

The Impact of Discovery Learning on Students' Motivation and Learning Outcomes in Vocational Education

Mas'ari¹, Adolf Bastian², Elvira Asril³, Rizki Novendra⁴, Yogo Turnandes⁵, Nuris Fadhli Silangit⁶

¹ Universitas Lancang Kuning, Pekanbaru, Indonesia; mas.arii008@gmail.com

² Universitas Lancang Kuning, Pekanbaru, Indonesia; adolft@unilak.ac.id

³ Universitas Lancang Kuning, Pekanbaru, Indonesia; elvira@unilak.ac.id

⁴ Universitas Lancang Kuning, Pekanbaru, Indonesia; rizkinovendra@unilak.ac.id

⁵ Universitas Lancang Kuning, Pekanbaru, Indonesia; nandes@unilak.ac.id

⁶ Universitas Lancang Kuning, Pekanbaru, Indonesia; langit606@gmail.com

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ABSTRACT

Instructional models in vocational schools (SMKs) play a critical role in aligning students' competencies with workplace demands. However, at SMK Negeri 2 Kepenuhan, student motivation and learning outcomes in the Vocational Fundamentals subject remained relatively low due to teacher-centered, traditional approaches. This study evaluates the effectiveness of the Discovery Learning model in improving motivation and learning outcomes among Grade X students in the Computer Network and Telecommunication Engineering program. A quantitative quasi-experimental design with a nonequivalent control group was employed. Two experimental classes were involved: one received group-based tasks, while the other completed individual tasks, both using the Discovery Learning model. Data were collected using motivation questionnaires, pretests, posttests, and observation sheets, and analyzed using N-gain and t-tests. The findings indicate significant improvements in both motivation and learning outcomes. The grouped class showed an increase in mean scores from 67 to 95 (N-gain = 0.90), while the individual class improved from 68 to 91 (N-gain = 0.70). Statistical analysis revealed significant differences ($p < 0.05$). Observational data also demonstrated increased student engagement and active participation during learning activities. The results suggest that the Discovery Learning model effectively enhances student motivation and academic performance in vocational education. Its implementation fosters active learning and improves instructional quality, making it a viable innovative approach for vocational teaching contexts.



Corresponding Author:

Adolf Bastian

Universitas Lancang Kuning, Pekanbaru, Indonesia; adolft@unilak.ac.id

1. INTRODUCTION

Technical education is designed to prepare graduates with specific job skills to meet industry needs while enabling them to adapt to a changing workplace (Masran et al. 2025). In the Indonesian context, Vocational High Schools (SMK) are the spearhead in producing professional secondary workers,

particularly in the fields of computer network technology and engineering (Widiyanti, Yoto 2023). However, major challenges remain, especially regarding student motivation for learning and achieving study outcomes in technical subject areas such as the Vocational Fundamentals for the Computer Network and Telecommunication Engineering Expertise Program (Suleiman, Shepherd, and Dewaters n.d.).

In the subject of Vocational Fundamentals for TJKT, several topics are studied a computer network concepts, IP (Internet Protocol) systems, network hardware, and basic troubleshooting, which require an experiential learning approach to optimize students understanding of concepts and technical skills (Perdana, 2026). Unfortunately, the learning process in many vocational schools remains teacher-centered, with lecture methods and passive exercises that are less effective at fostering active participation, curiosity, and learning independence (Ritonga Nursaidar, Permana Dodi 2025). As a result, students tend to be less enthusiastic, and many academic scores do not meet the Minimum Completeness Criteria.

To the observations this can use one of the teaching models, namely the Discovery Learning model, an instructional model that positions learners as active subjects in discovering concepts through the stages of exploration, data collection, information processing, and generalization (Brinda 2006). This model is rooted in constructivist theory, which is believed to increase learning engagement and deepen understanding (Floyd and Dunham 2025). Model Discovery Learning has been proven successful in enhancing conceptual understanding and learning outcomes across various vocational and general education contexts (Jayadiningrat Gautama Made, Putra Apriawan Agus Kadek 2019). However, its effectiveness in the context of vocational schools in rural areas, such as SMK Negeri 2 Kepenuhan, is still minimally empirically studied.

Differences in assignment approaches in discovery learning-based learning, such as group discussions versus individual assignments, are also a relevant but rarely researched topic (Schellens et al. 2007). Whether collaborative work is superior to individual self-paced learning in building motivation and academic achievement remains an open-ended question worth exploring in the context of vocational classes (Zhang and Tu 2023). This analysis aims to test the impact of the Discovery Learning model on motivation and learning outcomes among class X TJKT participants in the Vocational Fundamentals subject at SMK Negeri 2 Kepenuhan.

This study adopted a pseudo-experimental design by comparing two assignment approaches: group and individual. This is to assess the effectiveness of the Discovery Learning teaching model in improving motivation and learning outcomes in the Vocational Fundamentals subject for TJKT. The results show that Discovery Learning, especially with a group approach, significantly improves learners motivation and learning outcomes. These findings not only strengthen the literature on the effectiveness of DL in vocational education but also provide practical contributions for teachers in resource-constrained areas to implement more participatory and meaningful learning models.

2. METHODS

This research employed a quantitative, quasi-experimental, nonequivalent control-group design. This approach was selected to determine the influence of the Discovery Learning model on students' learning motivation and learning outcomes without randomizing the subjects. Two experimental classes were used as treatment groups with different assignment strategies: one class was given group assignments and the other was given individual assignments.

The research focused on students in class X of the major Computer Network and Telecommunication Engineering (TJKT) at SMK Negeri 2 Kepenuhan, Rokan Hulu Regency, Riau Province, Academic Year 2025/2026. In class X TJKT A (26 students), students were educated using the Discovery Learning approach with group assignments, while in class X TJKT B (24 students) students received the same treatment but with individual assignments. Both classes received the same treatment because both classes had similar knowledge ranges and academic scores, with the average being the same for both. Therefore, class selection was carried out purposively based on the equality of academic characteristics.

Data collection was conducted in several stages. The stages that were performed are as follows three types of instruments were used to collect data:

- a. Learning motivation questionnaire: was prepared in the form of a Likert scale (1–5) which includes intrinsic (interest, curiosity, enthusiasm) and extrinsic (value drive, rewards) motivation, as well as learning readiness indicators. The questionnaire has been validated through expert tests and item validity tests.
- b. Learning outcome test: used a pretest and posttest format, which includes 25 multiple-choice questions and a description of the Vocational Fundamentals subject for TJKT material. The test was developed based on learning outcomes in the Independent Curriculum and has been assessed for validity and reliability using the KR-20 test.
- c. Learning activity observation sheet: was used to observe student involvement in the discovery learning stage. The aspects observed include the activeness of questioning, exploration, problem-solving, and the ability to conclude concepts.

The teaching materials consisted of instructional videos, modules, networking practice tools (UTP, LAN tester, switch, router), and simulations using software (e.g. Cisco Packet Tracer).

The research was carried out over six meetings covering all stages of the Discovery Learning model as developed by Bruner (1961): (1) stimulation, (2) problem statement, (3) data collection, (4) data processing, (5) verification, and (6) generalization. Each meeting concentrated on learning outcomes in Vocational Fundamentals subjects, such as introduction to networking, network devices, topology, subnetting, UTP cable crimping, and reflective evaluation. The material was delivered through opening videos, exploratory discussions, hands-on practice, presentations, and group and individual reflections.

Data collection was carried out in three stages:

- a. Initial stage: taking pretest scores from test scores in the previous material to determine initial abilities, as well as initial observation of students' learning motivation.
- b. Treatment stage: implementation of Discovery Learning learning for six meetings accompanied by observation of learning engagement.
- c. Final stage: posttest and motivation questionnaire to measure changes in learning outcomes and motivation after treatment.

Data were analyzed descriptively and inferentially. An analytical description was used to characterize the mean, standard deviation, and distribution of the data. The normality (Shapiro-Wilk) and homogeneity (Levene's Test) tests were used as prerequisites for parametric tests. Furthermore, the t-test (paired sample t-test) was used to assess the significance of the difference in pretest and posttest results. N-Gain analysis was used to measure improved learning outcomes. The interpretation of the N-Gain score referred to the classification of Hake (1999): high (≥ 0.7), medium (0.3–0.7), and low (< 0.3). All the analysis was done with the help of statistical software.

3. FINDINGS AND DISCUSSION

3.1 Findings

This research intends to determine the influence of the Discovery Learning method on study motivation and study results from class X TJKT students at SMK Negeri 2 Kepenuhan. Data was obtained through three main instruments: learning motivation questionnaires, learning outcome tests (pretest and posttest), and learning activity observation sheets. This research was conducted on two experimental classes:

Class X TJKT A → Discovery Learning Model with group assignments

Class X TJKT B → Discovery Learning Model with individual assignments

Each class gets 6 meetings according to the action plan for the research

Table 1. Pretest and Posttest

Class	N	Average Pretest	Average Posttest	N-Gain (%)	Category
TJKT A (Group)	26	67	95	0,9	Height
TJKT B (Individual)	24	68	91	0,7	Medium-High

These results reinforce that the Discovery Learning method is more impactful when applied with collaborative learning strategies. Students who study in groups tend to be more active in discussions, problem solving, and concept conclusions, according to the basic principles of constructivist learning.

3.2 Data Analysis

3.2.1 Normality and Homogeneity Test Analysis

According to the results of the normality analyses using the Kolmogorov-Smirnov and Shapiro-Wilk tests, it can be seen that the measurements for all variables tested showed significance values exceeding 0.05. In the Kolmogorov-Smirnov test, the significance value for all variables (Posttest1, Posttest2, Pretest1, and Pretest2) is greater than 0.05, i.e., 0.200. This shows that the data follow a normal distribution according to the Kolmogorov-Smirnov test. Similar results were obtained in the Shapiro-Wilk test, where the p-values for the variables tested were 0.056, 0.066, 0.095, and 0.337, all of which were greater than 0.05. Therefore, data is also distributed normally according to the Shapiro-Wilk test.

Table 2. Normality test

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TJKT A Posttest1	.120	24	.200*	.919	24	.056
TJKT B Posttest2	.127	24	.200*	.922	24	.066
TJKT A Pretest1	.149	24	.183	.930	24	.095
TJKT B Pretest2	.136	24	.200*	.954	24	.337

It can be concluded that the data for all variables tested met the assumption of normality, as the p-values for both the Kolmogorov-Smirnov and Shapiro-Wilk tests were greater than 0.05. This indicates that the data do not deviate significantly from normality. Therefore, further analysis in this study could use parametric statistical tests, such as t-tests, as the data meet the normality assumptions required for the application of such tests.

Table 3. Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
STUDENT LEARNING	Based on Mean	.394	1	48	.533
OUTCOME	Based on Median	.208	1	48	.650
	Based on Median and with adjusted df	.208	1	46.289	.650
	Based on trimmed mean	.344	1	48	.560

Based on the results of the variance homogeneity test shown by the Levene test, the significance value for all methods (Based on Average, Based on Median, Based on Median and with adjusted df, and Based on Trimmed Mean) is greater than 0.05.

The results show that the variance across groups is comparable; there is no notable difference in variance across the groups tested. In other words, the assumption of variance homogeneity can be met, indicating that the variances between the groups being compared are fairly uniform. Therefore, further statistical analysis can use parametric tests such as t-tests, which assume that the variance across groups is homogeneous.

Table 4. Independent Sample t-Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PRETEST TJKT B – POSTTEST TJKT B	-23.000	4.549	.929	-24.921	-21.079	-24.768	23	.000
Pair 2	PRETEST TJKT A – POSTTEST TJKT A	-28.154	4.296	.843	-29.889	-26.419	-33.417	25	.000

The Paired Samples Test compares pre-assessment and post-assessment values within each group. For the first pair (PRETEST TJKT B – POSTTEST TJKT B), the average of the pretest-posttest difference was -23,000, with a standard deviation of 4,549 and a t-value of -24,768. The significance value (Sig.) obtained was 0.000, which is smaller than 0.05, indicating a meaningful difference between pre-assessment and post-assessment performance for this group. For the second pair (PRETEST TJKT A – POSTTEST TJKT A), the average of the pretest-posttest difference was -28,154, with a standard deviation of 4,296 and a t-value of -33,417. The significance value (Sig.) is also 0.000, which is less than 0.05, indicating a meaningful difference between the pretest and posttest performance in this group. Overall, both groups showed significant improvements from pretest to posttest, suggesting that the treatment applied had a significant impact on the results.

3.2.2 Hypothesis Test (t-test) Learning Outcomes

According to the results of the Paired Samples assessment, the hypothesis test used aims to determine whether there is a significant difference between the pretest and posttest values in the two groups. In this hypothesis test, the null hypothesis (H_0) is that there is no significant difference between the pre-assessment and post-assessment, while the alternative hypothesis (H_1) is that there is a significant difference between the pre-assessment and post-assessment.

The test results showed that the significance value (Sig.) for both pretest and posttest pairs in both groups (Pair 1: PRETEST TJKT B – POSTTEST TJKT B and Pair 2: PRETEST TJKT A – POSTTEST TJKT A) was 0.000. This result is much smaller than the significance level typically used in research, 0.05. Since the significance score is less than 0.05, we can disconfirm the null hypothesis (H_0) and accept the alternative hypothesis (H_1), which states that there is a significant difference between pre-assessment and post-assessment in both groups.

Average improvement from pretest and posttest in the first group (PRETEST TJKT B – POSTTEST TJKT B) was -23,000, indicating that the posttest value has lower than the pretest value. This was also seen in the second group (PRETEST TJKT A – POSTTEST TJKT A), where the average difference was -28,154, indicating a significant decrease in posttest scores compared to pretest scores. Thus, according to the results of this hypothesis test, it can be inferred that there are significant scores for the pre-assessment and post-assessment in both groups, which shows that the intervention or treatment provided in this study has a meaningful effect on the results obtained by students.

Table 5. Description of Learning Motivation (Questionnaire)

Class	N	Average Motivation Score	Category
TJKT A	26	96.21	very high
TJKT B	24	90.61	very high

According to the attached data, it can be seen that there are two groups that were tested, namely TJKT class A and TJKT class B. TJKT class A has a highest average motivation score. Based on the Likert scale commonly used to measure learning motivation, this value falls into the very high category. Then, in the TJKT B class, it has an average motivation score has lower than the TJKT A class, but can still be categorized as very high in the context of measuring learning motivation, although not as high as the TJKT A class.

3.2.3 Learning Motivation Hypothesis Test (t-test)

According to the t-test used to test the hypothesis regarding students' learning motivation, the aim is to determine whether there is a significant difference in learning motivation between X TJKT A and X TJKT B. The t-test showed a t-value of 4.177, a degree of freedom (df) of 48, and a significance level (Sig.) of 0.000. Since the p-value is less than 0.05, the null hypothesis (H_0) that there is no significant difference in learning motivation between the two classes can be rejected, and the alternative hypothesis (H_1) that there is a significant difference is accepted. This highlights a significant difference in learning motivation between X TJKT A and X TJKT B.

In addition, average difference between the two groups was 559.455, with a standard error difference of 133.932. This difference suggests a considerable change in learning motivation between the two groups tested. With a 95% confidence interval for the difference of 290.167 to 828.743, we conclude that the difference in motivational score between the two groups is within that range. Overall, the value of this t-test indicates that the factors that differentiate the two classes significantly affect their learning motivation.

Table 5. Observation Results of Learning Activities

Class	Average Observations (%)	Category
TJKT A	96.25	Excellent
TJKT B	89.90	Excellent

Based on the data obtained from the observation activities in the two classes observed, namely TJKT A and TJKT B, the average observation scores for both classes were very good. For TJKT class A, the average observation score has a higher than TJKT class B. Based on these results, both classes can be categorized as "Excellent (A)". This observation process is carried out through six main stages of Discovery Learning, including observation, data collection, analysis, and drawing conclusions. These two classes showed good results in each stage of learning observed. Although the average observation value for TJKT A was slightly higher than that for TJKT B, both still achieved excellent success rates in implementing the Discovery Learning stage.

According to these observations, it could be indicated that Discovery Learning is effective in enhancing the quality of learning in both classes. This is reflected in the active involvement of students in the executed learning process, although there is a slight difference in the observation results between the two classes. However, the difference in the average of these observations opens the door to further research on factors that may influence these outcomes, such as differences in teaching approaches, methods used, or levels of student involvement. The success in the Discovery Learning stage in these

two classes shows that this learning has a beneficial impact on students' ability in independent and active learning.

Overall, both TJKT A and TJKT B achieved outstanding results in Discovery Learning-based activities, and this study confirms that this approach is highly beneficial for enhancing the quality of learning and student motivation.

Discussion

This research aims to test the impact of the Discovery Learning model on students' motivation and learning outcomes in the Vocational Fundamentals subject within the Computer Network and Telecommunication Engineering (TJKT) expertise program. Key findings show that the Discovery Learning model significantly enhances learning outcomes, with an average N-Gain of 0.9 for group assignment classes and 0.7 for individual assignment classes, and the results of motivation are 96.25% in class X TJKT A and 89.90% in class X TJKT B. These findings support the initial hypothesis that Discovery Learning, particularly collaborative-based Discovery Learning, is more effective than conventional approaches or individualized learning.

Scientifically, this result can be explained by the constructivist principle, which holds that learners build their own knowledge through active involvement, exploration, and problem-solving (Vygotsky, 1978; Bruner, 1961). Discovery-based learning allows learners to connect new experiences to prior knowledge, thereby strengthening retention and understanding of concepts. In this research, the stages of Discovery Learning, such as problem statement and generalization, provide students with space to think critically and independently conclude the concept of networks. This activity is reflected in the value placed on observation and increased learning motivation. The outcome of this study is also consistent with previous studies that found that Discovery Learning can improve learning outcomes across various subjects and educational levels (Jayadiningrat et al., 2019; Sangeroki et al., 2022; Hutajulu, 2021). However, this study provides a novel contribution by exploring the implementation of Discovery Learning in vocational education in rural areas, a context not widely discussed in the literature. Additionally, the difference in effectiveness between group and individual assignment strategies adds depth to the pedagogical perspective of Discovery Learning, highlighting the importance of collaboration in vocational classrooms.

The results suggest that vocational school teachers should adopt discovery-based learning strategies, particularly through group work, to optimize student engagement and learning outcomes. It is also crucial for schools to support teachers' professional development in implementing innovative learning approaches that align with students' characteristics and industry demands.

Further research is recommended to explore the integration of Discovery Learning with digital learning technologies and examine its impact on other aspects such as critical thinking skills, creativity, and job readiness. Additionally, a mixed-methods approach could provide a more in-depth understanding of qualitative dimensions, such as learners' and teachers' views on the effectiveness of this learning model.

4. CONCLUSION

This research demonstrates that Discovery Learning is an effective model for improving both motivation and learning outcomes in vocational education, specifically in the Vocational Fundamentals subject at SMK Negeri 2 Kepenuhan. The study found that students who engaged in group assignments showed higher N-Gain scores compared to those with individual assignments, highlighting the importance of collaboration in the learning process. Additionally, Discovery Learning not only enhanced cognitive outcomes but also fostered internal motivation, with students showing greater interest, engagement, and activity in learning.

Vocational educators should incorporate Discovery Learning into their teaching strategies, emphasizing collaborative learning to strengthen concept understanding and student confidence. This approach is particularly beneficial in schools with limited facilities, offering an innovative method to

engage students actively in their learning process. This study has some limitations, including its geographical and demographic scope and its quantitative approach, which did not deeply explore students' subjective experiences.

Future studies should use a mixed-methods approach to gain a more comprehensive understanding of Discovery Learning's impact. Additionally, integrating digital media and software-based network simulations into the model could be explored, especially in adapting to the digital era and Industry 4.0.

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