PBL *Berbasis Experiential Learning* untuk Meningkatkan Kemampuan Peserta Didik Kelas XII Teknik Kendaraan Ringan

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Abstract

Initial observations at SMK Negeri 1 West Sumatra showed that only 45% of class XII Light Vehicle Engineering students could disassemble the vehicle alarm system correctly. The main problem is the lack of direct practical experience and understanding of theory not connected to real applications. This study aims to improve students' ability to disassemble vehicle alarm systems by applying the Experiential Learning-based Problem Based Learning (PBL) model. The research method used was Classroom Action Research (PTK) with 3 cycles on 30 students in class XII Light Vehicle Engineering SMK Negeri 1 West Sumatra. Data collection through observation, tests, and documentation, then analyzed descriptively quantitatively by calculating the percentage of learning completeness in cognitive, affective, and psychomotor aspects. The results showed an increase in students' disassembly skills from cycle I (68.5%) and cycle II (75.2%) to cycle III (83.7%). The Experiential Learning-based PBL model improved students' practical skills and achieved the 80% completion target.

Keywords: *Problem based learning, experiential learning, vehicle alarm system, dismantling skills, vocational education.*

Abstrak

Observasi awal di SMK Negeri 1 Sumatera Barat menunjukkan hanya 45% siswa kelas XII Teknik Kendaraan Ringan mampu melakukan pembongkaran sistem alarm kendaraan dengan benar. Permasalahan utama adalah kurangnya pengalaman praktis langsung dan pemahaman teori yang tidak terhubung dengan aplikasi nyata. Penelitian ini bertujuan meningkatkan kemampuan siswa dalam pembongkaran sistem alarm kendaraan melalui penerapan model *Problem Based Learning* (PBL) berbasis *Experiential Learning*. Metode penelitian menggunakan Penelitian Tindakan Kelas (PTK) dengan 3 siklus pada 30 siswa kelas XII Teknik Kendaraan Ringan SMK Negeri 1 Sumatera Barat. Pengumpulan data melalui observasi, tes, dan dokumentasi, kemudian dianalisis secara deskriptif kuantitatif dengan menghitung persentase ketuntasan belajar pada aspek kognitif, afektif, dan psikomotor. Hasil penelitian menunjukkan peningkatan kemampuan pembongkaran siswa dari siklus I (68,5%), siklus II (75,2%), hingga siklus III (83,7%). Model PBL berbasis *Experiential Learning* terbukti efektif meningkatkan keterampilan praktis siswa dan mencapai target ketuntasan 80%.

Kata Kunci: *Problem based learning*, *experiential learning*, sistem alarm kendaraan, keterampilan pembongkaran, pendidikan kejuruan.

1. Introduction

Vocational education has a strategic role in preparing a skilled workforce ready to face the challenges of the industrial world (Mouzakitis, 2010). In the era of the industrial revolution 4.0, the need for vocational education graduates with high technical competence is increasing, especially in the automotive field experiencing rapid technological transformation. One of the much-needed expertise programs is Light Vehicle Engineering, especially in vehicle electronic security systems (Rifdarmon et al., 2022) . Vehicle alarm systems are increasingly complex security technology and require special skills in maintenance and repair (Fraga-Lamas & Fernández-Caramés, 2019) .

The development of automotive technology requires vocational students to master not only traditional mechanical skills, but also increasingly sophisticated electronic systems. Modern vehicle alarm systems integrate various electronic components such as vibration sensors, door sensors, control modules, and wireless communication systems that require an in-depth understanding of working principles and safe disassembly procedures. Alarm system disassembly skills are crucial competencies that students must master to prepare them for the demands of the modern automotive industry.

Based on preliminary studies conducted at several vocational schools in West Sumatra, it was found that learning automotive technical skills still faces various challenges. Survey results show that 67% of students have difficulty understanding vehicle electronic systems, and 72% of students feel less confident in disassembling electronic components (internal survey data, 2024). These problems align with the findings of Wagino et al. (2023), which show that traditional learning in technical vocational schools is still not optimal in integrating theory and practice.

Initial observations conducted at SMK Negeri 1 West Sumatra confirmed these problems. Students in class XII of Light Vehicle Engineering experienced significant difficulties in disassembling vehicle alarm systems. Initial evaluation of 30 students showed that only 45% of students were able to perform the disassembly correctly according to safety procedures, 38% of students had difficulty identifying alarm components, and 55% of students were unable to perform cable marking procedures appropriately.

Further analysis identified three main problems: (1) lack of practical hands-on experience due to theoretical and demonstrative learning; (2) theoretical understanding that is not connected to real applications so that students have difficulty transferring knowledge to practical contexts; and (3) students' low reflective ability on the learning process which causes a lack of in-depth understanding of concepts and procedures (Wagino et al., 2023; Wagino, Nasution, et al., 2024) .

Various studies have explored innovative learning approaches to improve the practical skills of vocational students. Research by Sangwan and Singh (2021) shows that integrating experiential learning in engineering education can improve students' problem solving ability by 34%. Meanwhile, a study conducted by López et al. (2021) proved the effectiveness of Problem Based Learning in improving the technical skills of automotive engineering students with a 28% increase in learning outcomes.

Recent research by Azrina et al. (2024) shows that the application of PBL models with experiential learning approaches in science subjects can improve students' cognitive learning outcomes by 23%. Similar findings were also reported by Wagino, Maksum, et al.(2024), which showed that the integration of problem-based learning with *e-learning* technology can improve student engagement and learning outcomes in engineering.

However, these previous studies still have limitations. First, most of the studies were conducted at the university level with different student characteristics from those of vocational

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students. Second, research on vehicle alarm system disassembly skills is still very limited. Third, integrating the PBL model with *experiential learning* specifically to improve automotive technical skills has not been widely explored.

This research presents novelty in several aspects. First, it specifically integrates the Problem-Based Learning model with Kolb's Experiential Learning cycle to improve vehicle alarm system disassembly skills, which has never been done before. Second, this study developed a comprehensive assessment instrument that integrates cognitive, affective, and psychomotor aspects to measure alarm system disassembly skills. Third, this research provides a practical contribution in the form of a learning model that can be directly implemented in vocational schools with available resources.

The condition of the problem shows the need for innovation in learning models that can integrate theory and practice effectively. The Experiential Learning-based Problem Based Learning (PBL) model was chosen because this approach combines problem-based learning with Kolb's experiential learning cycle which includes concrete experience, reflective observation, abstract conceptualization, and active experimentation. These two approaches are expected to bridge the gap between theory and practice while developing students' critical and reflective thinking skills (Azrina et al., 2024; Sangwan and Singh, 2021; Wagino, Maksum, et al., 2024) .

This study has several limitations that need to be understood. First, the research was limited to the competency of dismantling vehicle alarm systems and did not include other vehicle security systems. Second, the research subjects were limited to students of class XII of Light Vehicle Engineering at SMK Negeri 1 West Sumatra. Third, the research was conducted within one semester with three PTK cycles. Fourth, the measured variables are limited to cognitive, affective, and psychomotor aspects of alarm system disassembly skills.

Based on the background and problems that have been described, this research aims to:

1. Improve students' cognitive abilities in understanding vehicle alarm system disassembly components and procedures.
2. Develop students' positive attitude and responsibility towards work safety in alarm system disassembly.
3. Improve students' psychomotor skills in performing vehicle alarm system disassembly systematically and safely.
4. Analyzing the effectiveness of the application of Experiential Learning-based PBL model in learning vehicle alarm system disassembly.

Achieving the objectives of this research is expected to significantly contribute to improving the quality of learning in SMK, especially in the field of Light Vehicle Engineering, and provide an innovative learning model that can be adapted for other technical competencies.

2. Literature Review

2.1 Problem Based Learning Model Based on Experiential Learning

Problem Based Learning (PBL) is a learning model that uses real problems as a learning context to develop critical thinking and problem-solving skills (Wagino, Maksum, et al., 2024). This model was first developed in medicine in the 1960s and then adapted for various disciplines, including engineering education. According to Barrows (1986), PBL has the main characteristics of student centered learning, problems as the focus of learning, and teachers as facilitators who guide the learning process.

Recent research shows that PBL effectively improves students' problem solving and critical thinking skills. A study conducted by Sangwan and Singh (2021) on engineering students showed that applying PBL can improve problem solving skills by 34% compared to conventional learning methods. Meanwhile, López et al. (2021), in their research on automotive engineering programs, found that PBL improved students' practical skills by 28% and problem analysis ability by 31%. Maksum et al. (2024) also confirmed the effectiveness of PBL in automotive vocational education by significantly improving communication and problem-solving skills.

Key characteristics of PBL, according to various studies include: (1) authentic problems that reflect real-world situations; (2) student centered learning with an active role in knowledge construction; (3) collaborative learning in small groups; (4) teachers as facilitators who encourage inquiry and reflection; and (5) evaluation that emphasizes the process and product of learning (Azrina et al., 2024). This model has proven to be very suitable for vocational education because it provides a real context relevant to the world of work that students will face.

2.2 Experiential Learning and Kolb's Learning Cycle

Experiential Learning, developed by David Kolb in 1984, is a process of learning through direct experience that emphasizes transforming experience into knowledge. The theory is based on the work of prominent philosophers and psychologists such as John Dewey, Kurt Lewin, and Jean Piaget, who emphasized the importance of experience in the learning process. Kolb defines learning as "the process by which knowledge is created through the transformation of experience" (Passarelli & Kolb, 2012).

Kolb's Experiential Learning Cycle consists of four interrelated stages: Concrete Experience (CE) where students are directly involved in learning activities; Reflective Observation (RO) where students observe and reflect on the experience; Abstract Conceptualization (AC) where students build theories and concepts based on reflection; and Active Experimentation (AE) where students test concepts in new situations (Bossche & Baktiran, 2021; Devi & Thendral, 2023; Gencel et al., 2021). Each stage in this cycle has an important role in ensuring deep and meaningful learning.

Empirical research shows the effectiveness of the Experiential Learning model in various educational contexts. A longitudinal study conducted by Berg et al. (2023) on students who participated in a study abroad program showed that the systematic application of the Kolb cycle increased adaptability and cross-cultural understanding by 42%. Lestari (2021), in her research on STEM learning showed that experiential learning increased students' problem solving ability by 29% and engagement in learning by 38%. Meanwhile, Fukami and Armstrong (2009), in their meta-analysis found that experiential learning consistently produces better learning outcomes than traditional methods, especially in terms of knowledge retention and skills transfer (Elendu et al., 2024; Wang et al., 2025).

2.3 Integration of PBL and Experiential Learning in Engineering Education

Integrating Problem Based Learning and Experiential Learning creates a synergistic and comprehensive learning approach. In this context, real problems from PBL become the source of concrete experiences in Kolb's cycle, while the reflection and conceptualization stages in Experiential Learning strengthen the analysis and problem-solving skills in PBL. The combination of these two models allows students to experience real problems, reflect deeply on the experience, build strong theoretical concepts, and test solutions through practical experiments (López et al., 2021; Singha & Singha, 2024).

Recent research shows the effectiveness of integrating these two models in engineering education. A study conducted by Ardiansyah et al. (2024) on learning environmental pollution

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showed that the application of PBL with an experiential learning approach improved students' cognitive learning outcomes by 23% and critical thinking skills by 31%. Similar research by Ramírez-Montoya et al. (2022) in the context of sustainable education showed that the integration of these two models resulted in a significant increase in inquiry and innovation skills. Wagino, Maksum, et al. (2024) also confirmed that the integration of PBL with learning technology can improve student engagement and learning outcomes in engineering.

The advantages of PBL and Experiential Learning integration include: (1) holistic learning by integrating cognitive, affective, and psychomotor aspects; (2) increased ability to transfer knowledge from the learning context to real-world situations; (3) development of 21st-century skills such as critical thinking, creativity, and collaboration; and (4) increased student motivation and engagement through meaningful learning experiences. This integrated model is particularly appropriate for vocational education as it reflects professional work characteristics that require solving complex problems through continuous experience and reflection (Hasan et al., 2023; Jamison et al., 2022; Rosenkranz, 2022).

2.4 Vehicle Alarm Systems and Automotive Security Technology

Vehicle alarm systems are electronic security devices designed to detect and respond to theft attempts or vehicle tampering through sensors, actuators and integrated control systems (Onyeanakwe et al., 2024). The technology has evolved rapidly from simple alarm systems in the 1980s to advanced security systems integrated with various modern technologies such as GPS, GSM, and the Internet of Things (IoT). The complexity of modern alarm systems requires automotive technicians to have a deep understanding of electronics, sensor technology, and communication protocols (Fraga-Lamas & Fernández-Caramés, 2019; Rahimi et al., 2025).

The main components of modern vehicle alarm systems include: (1) the main control module that serves as the brain of the system and integrates all components; (2) various types of sensors such as door, vibration, tilt, and motion sensors that detect intrusions; (3) communication systems including remote control, GSM communication, and smartphone notifications; (4) actuators such as sirens, warning lights, and immobilizer systems; and (5) power supply systems including backup batteries and power management. Each component has specific functions and is interrelated in a complex system (Arinde & Idowu, 2024; Muslam, 2024; Thandlam et al., 2024).

Vehicle alarm system disassembly procedures require a systematic approach and attention to safety aspects. Research by Beghi et al. (2023) emphasized the importance of safety protocols in vehicle electronic system disassembly, including battery disconnection procedures, cable marking, and the use of personal protective equipment. Recent studies have also shown that errors in disassembly procedures can cause damage to other electronic systems in the vehicle, given that modern alarm systems are integrated with vehicle management systems via CAN bus and other communication protocols (Fleischer et al., 2021; Meng et al., 2022).

2.5 Technical Skills Learning in Vocational Education

Technical skills learning in vocational education has unique characteristics that are different from general academic learning. According to Li & Pilz (2023), vocational education must be able to bridge the gap between theoretical learning and the practical demands of industry. This requires learning approaches integrating procedural knowledge, motor skills and problem-solving abilities in authentic contexts. Recent research suggests that effective technical skills learning should include three key elements: hands-on experience with industrial equipment and procedures, structured reflection to build conceptual understanding, and application in the context of real problems.

A study conducted by Roy & Roy (2021) in the context of automotive engineering education showed that vocational students need learning experiences that balance theory and practice. Their research found that 78% of students have difficulty transferring theoretical knowledge to practical applications when there is no adequate experiential bridge. This indicates the importance of learning models that provide concrete experiences while facilitating reflection and conceptualization.

Longitudinal research conducted by Wagino et al. (2023) on graduates of technical vocational schools showed that the skills most needed in the industrial world are solving non-routine technical problems, working in teams, and adapting to new technologies. These findings strengthen the argument for using learning approaches that not only focus on specific technical skills but also develop critical thinking and adaptability. The Experiential Learning-based PBL model offers an appropriate solution to this need, integrating technical skill development with higher-order cognitive abilities through authentic and reflective learning experiences.

3. Research Methods

This research utilized the Classroom Action Research (CAR) method with a Kemmis and McTaggart spiral design (Nagai & Birch, 2024). PTK was chosen because it can provide direct solutions to learning problems in the classroom while improving the quality of learning in a sustainable manner (Agustinova et al., 2025).

The research subjects were 30 students of class XII of Light Vehicle Engineering of SMK Negeri 1 West Sumatra in the even semester of the 2024/2025 academic year. The subject selection used purposive sampling technique with the following criteria: (1) active students of class XII of Light Vehicle Engineering; (2) have completed the Light Vehicle Electrical System subject with a minimum score of 70; (3) have a minimum attendance of 80% in the previous semester; and (4) willing to participate in all research activities. The research location was chosen because SMK Negeri 1 West Sumatra has adequate automotive workshop facilities, a good track record of implementing learning innovations, and representative student characteristics for technical vocational schools in West Sumatra.

The research was conducted in 3 cycles using the Kemmis and McTaggart spiral model of Classroom Action Research (*Penelitian Tindakan Kelas*) design, with each cycle consisting of 4 stages: planning, implementation, observation, and reflection. The study duration was 9 meetings (72 lesson hours) over 9 weeks, with students divided into 6 groups of 5 members. Cycle I focused on introducing the Experiential Learning-based PBL model with fundamental problems, Cycle II used more complex problems with peer tutoring techniques. Cycle III was a consolidation with the simulation of real industrial working conditions to achieve learning completeness targets.

Data collection methods include observation of student activities, assessment of alarm system dismantling practices, and documentation of the learning process. The research tools used include observation sheets, practical skill evaluation rubrics, and disassembly process checklists (Al Harrasi, 2024). The assessment was conducted on three aspects: (1) Cognitive, including understanding alarm components, safety procedures, damage identification, and electronic system theory; (2) Affective, including discipline in procedures, safety responsibility, cooperation in groups, and thoroughness in work; (3) Psychomotor, including the use of PPE, cable marking, systematic disassembly, and evaluation of work results (Pranajaya et al., 2023).

Data analysis was carried out descriptively quantitatively by calculating the percentage of student learning completeness in each aspect of the assessment. Students were declared complete

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if they achieved a minimum score of 75 on a scale of 0-100. The research success indicator was determined if 80% of students achieved mastery in each aspect of the assessment (Ly et al., 2024).

4. Results and Discussion

4.1. Research Results

4.1.1. Cycle I Results

Cycle I planning begins with analyzing learning problems and preparing an action plan. The planning stage includes the preparation of lesson plans with Experiential Learning-based PBL models, preparation of learning media in the form of vehicle alarm systems for practicum, preparation of Experiential Learning worksheets, and preparation of assessment instruments. The implementation of cycle I was carried out in 3 meetings with a duration of 8 lesson hours (8 x 45 minutes). Learning begins with student orientation to a real problem: a malfunctioning vehicle alarm system. Students are divided into 6 groups, each getting a set of alarm systems for practicum.

The Concrete Experience stage begins with students directly observing the condition of the problematic alarm system. Students make visual observations, listen to damage symptoms, and experience the complexity of vehicle electronic systems. At this stage, students record initial findings and document the condition of the alarm system.

The Reflective Observation stage is carried out through group discussions about the results of observations. Students reflect on the experience of observing the alarm system, identify possible causes of damage, and compare findings between groups. The teacher facilitates the discussion by providing trigger questions to explore students' understanding.

The Abstract Conceptualization stage involves students building a theoretical understanding of vehicle alarm systems. Students learn the alarm components, how the system works, and safe disassembly procedures. The teacher provides the necessary technical explanations to reinforce students' concepts.

The Active Experimentation stage is the core of learning, where students disassemble the alarm system according to the plan that has been developed. Students apply safety procedures, use the right tools, and document each disassembly step.

The cycle's observation results showed some important findings. From the aspect of student activity, the level of student engagement in learning was quite good, with an average of 72%. Students showed high enthusiasm at the concrete experience stage but still had difficulties at the abstract conceptualization stage. The observation results of cycle I are shown in Tables 1 to 3.

Table.1. Cognitive Assessment Results Cycle I

No.	Aspect of Cognitive Assessment	Number of Students Completed	Percentage (%)	Average Score
1	Component Understanding	18	60.0	72.5
2	Safety Procedures	22	73.3	76.2
3	Malfunction Identification	19	63.3	73.8
4	Electronic System Theory	16	53.3	71.2
	Average	18.75	62.5	73.4

Table.2. Cycle I Affective Assessment Results

No.	Aspects of Affective Assessment	Number of Students Completed	Percentage (%)	Average Score
1	Discipline in Procedure	24	80.0	78.5
2	Safety Responsibility	21	70.0	75.8
3	Group Cooperation	26	86.7	81.2
4	Accuracy in Work	19	63.3	74.1
	Average	22.5	75.0	77.4

Table.3. Psychomotor Assessment Results Cycle I

No.	Aspects of Psychomotor Assessment	Number of Students Completed	Percentage (%)	Average Score
1.	Use of PPE	23	76.7	78.0
2.	Cable Marking	17	56.7	70.5
3.	Systematic Disassembly	20	66.7	74.8
4.	Work Result Evaluation	18	60.0	72.3
	Average	19.5	65.0	73.9

The evaluation results showed that 68.5% of students achieved completeness with a score above 75. Affective aspects showed the best results (75.0%), followed by psychomotor (65.0%), and cognitive (62.5%).

Cycle I reflection identified several weaknesses that needed to be improved. First, the time allocation for the abstract conceptualization stage was still insufficient, so students' understanding of the theory was not optimal. Second, learning media in the form of alarm system diagrams needs to be added to strengthen concept visualization. Third, the cable marking procedure needs to be clarified and practiced intensively. Strengths that need to be maintained include the high motivation of students in practical learning, the effectiveness of group learning in improving collaboration, and the successful integration of hands-on experience with reflection in improving student understanding.

4.1.2. Cycle 2 Results

Based on the reflection of cycle I, the planning of cycle II focused on improving weaker aspects. First, the time allocation for the abstract conceptualization stage was increased from 30 minutes to 45 minutes. Second, the learning media was enriched with a video tutorial on disassembly and a more detailed alarm system diagram. Third, the student worksheets were improved by adding a more straightforward guide to cable marking procedures.

The implementation of cycle II showed significant improvements in several aspects. The Concrete Experience stage is strengthened by adding a variety of alarm system damage cases, so that students get a richer experience. Students not only observe one type of damage, but also compare different symptoms of damage.

The reflective observation stage uses the fishbowl discussion technique, where some students sit in the inner circle to discuss while others observe from the outer circle. This technique is proven to improve the quality of reflection, as students are more focused and purposeful.

The Abstract Conceptualization stage is reinforced by video tutorials showing the detailed disassembly procedure. Students can see the correct disassembly steps, effective cable marking

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techniques, and safety procedures that must be followed. Theoretical discussions become more in-depth as students have an apparent visual reference.

The Active Experimentation stage is conducted with a peer tutoring approach, where advanced students help students who are still having difficulties. This approach not only improves the skills of weak students, but also strengthens the understanding of students who become tutors.

The observation results of cycle II showed significant improvements in various aspects. The level of student engagement increased to 82%, with the improvement mainly at the abstract conceptualization stage. Students showed a deeper understanding of the theory of vehicle alarm systems. Cycle I observation results are shown in Table 4 to Table 6.

Table.4. Cognitive Assessment Results Cycle II

No.	Aspects of Cognitive Assessment	Number of Students Completed	Percentage (%)	Average Score
1.	Component Understanding	24	80.0	78.5
2.	Safety Procedures	26	86.7	81.2
3.	Malfunction Identification	23	76.7	77.8
4.	Electronic System Theory	21	70.0	76.1
	Average	23.5	78.3	78.4

Table.5. Results of Psychomotor Assessment Cycle II

No.	Aspects of Affective Assessment	Number of Students Completed	Percentage (%)	Average Score
1.	Discipline in Procedure	27	90.0	83.5
2.	Safety Responsibility	26	86.7	81.8
3.	Group Cooperation	28	93.3	85.2
4.	Accuracy in Work	24	80.0	79.1
	Average	26.25	87.5	82.4

Table.6. Results of Psychomotor Assessment Cycle II

No.	Aspects of Psychomotor Assessment	Number of Students Completed	Percentage (%)	Average Score
1.	Use of PPE	27	90.0	83.0
2.	Cable Marking	23	76.7	78.5
3.	Systematic Disassembly	25	83.3	80.8
4.	Work Result Evaluation	22	73.3	77.3
	Average	24.25	80.8	79.9

The evaluation results showed that 75.2% of students achieved overall mastery. Significant improvements occurred in all aspects: affective (87.5%), psychomotor (80.8%), and cognitive (78.3%). Reflection on cycle II shows encouraging progress, but there are still some aspects that need to be improved. The results were close to the 80% target, but not yet fully achieved. Further analysis showed that students still needed reinforcement in the aspects of safety evaluation after disassembly and troubleshooting ability when facing unexpected problems. Based on this analysis, cycle III will focus on strengthening the evaluation and troubleshooting aspects and consolidating all the skills learned in the previous two cycles.

4.1.3. Cycle 3 Results

The planning for cycle III was designed to achieve the research targets and consolidate all the learning from the previous cycles. The primary focus was on strengthening security evaluation and troubleshooting skills. The action plan included adding a special session to evaluate demolition results, simulation of unexpected problems during demolition, and a comprehensive assessment covering all aspects of the skills. The implementation of cycle III showed students' maturity in applying the Experiential Learning-based PBL model. The Concrete Experience stage was enriched with more complex problem scenarios, including alarm systems with multiple malfunctions and complicated wiring conditions.

The Reflective Observation stage is carried out with structured reflection techniques. Students use a systematic reflection guide to analyze their experiences. They reflect not only on what happened but also on why it happened and its implications for their learning.

The Abstract Conceptualization stage is reinforced with case study analysis, where students analyze real cases from the automotive industry. Students learn from the experiences of professional technicians and understand the wide variety of problems they may face in the working world.

The Active Experimentation stage simulates real working conditions, including time pressure and industry quality standards. Students also practice performing safety evaluations and troubleshooting problems that arise during disassembly.

The observation results of cycle III showed satisfactory achievement. The level of student engagement reached 90%, with students showing high independence and confidence in performing alarm system disassembly. The quality of student reflections also improved significantly, with students able to analyze experiences in depth and relate to theoretical concepts. Cycle I observation results are shown in Table 7 through Table 9, and a recapitulation of the three cycles in Table 10.

Table.7. Cognitive Assessment Results Cycle III

No.	Aspects of Cognitive Assessment	Number of Students Completed	Percentage (%)	Average Score
1.	Understanding of Alarm Components	27	90.0	84.5
2.	Safety Procedures	28	93.3	86.2
3.	Malfunction Identification	26	86.7	83.8
4.	Electronic System Theory	25	83.3	82.1
	Average	26.5	88.3	84.2

Table.8. Results of Cycle III Affective Assessment

No.	Affective Assessment Aspect	Number of Students Completed	Percentage (%)	Average Score
1.	Discipline in Procedure	29	96.7	88.5
2.	Safety Responsibility	28	93.3	86.8
3.	Group Cooperation	30	100.0	89.2

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4.	Accuracy in Work	27	90.0	85.1
	Average	28.5	95.0	87.4

Table.9. Psychomotor Assessment Results Cycle III

No.	Aspects of Psychomotor Assessment	Number of Students Completed	Percentage (%)	Average Score
1.	Use of PPE	29	96.7	87.0
2.	Cable Marking	26	86.7	83.5
3.	Systematic Disassembly	28	93.3	85.8
4.	Work Result Evaluation	25	83.3	82.3
	Average	27.0	90.0	84.7

Table.10. Recapitulation of Learning Completeness Results Per Cycle

Cycle	Cognitive (%)	Affective (%)	Psychomotor (%)	Overall Completeness (%)
I	62.5	75.0	65.0	68.5
II	78.3	87.5	80.8	75.2
III	88.3	95.0	90.0	83.7
I-III Improvement	+25.8	+20.0	+25.0	+15.2

Evaluation results showed that 83.7% of students achieved overall mastery, exceeding the research target of 80%. All aspects showed excellent achievement: affective (95.0%), psychomotor (90.0%), and cognitive (88.3%). Reflection of cycle III showed the success of the application of Experiential Learning-based PBL model in improving vehicle alarm system disassembly skills. The research target has been achieved with a fairly good margin. Students showed improvement not only in technical skills, but also in critical thinking, problem-solving, and teamwork.

4.2. Discussion

The results showed that the application of Experiential Learning-based PBL model effectively improved students' vehicle alarm system disassembly skills. The consistent increase from cycle I (68.5%), cycle II (75.2%), and cycle III (83.7%) shows that this learning model is suitable for learning complex practical skills. More details can be seen in Table 11.

Table.11. Analysis of Improvement of Completion Per Aspect

Assessment Aspect	Cycle I (%)	Cycle II (%)	Cycle III (%)	Improvement (%)
Cognitive:				
a. Component Comprehension	60.0	80.0	90.0	+30.0
b. Safety Procedures	73.3	86.7	93.3	+20.0
c. Malfunction Identification	63.3	76.7	86.7	+23.4
d. Electronic System Theory	53.3	70.0	83.3	+30.0

Affective:				
a. Discipline	80.0	90,0	96.7	+16.7
b. Responsibility	70.0	86.7	93.3	+23.3
c. Cooperation	86.7	93.3	100.0	+13.3
d. Rigor	63.3	80.0	90.0	+26.7
Psychomotor:				
a. PPE use	76.7	90.0	96.7	+20.0
b. Cable Marking	56.7	76.7	86.7	+30.0
c. Systematic Dismantling	66.7	83.3	93.3	+26.6
d. Work Result Evaluation	60.0	73.3	83.3	+23.3

Based on Table 11, the aspects that experienced the most significant improvement were understanding alarm components, electronic system theory, and cable marking (+30.0% each). This shows that the Experiential Learning-based PBL model effectively improves conceptual understanding and specific technical skills (Lestari, 2021; Sangwan & Singh, 2021).

The aspect of cooperation in groups has shown promising results since cycle I (86.7%) and reached perfection in cycle III (100.0%). This indicates that collaborative learning in this model is very suitable for the characteristics of vocational students (Mindarta, 2025). The success of this model can be explained through several factors. First, integrating real-life problems into learning makes students more motivated and see the direct relevance of what they are learning. Second, the Experiential Learning cycle allows students to learn through multiple modalities: direct experience (kinesthetic), observation and reflection (visual), conceptualization (auditory), and experimentation (kinesthetic) (Bossche & Baktiran, 2021). Third, problem-based learning encourages students to develop higher-order thinking skills. Students do not just memorize procedures, but understand the rationale behind each step and can adapt when facing different situations (Wagino, Nasution, et al., 2024). Fourth, collaborative learning through group work improves students' social and communication skills. In the real world of work, automotive technicians often work in teams, so these skills are very relevant (Maksum et al., 2024; Wagino et al., 2023).

The challenges in implementing this model include the need for more time than conventional learning, adequate media and practicum tools, and teacher skills in facilitating student centered learning.

5. Conclusion

The application of the Problem Based Learning (PBL) model based on Experiential Learning is proven to be effective in improving the ability of students of class XII Light Vehicle Engineering to dismantle vehicle alarm systems. The results showed an increase in learning completeness from cycle I (68.5%), cycle II (75.2%), and cycle III (83.7%), exceeding the research target of 80%. All research objectives were achieved with an increase in cognitive (62.5% → 88.3%), affective (75.0% → 95.0%), and psychomotor (65.0% → 90.0%) abilities. This learning model successfully integrates concrete experience, reflective observation, abstract conceptualization, and active experimentation, so it can be an effective alternative to improve the practical skills of vocational students in facing the demands of the automotive industry.

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