LITERACY : International Scientific Journals of Social, Education, Humanities

E-ISSN: 2829-3649
P-ISSN: 2829-3908

Research Article

Implementation of Discovery Learning on Student Activeness and Learning Outcomes in Automotive Electricity Learning at Vocational High Schools

Dwi Jatmoko[1*], Agung Setiawan[2], Amirudin[3], Edi Tetra Wibowo[4], Muhamad Nurkholis[5]

[1-5]Pendidikan Teknik Otomotif, Universitas Muhammadiyah Purworejo, Indonesia
*****Corresponding Author : dwijatmoko@umpwr.ac.id

Abstract. This study was motivated by the low activeness and learning outcomes of students in the subject of Automotive Electrical Systems. The aim of the research was to improve the activeness and learning outcomes of Grade XI TKR 2 students at SMK Giripuro Sumpiuh through the implementation of the discovery learning model. This research was a Classroom Action Research (CAR) conducted in three cycles, each consisting of planning, implementation, observation, and reflection stages. The research subjects were 42 students, while the objects of the study included student activeness and learning outcomes. Data were analyzed using quantitative analysis techniques. The results showed an increase in student activeness, namely 52.38% in the first cycle, increasing to 64.29% in the second cycle, and reaching 74.79% in the third cycle. Learning outcomes also improved, with an average score of 47.62% in the first cycle, 64.29% in the second cycle, and 88.10% in the third cycle. Based on these findings, it can be concluded that the implementation of the discovery learning model can improve student activeness and learning outcomes in Automotive Electrical Systems for Grade XI TKR 2 students at SMK Giripuro Sumpiuh

Keywords: Automotive Systems; Classroom Research; Discovery Learning; Learning Outcomes; Student Activeness

1. Introduction

Advances in science and technology are bringing changes to all aspects of human life, leading us to increasingly fierce global competition. To be able to play a role in global competition, as a nation, we need to develop and improve the quality of our Human Resources (HR). Therefore, improving human resources through education is a reality that must be carried out in a planned, directed, effective, and efficient manner, lest this nation be left behind in the current era of globalization.

One effort to develop human resources is through vocational education, or Vocational High Schools (SMK). Vocational high school education, as part of the national education system, is an educational institution that strives to prepare a ready-to-use workforce. Vocational high schools have the mission of creating skilled workers in specific areas of specialization. Graduate competency standards in vocational high school education units aim to improve intelligence, knowledge, personality, noble character, and skills for independent living and further education in accordance with their vocation (Minister of National Education Regulation No. 19 of 2005).

Based on the description above, SMK is an educational institution designed to create graduates who are ready to work and have skills according to the chosen expertise program. In accordance with the objectives of the vocational school, light vehicle engineering is one of the study programs at SMK Giripuro Sumpiuh with an A study program accreditation score.

Received: August 15, 2024;
Revised: September 30, 2024;
Accepted: Oktober 21, 2024;
Online Available: December 30, 2024;
Curr. Ver.: December 30, 2024

The curriculum used in class XI Light Vehicle Engineering (TKR) is the KTSP curriculum. The subject of light vehicle electrical systems implemented in semester 4 has two competencies, namely the starter system and the charging system. In order for the learning process to be successful, learning facilities are needed such as adequate practicum facilities, conducive classroom conditions, and appropriate learning models so that the learning objectives of light vehicle electrical systems can be achieved by students well.

Rabiman (2015: 3) states that vocational high school teachers must use appropriate learning methods, which can combine theoretical and practical learning to create student-centered (active students) yet effective learning. The selection of appropriate learning methods will effectively achieve learning objectives. The learning objectives of light vehicle systems can be achieved if the learning process takes place ideally. The ideal learning process requires (I2) and (M3). I2 stands for Interactive and Inspirational. While M3 stands for Fun, Challenging, and Motivating students to participate actively (student-centered). The learning process is emphasized to provide sufficient space for initiative, creativity, and independence in accordance with the talents, interests and physical and psychological development of students (Minister of National Education Regulation No. 41 of 2007).

Rusman (2016: 322) states that achieving learning objectives can be seen from the participatory, active, creative, effective, and enjoyable learning process that supports the learning outcomes process. The success of an effective learning process is determined by several components, including students, teachers, and the learning model used. An effective learning process will be successful if the teacher can use the right learning model and involve many active roles from students. Nana Sudjana (2011: 20) says that in learning planning activities there are four main components, namely: objectives as a guide for teachers in carrying out actions, lesson content, learning models used and techniques and assessments. These four components do not stand alone, but are interconnected and influence each other.

Based on the above opinion, the learning model used is a crucial point in the learning components that must be considered. This is because in learning, teachers should not only use one method but also use more than one. The learning methods used in this learning process are then packaged into one learning model, meaning that more than one learning method can be used in one learning model. Furthermore, Suprihatiningrum (2016: 145) states that a learning model is a design that describes a learning process that can be implemented by teachers in transferring knowledge to students. The use of an appropriate learning model will also determine the effectiveness and efficiency of learning. The model in question can then be used as a guideline by teachers in planning and implementing teaching and learning activities.

Observing the initial conditions in class XI TKR 2 SMK Giripuro Sumpiuh during the learning process of light vehicle electrical systems, it is known that the delivery of material in the learning process tends to use a lecture method that focuses on the teacher (teacher-centered). The teacher still predominantly uses the lecture method, so some students are less focused in paying attention to the explanation, the learning process is less conducive, there are still some students who do not pay attention and some students are sleepy. The use of the lecture method in the subject of light vehicle electrical systems is not a mistake, however, the use of the lecture method does not provide enough stimulation for students to be actively involved in the learning process. The disadvantage of the lecture method is that the delivery of material is only one-way, centered on the teacher, students feel bored and tired during the lesson and do not pay close attention to the lesson (Wina Sanjaya, 2013: 149). The use of a less effective lecture learning model has an impact on low student learning outcomes, this can be seen from the results of the daily test for light vehicle electrical systems in class XI TKR

Daily test scores for light vehicle electrical systems indicate that many students' learning outcomes have not yet met the Minimum Completion Criteria (KKM). This is evident from

the average score of 67.43 out of 42 students. The KKM for light vehicle electrical systems is 75. Twenty-nine of the 42 students in class XI TKR 2, or 69.05%, have not achieved the KKM. This indicates low student learning outcomes.

Based on the problems described, it is clear that the learning activity of class XI TKR 2 students at SMK Giripuro Sumpiuh during the learning process is still ineffective. Teachers use learning models that do not encourage students to actively participate in the learning process. This results in a lack of student engagement in the light vehicle electrical systems subject, resulting in low student learning outcomes, as evidenced by the daily test scores for light vehicle electrical systems. One solution to address the learning challenges of class XI TKR 2 students at SMK Giripuro Sumpiuh is to implement a student-centered learning model.

Rabiman (2015: 6) stated that student-centered learning methods include discussion methods, cooperative learning, and problem-based learning, as well as methods that emphasize inquiry and discovery. The discovery learning model is a learning model that uses discovery. The reason for choosing discovery learning is that with this learning model, students are required to actively seek information and discover the concepts of the material being studied. According to Rusman (2016: 203), this learning will create a broader interaction, namely interaction and communication carried out by teachers with students, students with students, and students with teachers. According to Rusman's opinion, learning using the discovery learning model in learning about light vehicle electricity will make students more active. Based on the description above, the researcher is interested in implementing the discovery learning model to improve the activeness and learning outcomes of light vehicle electricity of class XI TKR 2 students at SMK Giripuro Sumpiuh.

2. Literature Review

Discovery Learning

The Discovery Learning Model is a constructivist approach that emphasizes the active role of students in independently discovering ideas and principles. Discovery Learning students not only receive instruction from the teacher but are also asked to think critically and exploratively to organize, process, and discover relationships between concepts, according to Bruner (1961). Stimulation, problem identification, data collection, data processing, verification, and generalization are the main stages of this model. At this stage, students are trained to construct their own knowledge through direct learning experiences. The Discovery Learning Model can help students understand electrical concepts in a practical way in vocational education, particularly in light vehicle electrical lessons. Students can connect theory to workshop practice through simple discoveries and experiments. This model also fosters curiosity and learning motivation because students are actively involved in solving common vehicle electrical problems.

Student Learning Activity

The success of the learning process depends on student learning activity. Student engagement in learning activities such as asking questions, discussing, conducting experiments, and solving problems is a sign of student engagement, according to Sardiman (2018). Because students are placed at the center of learning activities (student-centered learning), student engagement is a key component of the Discovery Learning model. Student engagement in observing electrical circuits, examining symptoms of damage, and drawing conclusions about the working principles of electrical systems is evidence of increased engagement. The more students engage in these activities, the more likely they are to master the basic skills required for light vehicle electrical engineering.

Learning Outcomes

Behavioral changes that occur after the learning process are known as learning outcomes, which encompass cognitive, affective, and psychomotor aspects (Bloom, 1979). Vocational learning outcomes are measured through practical skills, technical problem-solving abilities, and theoretical mastery. Most people believe that the discovery learning model can improve student learning outcomes because it enables them to think independently, consider ideas in real-world situations, and apply those ideas in real-world contexts. Knowledge gained through discovery and reflection becomes more valuable and lasting.

The Relationship between Discovery Learning, Activeness, and Learning Outcomes

Theoretically, learning outcomes and student activeness can be positively influenced by the discovery learning model. Students have sufficient time to research concepts, generate hypotheses, and verify their own results, which results in activeness. Students gain a deeper understanding of the subject through their self-created learning experiences, meaning this increased activeness has a direct impact on their learning outcomes. Utilizing the discovery learning process in light vehicle electrical engineering learning allows students to improve their conceptual understanding and practical skills by linking electrical principles to vehicle failures that occur in the field. Therefore, the application of this model allows for measuring the effectiveness of Discovery Learning through increased activeness during the learning process and learning outcomes.

As a vocational education institution, vocational high schools (SMK) require a learning process that balances knowledge, skills, and work attitudes. The Factory Teaching and Project-Based Learning philosophies align with the Discovery Learning Model, which engages students as active participants in project-based learning activities. Therefore, the application of Discovery Learning in light vehicle electrical learning at vocational high schools enhances students' understanding of electrical theory and enhances their ability to think critically, collaborate, and solve problems, which are essential skills in the modern automotive workforce.

3. Method

The action research design chosen was the Kemmis and McTaggart model. Kemmis & McTaggart, as cited in Arikunto (2015: 41), explain that this model consists of four stages in each cycle: (1) initial reflection, planning, (2) action, (3) observation, and (4) reflection. This research design is a continuous cycle. If the success indicator for the action has not been achieved in one cycle, the second cycle is continued based on the results of the reflection from the first cycle. However, if the success indicator for the action has not been achieved in the second cycle, the next cycle continues until the success indicator is achieved. The subjects of this research were 42 class XI TKR 2 students at SMK Giripuro Sumpiuh. The object of this research is the target. Therefore, the object of this research is the activity and learning outcomes of class XI TKR 2 students in the light vehicle electrical system using the discovery learning model. During the implementation of the action, the researcher acted as an observer and the teacher as the implementer. The first stage is action planning, at this stage the activities carried out consist of compiling a Learning Implementation Plan (RPP) related to the material, making observation sheets for learning implementation, observation sheets for student activity, and making evaluation questions.

The second stage is the implementation of actions by applying the discovery learning model which consists of 6 stages, namely: (1) Stimulation, this stage provides conditions for learning interactions that can develop and help students in exploring the material, (2) Problem statement, this stage the teacher gives students the opportunity to identify as many problems as possible that are relevant to the learning material, (3) Data collection, this stage students are given the opportunity to collect data from various relevant information sources, (4) Data

processing, this stage functions to form concepts and students' understanding is directed towards more specific concepts, (5) Verification, this stage students carry out careful examinations to prove whether the hypothesis is true or not, (6) Generalization, the process of drawing conclusions from the verification results.

The third stage is observation, which can be conducted during the implementation of the action. Observed are student learning engagement during the discovery learning model and the teacher's appropriateness in implementing the discovery learning model, using a previously created observation sheet.

The fourth stage is reflection. The researcher and teacher reflect on the activities undertaken to determine whether they have improved student learning engagement and learning outcomes in the light vehicle electrical system subject. If improvements have not been achieved, a second cycle is necessary, aimed at improving the results not achieved in the first cycle. The cycle ends when the criteria for success of the action have been met.

Data Collection Techniques and Instruments

The data for this study were quantitative and measured using the following instruments: First, a student learning activity observation sheet containing indicators of learning activity. This observation sheet consisted of 17 indicators representing eight categories of student activity. Each indicator item completed received a score of 1, and each item not completed received a score of 0.

Second, a learning outcome test on light vehicle electrical systems was used to determine learning outcomes. This test consisted of 20 multiple-choice questions, administered three times, based on the material presented at the end of Cycle I, Cycle II, and Cycle III. Each correct item received a score of 1, and each incorrect item received a score of 0. Indicators of Action Success and Data Analysis Techniques

The indicators of action success in this study are said to be successful if (1) The percentage of student activity increases in each cycle, and reaches the active predicate, (2) Students who achieve the Minimum Competency (KKM) are more than 75%, (3) The level of student success in the classroom reaches 75% of the total number of students who have passed the KKM with a score of at least 75. (4) There is an increase in student test scores from cycle I to the next cycle. The data analysis technique for measuring learning activity in the classroom is based on the average score obtained by students from the activity observation sheet, then conclusions are drawn according to the criteria using the following formula:

$$DP = \frac{n}{N} x\ 100\%$$

Description:

P = Percentage of students who completed the test.
F = Number of students who scored 75 or higher.
A = Number of students who took the test.

4. Results and Discussion

The results of student learning activity for each indicator showed that student learning activity increased from cycle I, cycle II, and cycle III. In cycle I, the percentage of student learning activity was 52.38%. With these results, it is said that after the action in cycle I, class XI TKR 2 SMK Giripuro Sumpiuh after the action was carried out was categorized as "quite active". In cycle II, the percentage of student learning activity was 64.29%. With these results, it is said that after the action in cycle II, class XI TKR 2 SMK Giripuro Sumpiuh after the action was carried out was categorized as "active". In cycle III, the percentage of student learning activity was 74.79%. With these results, it is said that after the action in cycle III, class

XI TKR 2 SMK Giripuro Sumpiuh after the action was carried out was categorized as "active". The following are the results of the comparison of the increase in student learning activity between cycles, which can be seen in table 2.

Table 1. Comparison of Student Learning Activity Results From Cycle I, Cycle II, and Cycle III.

No.	Learning Activity Indicators	Student learning activity items	Comparison of student learning activity between cycles		
			Cycle I	Cycle II	Cycle III
			Active (%)	Active (%)	Active (%)
1	Visual	1, 2	54,76	67,86	73,81
2	Oral	3, 4	23,81	40,48	58,33
3	Listening	5, 6	26,19	48,81	57,14
4	Writing	7, 8	38,10	55,95	71,43
5	Drawing	9, 10	92,86	94,05	96,43
6	Motor	11, 12	70,24	78,57	90,48
7	Mental	13, 14, 15	54,76	60,32	73,02
8	Emotional	16, 17	57,14	70,24	78,57
	Total		52,38	64,29	74,79

Description of student learning activity items: (1) Students pay attention to the teacher's explanation, (2) Students read the material, books / other references related to the lesson material, (3) Students ask questions about the material taught by the teacher. (4) Students respond to comments, opinions, and answers from friends. (5) Students listen to the teacher's explanation. (6) Students listen to explanations, statements, answers, responses from friends. (7) Students note down the teacher's explanation. (8) Students fill in the starter system and charging system worksheet. (9) Students draw the components of the starter and charging system. (10) Students draw the electrical circuits of the starter and charging system. (11) Students practice the starter system and charging system. (12) Students check the components of the starter system and charging system. (13) Students can discuss, work together in groups (14) Students hold discussions between other groups. (15) Students dare to explain the results of group discussions to the teacher. (16) Students are enthusiastic / excited in the electricity learning process. (17) Students are enthusiastic / excited in practicing the starter system and charging system.

Based on the table above, the average result of overall learning activity in cycle I was 52.38%, increasing to 64.29% in cycle II, and increasing to 74.79% in cycle III. A comparison of the average increase in student learning activity from cycle I, cycle II, and cycle III for each indicator can be seen in Figure 1.

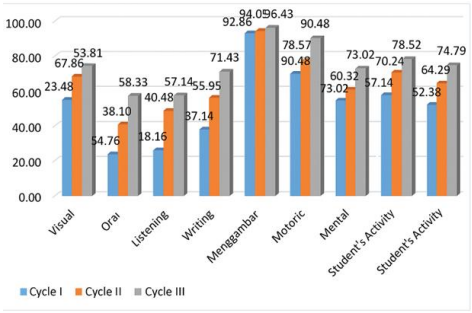

Figure 1. Comparison of Average Percentage of Student Learning Activity in Cycle I, Cycle II and Cycle III.

Learning Outcomes for Light Vehicle Electrical Systems

Student learning outcomes for each cycle showed improvement from Cycle I, Cycle II, and Cycle III. A summary of pre-cycle, Cycle I, Cycle II, and Cycle III scores can be found in the appendix. A comparison of results between cycles can be seen in the following table:

Table 2. Comparison of Daily Test Data, Post-Test Cycle I, Post-Test Cycle II, and Post-Test Cycle III.

Criteria	Daily Test	Cycle I	Cycle II	Cycle III
Number of students who completed the test	13	20	27	37
Number of students who did not complete the test	29	22	15	5
Average student score	67,43	71,19	74,17	77,86
Percentage of completion	30,95%	47,62%	64,29%	88,10%
Number of test participants	42	42	42	42

Based on table 3. the results of the evaluation test on daily tests, cycle I, cycle II and cycle III the average student scores increased. A significant increase can be seen from the number of students who completed the daily test, 13 students increased to 20 students in cycle 1, in cycle 2 increased to 27 students, and increased to 37 students in cycle 3. The number of students who did not complete decreased from 29 to 22 students in cycle 1, in cycle 2 decreased to 15 students, and decreased to 5 students in cycle 3. The average student score increased from 67.43 to 71.19 in cycle 1, in cycle 2 increased to 74.17 and increased to 77.86 in cycle 3. The percentage of completion was from 30.95% increased by 47.62% in cycle I, in cycle 2 increased by 64.29%, and in cycle III the percentage of completion increased by 88.10%. This increase can be seen in Figure 2.

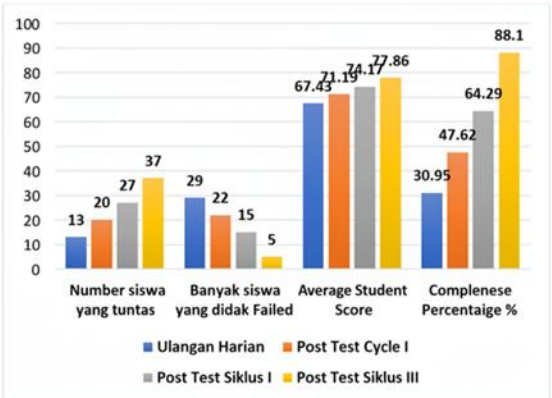

Figure 2. Comparison of Learning Outcomes in Daily Tests, Cycle I, Cycle II, and Cycle III.

Analysis and Discussion

In the Light Vehicle Electrical Engineering subject in grade XI TKR 2 of SMK Giripuro Sumpiuh, students demonstrated a gradual increase in their learning engagement and learning outcomes over time. Prior to the implementation of the model, initial learning conditions indicated low student participation and enthusiasm. Many students appeared inactive, reluctant to voice their opinions, and unable to understand the material independently. This indicated that the previous learning approach was too teacher-centered and did not allow students to actively discover ideas. Student engagement began to show a change after Discovery Learning was implemented in Cycle I. Students have adapted to the learning method that requires them to research, observe, and discuss topics independently. Currently, the learning engagement rate is 52.38%, indicating a fairly active learning level. This improvement indicates that the discovery-based approach can attract students' interest and encourage them to be more involved in the learning process, although it is not yet ideal.

The learning atmosphere improved during the second cycle. Students became accustomed to speaking, asking questions, and working collaboratively in groups. Through practical activities and conceptual exploration, they demonstrated their enthusiasm for solving light vehicle electrical problems. This increased to 64.29%, categorizing them as active learners. Furthermore, this improvement was accompanied by a shift in students' perspectives on learning, resulting in more confident and courageous students expressing their own opinions.

Cycle III showed the greatest improvement, with an active percentage of 74.79%. By this time, students were accustomed to the discovery-based learning model. They were able to ask critical questions, put forward ideas, and independently solve light vehicle electrical problems. This demonstrates the discovery learning model's ability to create a creative, participatory learning environment and foster a strong sense of curiosity.

Data on the increase in student learning activity from each cycle is presented below:

Table 3. Increase in Student Learning Activity.

Cycle	Activity Percentage (%)	Category
I	52,38	Quite Active
II	64,29	Active
III	74,79	Active

Student learning outcomes also improved significantly, in addition to increased engagement. In the first cycle, students achieved an average score of 71.19 with a range of 60–85, indicating an improvement compared to the previous score before the Discovery Learning model was implemented, which averaged 67.43. Although some students still struggled to adapt to the new learning model, most students began to understand the basic concepts of light vehicle electrical engineering through an exploratory process.

Learning outcomes improved during the second cycle, with an average score of 74.17. Students demonstrated a better understanding of the relationships between electrical concepts. They were also able to analyze circuits and relate them to real-world situations in the automotive industry. Students were also able to help each other understand the material through stronger group activities.

Student learning outcomes improved again during the third cycle, with a peak score of 90 and an average of 77.86. At this point, students were able to apply the ideas they learned in real-world workshop situations. As students became more active in interacting, speaking, and demonstrating their experimental results to their peers, the classroom atmosphere became more lively. The following table shows the improvement in student learning outcomes:

Table 4. Showing the improvement in student learning outcomes.

Cycle	Lowest Value	The highest score	Average Learning Outcomes
I	60	85	71,19
II	65	85	74,17
III	70	90	77,86

The increase in student engagement and learning outcomes in each cycle demonstrates the effectiveness of the Discovery Learning model in teaching light vehicle electrical engineering. This model places students at the center of learning activities and allows them to more actively discover concepts through exploratory activities. Furthermore, direct involvement in discovering and solving problems enhances students' contextual and in-depth understanding of the material.

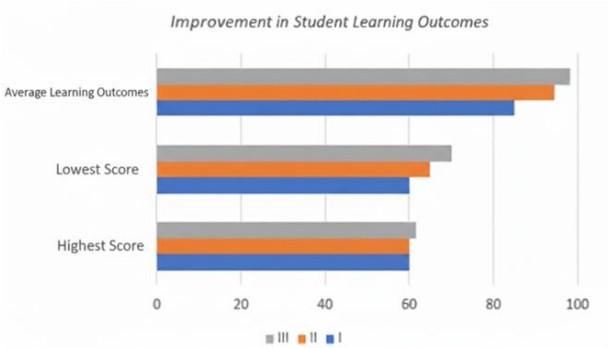

Figure 3. Increase Student Learning Outcomes.

Overall, this study shows that the use of Discovery Learning can improve learning outcomes and student engagement in vocational high schools. With this model, learning focuses not only on the final result but also on the process of thinking, collaborating, and discovering ideas, which are the foundation of vocational competencies in the automotive field.

5. Comparison

When compared to other popular learning strategies in vocational education, the application of the Discovery Learning model in this study demonstrates a notable improvement. In contrast to teacher-centered traditional or project-based models, Discovery Learning encourages students to investigate ideas on their own, increasing their level of engagement and comprehension. The findings show a consistent rise in learning outcomes from 47.62% to 88.10% and student activity from 52.38% in Cycle I to 74.79% in Cycle III. These results suggest that Discovery Learning provides a more efficient and interesting method for raising students' Automotive Electrical Systems performance.

6. Conclusions

Research at SMK Giripuro Sumpiuh found that student engagement and learning outcomes in the Light Vehicle Electrical Engineering subject improved thanks to the implementation of the Discovery Learning model. The results showed that from cycle I to cycle III, student engagement increased from 52.38% to 74.79%, and the learning completion rate significantly increased from 30.95% on daily tests to 88.10% in cycle III. This improvement demonstrates that discovery-based learning can create a more active, collaborative learning environment, and focus on deeper conceptual understanding. Furthermore, it is recommended that the discovery learning model be continuously implemented in productive subjects at vocational schools, particularly those related to light vehicle electrical engineering. In its application to the automotive industry, this research is novel because it emphasizes

students' active involvement in exploring and discovering electrical concepts through hands-on practice. This method not only improves academic performance but also helps students learn critical thinking, problem-solving, and independent learning—skills critical for the 21st-century automotive industry.

Author Contributions: The research design and framework were conceived by D.J. and A.S. D.J. created the initial paper draft, carried out data analysis, and designed the technique. The instruments were validated and the results were examined by A.S., A., and E.T.W. Data collection and classroom implementation were done by M.N. and D.J. The manuscript was reviewed and edited by E.T.W. and M.N. A.S. oversaw the entire procedure and provided resources and cash for the study.

Funding: There was no outside support for this study. The research team from Universitas Muhammadiyah Purworejo, Indonesia, took the initiative to completely support the project.

Data Availability Statement: The corresponding author can provide the data supporting the study's conclusions upon request. Due to institutional privacy and ethical constraints pertaining to respondents (teachers and students from vocational schools), the data are not publicly accessible.

Acknowledgments: Universitas Muhammadiyah Purworejo provided academic and administrative support during the project, for which the authors are very grateful. We also like to express our gratitude to the Kedu Residency area's vocational school partners for their assistance with the data collection.

Conflicts of Interest: There is no conflict of interest disclosed by the writers. The funders were not involved in the study's design, data collection, analysis, or interpretation, manuscript writing, or decision to publish the findings.

References

Agus Cahyo. (2013). *Panduan aplikasi teori-teori belajar mengajar teraktual dan terpopuler*. Yogyakarta: Diva Press.

Ainur Rochim, & Joko. (2014). Implementasi model pembelajaran penemuan (discovery learning) pada kompetensi inti memperbaiki peralatan rumah tangga listrik. *Jurnal Pendidikan Teknik Elektro, 3*(3), 485–491.

Alfian Mintarta, & Pairun Roniwijaya. (2015). Penerapan metode inkuiri untuk meningkatkan motivasi dan hasil belajar alat ukur siswa kelas X program studi mekanik otomotif di SMK Tamansiswa Jetis Yogyakarta tahun pelajaran 2014/2015. *Jurnal Taman Vokasi, 3*(32), 477–489.

Atika, A., & Andriati, N. (2023). *Minat belajar anak slow learner*. Jambi: PT Sonpedia Publishing Indonesia.

Bambang Wiji Prayitno, & Rezky Nefianthi Dian. (2017). Meningkatkan keaktifan siswa dengan model discovery learning pada konsep klasifikasi makhluk hidup. *Jurnal Pendidikan Hayati, 3*(4), 136–143.

Chusin Mubarok, & Edi Sulistyo. (2014). Penerapan model pembelajaran discovery learning terhadap hasil belajar siswa kelas X TAV pada standar kompetensi melakukan instalasi sound system di SMK Negeri 2 Surabaya. *Jurnal Pendidikan Teknik Elektro, 3*(1), 215–221.

Depdiknas. (2005). *Permendiknas Nomor 19 Tahun 2005 tentang Standar Nasional Pendidikan*. Jakarta: Depdiknas.

Depdiknas. (2007). *Permendiknas Nomor 41 Tahun 2007 tentang Standar Proses*. Jakarta: Depdiknas.

Dharmayanti, W., & Munadi, S. (2014). Faktor-faktor yang memengaruhi minat siswa SMP masuk SMK di Kota Pontianak. *Jurnal Pendidikan Vokasi, 4*(3), 405–419.

Diba, A. F. (2013). *Pengaruh persepsi siswa dan interaksi teman sebaya terhadap minat studi ke SMK siswa SMP Negeri 1 Pleret Bantul* (Skripsi). Universitas Negeri Yogyakarta, Yogyakarta.

Diba, M. F. (2019). *Pengaruh status sosial ekonomi orang tua, budaya belajar, dan lingkungan sosial terhadap minat melanjutkan studi pada siswa SMP Negeri 1 Saptosari Gunungkidul* (Tesis). Universitas Negeri Yogyakarta, Yogyakarta.

Dimyati, & Mudjiono. (2013). *Belajar dan pembelajaran*. Jakarta: Rineka Cipta.

Dodi Setiawan, & Suparmin. (2016). Meningkatkan keaktifan dan hasil belajar materi sistem stater pada mata pelajaran pemeliharaan kelistrikan kendaraan ringan dengan metode penemuan terbimbing. *Jurnal Taman Vokasi, 4*(2), 271–277.

Dony Borneo, & Rabiman. (2015). Penerapan metode pembelajaran inkuiri untuk meningkatkan keaktifan belajar dan hasil belajar mata diklat sistem injeksi bahan bakar bensin. *Jurnal Taman Vokasi, 3*(32), 444–453.

Euis Karwati. (2014). *Manajemen kelas (classroom management)*. Bandung: Alfabeta.

Harry Suhato, & Pairun Roniwijaya. (2014). Improvement efforts to learn lessons activities chassis power transfer standard competence and correct steering system. *Jurnal Taman Vokasi, 1*(2), 264–274.

Hosnan, M. (2014). *Pendekatan saintifik dan kontekstual dalam pembelajaran abad 21*. Bogor: Ghalia Indonesia.

Ihdi Shabrona Putri, Rita Juliani, Ilan, & Nia Lestari. (2017). Pengaruh model pembelajaran discovery learning terhadap hasil belajar siswa dan aktivitas siswa. *Jurnal Pendidikan Fisika, 6*(2), 91–94.

Jatmoko, D., Susanto, A., & Purwoko, R. Y. (2021). The implementation of ARCS learning model to improve students learning activities and outcomes. *Tarbawi: Jurnal Ilmu Pendidikan, 17*(2), 137–144.

Jefrian. (2022). Minat siswa kelas IX SMP Negeri 17 Bengkulu Utara untuk melanjutkan studi ke sekolah menengah kejuruan. *Computer and Informatics Education Review (CIER), 3*(1), 17–21.

Maher, A. (2004). Learning outcomes in higher education: Implications for curriculum design and student learning. *Journal of Hospitality, Leisure, Sport and Tourism Education, 3*(2), 1–11.

Nana Sudjana. (2011). *Penilaian hasil proses belajar mengajar*. Bandung: PT Remaja Rosda Karya.

Nurmala, S. (2012). Faktor-faktor yang mempengaruhi minat siswa untuk melanjutkan ke sekolah menengah kejuruan. *Jurnal Kependidikan, 42*(2), 162–172.

Oemar Hamalik. (2008). *Perencanaan pengajaran berdasarkan pendekatan sistem*. Jakarta: Bumi Aksara.

Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 34 Tahun 2018 tentang Standar Nasional Pendidikan SMK/MAK.

Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 1 Tahun 2021 tentang Penerimaan Peserta Didik Baru.

Primartadi, A., Jatmoko, D., Kamin, Y. B., & Arifin, Z. (2025). Integration of virtual reality media in teaching factory to enhance 4C skills in vocational education. *International Journal of Recent Educational Research, 6*(4), 1136–1148. https://doi.org/10.46245/ijorer.v6i4.936

Rabiman. (2015, Mei). Memilih metode pembelajaran untuk mata pelajaran produktif pada SMK program keahlian teknik otomotif. Makalah pada *Seminar Nasional Pendidikan Teknik Otomotif*, Universitas Muhammadiyah Purworejo.

Rahmat, P. S. (2018). *Psikologi pendidikan*. Jakarta Timur: PT Bumi Aksara.

Rusman. (2016). *Model-model pembelajaran*. Jakarta: PT Raja Grafindo Persada.

Sardiman. (2012). *Interaksi dan motivasi belajar mengajar*. Jakarta: PT Raja Grafindo Persada.

Sudijono, A. (2010). *Pengantar statistik pendidikan*. Jakarta: Raja Grafindo Persada.

Sugiyono. (2019). *Metode penelitian kuantitatif, kualitatif, dan R&D*. Bandung: Alfabeta.

Suharsimi Arikunto. (2015). *Penelitian tindakan kelas*. Jakarta: Bumi Aksara.

Suprihatiningrum, J. (2016). *Strategi pembelajaran: Teori & aplikasi*. Yogyakarta: Ar-Ruzz Media.

Suyitno, S., Yusri bin Kamin, N. A. L., Widiyatmoko, W., & Jatmoko, D. (2024). Starter system learning media to improve learning outcomes in vocational school. *Jurnal Kependidikan / Mandala Education*.

Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional.

Widoyoko, S. E. P. (2017). *Evaluasi program pembelajaran: Panduan praktis bagi pendidik dan calon pendidik* (Cet. 1). Yogyakarta: Pustaka Pelajar.

Widoyoko, S. E. P. (2018). *Teknik penyusunan instrumen penelitian*. Yogyakarta: Pustaka Pelajar.

Wina Sanjaya. (2013). *Strategi pembelajaran berorientasi standar proses pendidikan*. Jakarta: Kencana.