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Effect of the 2D-LoA instructional model on vocational students' learning outcomes in higher education

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Abstract: This study aims to help vocational students in higher education learning environments. One way to achieve this goal is by using the 2D-LoA instructional model. This model is based on the widening gap between theoretical and practical knowledge, especially technical skills for vocational students. This quasi-experimental study compared the learning outcomes of 34 automotive engineering students following pre-test and post-test assessments. The experimental group was given treatment with the 2D-LoA model, while the control group received traditional learning. The independent samples t-test analysis showed that the experimental group significantly improved practical learning outcomes ($p < 0.05$) and demonstrated an average N-gain on practical skills of 0.58. However, practical learning outcomes did not show improvement as predicted by previous learning outcome models but indicated a positive trend ($p=0.08$). These findings contribute to practical skills, an essential aspect of vocational education, using the 2D-LoA model. The study emphasizes the promise of the 2D-LoA instructional approach in providing non-immersive computer-based interactivity for learners, as opposed to the passive absorption of theoretical concepts. More moderate results in enhancing the learning of theoretical concepts point to a need to improve the model to better aid the learning of concepts. The practical implications of this study are that teachers can use the 2D-LoA model in subjects that require a strong mastery of practical skills, such as science, technology, and vocational education.
Keywords: *Direct learning, Drill and practice, Higher education, Learning outcomes, Learning-oriented assessment.*

1. Introduction

Rapid change is a characteristic of industry 4.0. Human Resources (HR) must follow the rapid changes in this era. Optimizing education is an effort to improve HR capabilities in mastering knowledge and skills in science and technology. Reliable HR can contribute to national productivity and affect community welfare. The main determining factor for the high competitiveness of a nation is the high quality of the nation's HR so that it can face rapid changes. Reforming the education system is a means to build capacity for sustainable improvement commonly carried out in the Asia-Pacific region [1-4]. Teachers have a heavy burden in carrying out their profession, namely producing quality graduates and leading them to graduate and achieve their dreams. One of the goals of graduates is to work. However, according to data from the Central Statistics Agency (Badan Pusat Statistik or BPS in Indonesia), the open unemployment rate based on education level is 9.31% of vocational high school graduates [5].

Vocational education has long relied on a variety of instructional models to equip students with the practical skills needed in their respective fields. Traditional methods often include teacher-based approaches, where theoretical concepts are taught without sufficient hands-on application, and

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demonstration models, which showcase skills but may provide few opportunities for student engagement. Previous research results show several problems. First, the dominant learning approach focuses on theory without adequate integration with direct practice. Thus, students' understanding is less in-depth. This lack of practical application causes a gap between what is studied and its application to facts in the field. Furthermore, existing instructional models often ignore the development of high-level thinking skills, problem-solving abilities, and student motivation [6]. Teachers tend to rely on conventional teaching methods [7]. Excessive emphasis on theoretical knowledge and lack of practical application have a negative impact on student's academic performance and achievement [8]. Second, repetitive exercises or drills and practices that are less structured and rarely applied in the learning process result in low practical skills for students. Many students have difficulty identifying information related to critical problems and solving problems due to the inability of teachers to facilitate active learning [9]. Empirical data shows that this non-holistic learning model hurts student learning outcomes. The academic grades do not reflect mastery of the material and are often below expected standards. The lack of media use and reliance on monotonous conventional teaching methods cause students to pay less attention and have difficulty understanding the concepts [10]. Furthermore, the assessment process does not accurately evaluate students' high-level thinking skills, including focusing on memorization and shallow learning [6].

Direct learning is time-efficient and aims to teach procedures and skills directly [10]. In this model, instructions and demonstrations provide real examples that students can imitate, helping them observe, understand, and develop skills through practice. Effective implementation of direct learning can attract students' interest in imitating and developing the material presented [11]. Deliberate practice with feedback produces powerful results in improving students' procedural skills [12]. The drill & practice method focuses on repetitive practice with direct experience to optimize learning outcomes, improve performance, and reduce the cognitive load of learners [13, 14].

Learning-oriented Assessment (LOA) emphasizes assessment as an integral part of learning, with assessment as learning as a central component that encourages learners to control their learning activities [15]. The combination of direct learning models and drill and practice methods with the LOA approach aims to improve student learning outcomes in college as prospective automotive teachers. However, the design and implementation of the model need to be formulated to achieve optimal learning outcomes. In the automotive sector, especially in vehicle maintenance and repair, this approach is very relevant to improving the technical competence of prospective teachers. This study uses the term 2D-LOA for this instructional model.

2. Literature review

2.1. Theoretical Framework

The learning theories of the 2D-LOA instructional model include behavioral, cognitive, and constructivist learning theories. Thorndike argued that learning often occurs through a series of trial-and-error experiments. Repetition allows for the formation of mechanical connections. Thorndike proposed the law of readiness, practice, and consequences. There will be an increase in the relationship between the stimulus and the satisfying response. Practicing and using associations increases their strength [16].

According to Piaget, assimilation, accommodation, and equilibration are the three steps in the learning process. Assimilation and accommodation play an essential role in the human brain. Accommodation means continuous adjustment between assimilation and accommodation, while accommodation means changing the internal structure to be consistent with the outside world. Therefore, the knowledge structure is changed to accept or adjust to new experiences [16]. Cognitive learning theory includes Roger Schank's theory of learning by doing. Providing opportunities to do so is a learning process. Learning experiences consist of various actions taken. The concept can be applied by doing, correcting errors, varying tasks, giving repeated tasks, and eliminating actions [17].

Constructivism theory explains learning as an active process in which students create knowledge. Constructivism emphasizes the relationship between individuals and various situations in the development and development of skills. According to the social constructivist model, social interactions are essential for mastering knowledge and skills. Constructivism states that humans actively develop knowledge. Observing phenomena, collecting data, creating or testing hypotheses, and working together are all examples of constructivist learning activities [16]. Therefore, constructivism is consistent with social cognitive theory, which states that individuals, behavior, and the environment interact.

Unlike traditional instructional models that often emphasize theoretical understanding, the 2D-LOA instructional model emphasizes hands-on experience. In automotive engineering, students engage in hands-on manipulation of tools and components, allowing them to apply theoretical concepts to real-world scenarios. This experiential learning promotes deeper understanding and retention of skills, in line with Dale's Learning Pyramid, which suggests that students retain more material from hands-on activities.

2.2. Direct Learning

Direct learning or direct instruction is also known as active teaching. Direct learning is also called whole-class teaching. This term refers to a teaching style where the teacher is actively involved in bringing the content to students and teaching it directly to the entire class [18]. This model can build well-structured declarative knowledge and procedural knowledge through gradual and step-by-step activity patterns [19]. Direct learning develops student learning activities to aspects of procedural knowledge (knowledge of how to do something) and declarative knowledge (knowledge about something that can be facts, concepts, principles, or generalizations) that are well structured and learned gradually. The focus of learning is training from simple to complex. Direct teaching is more teacher-centered, so it must ensure active student involvement. Educators deliver academic material in a structured manner, direct student activities, and test skills through exercises under the guidance and direction of educators. The friendly learning environment supports direct teaching [20].

2.3. Drill and Practice

Drill and practice are rooted in behaviorism theory. It focuses on the repetition of stimulus-response exercises that lead to the reinforcement of habits and consequently facilitate the mastery of learning content. Drill techniques involve repetitive practice activities to improve learning outcomes in various areas. In the educational context, the drill method ensures continuous practice and reinforcement of skills [21-23]. This technique is valuable for improving specific skills such as speaking ability in language learning, movement development in children with cerebral palsy, and skill development in sports such as tennis. By combining repeated practice and activities, drill techniques help individuals refine their abilities, improve understanding, and achieve proficiency in various domains [21, 22, 24]. The drill approach encourages consistent practice and increases skill and mastery over time.

2.4. Learning-Oriented Assessment

LOA focuses on three core elements, namely assessment tasks that promote learning, student engagement in assessment through evaluative skills, and feedback that facilitates improvement [25]. In addition, assessment tasks reflect desired learning outcomes and encourage a focus on learning experiences [26]. Student engagement in the assessment process is also essential to enhance their understanding of learning objectives and assessment standards, including peer feedback and the development of evaluative skills [27-29]. Relevant and applicable feedback for future improvement is another component of LOA, but feedback is only effective if students actively use it [25]. These three components should be viewed as an integrated whole, as feedback is more effective when students understand the criteria and monitor their progress toward the standards.

Learning-oriented assessment (LOA) supports student learning rather than simply evaluating their performance [30]. LOA emphasizes the importance of assessment tasks that support appropriate learning approaches. However, the challenge for educators is to balance the dual functions of assessment, namely formative assessment for learning and summative assessment for certification [31]. Assessment practices must enhance the learning process while recognizing that assessment serves multiple functions, including in higher education contexts where research is often prioritized over teaching [32].

2.5 Learning Outcomes

Learning outcomes refer to changes in knowledge, skills, attitudes, and values that students acquire. Learning outcomes include cognitive, affective, and psychomotor abilities. Bloom classifies learning outcomes into three main domains, namely cognitive (knowledge), affective (attitudes), and psychomotor (skills) [26]. Learning outcomes include various factors, such as the quality of instruction, student motivation, and feedback [33, 34]. The quality of instruction plays a significant role, where effective educators use strategies according to student needs and create a supportive learning environment [35]. Motivation also greatly determines how much effort students put into learning, where high motivation tends to increase engagement and learning outcomes [36]. A conducive learning environment, including facilities and a positive classroom atmosphere, helps students learn more effectively [37].

In addition, students' readiness, whether physical, emotional, or cognitive, affects their ability to absorb information. Constructive and timely feedback also plays an essential role in helping students understand their weaknesses and strengths, thereby improving learning outcomes [38]. Retention of memory through the stages of sensory, short-term, and long-term memory also affects the learning process and its final results [39].

3. Research Question

The research questions include:

1. Is there a difference in pre-test and post-test scores of theoretical learning outcomes in each group?
2. Is there a difference in pre-test and post-test scores of practical learning outcomes in each group?
3. How does the effect size of using the 2D-LOA instructional model contribute to improving the learning outcomes of vocational students in higher education?

4. Methods

4.1. Settings

This research was conducted in the Automotive Engineering Education Department, Faculty of Engineering, Universitas Negeri Yogyakarta in the even semester of the 2023/2024 academic year. It was chosen as the research location because it has appropriate and complete facilities for the needs of this research. This workshop is also a place for practicums for Automotive Engineering students, so it has relevant and adequate tools and materials to support research activities. In addition, this location allows researchers to interact directly with experienced practitioners and students, who can provide valuable input.

4.2. Participants

The research sample consisted of 68 students selected by purposive sampling. Samples include two groups, namely the experimental and control classes, each consisting of 34 vocational students in higher education. The experimental group received treatment by implementing the 2D-LOA model to improve learning outcomes, while the control group received treatment with learning, discussion, and demonstration practice methods.

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4.3. Design

Product trials or validations aim to find out theoretically and empirically whether the learning model that has been developed is feasible to implement in learning or not. According to the model stages, in this study trials were conducted in the design, development & implementation stages. At the design stage, the trials carried out were validated by promoters and co-promoters. Trials at the development stage were expert and practitioner validation (expert judgment) and limited-scale trials (small group). Large-scale trials or field trials were carried out at the implementation stage (see Table 1).

Table 1.
Research design randomized pretest-posttest control group design.

Class	Pre-test	Treatment	Post-test
Experimental	T_1	X	T_2
Control	T_3	-	T_4

Description: T_1 and T_3: pretest; T_2 and T_4: posttest; X: treatment using the 2D-LOA instructional model

4.4. Material and Procedure

The learning process consists of theory and practice. In theory, educators use the method supported by presentation slide shows accompanied by dialogue and/or questions and answers. Practical learning is carried out in groups of 4-5 students without scenarios and activity divisions. Practical steps are given through job sheets with general steps. Group practice without specific arrangements and divisions of tasks or roles does not guarantee that all group members will carry out the practice completely and independently. Student practice is also still limited to supporting or strengthening the understanding of knowledge or theory, not yet training to be skilled and competent in doing work, referring to standards or competency test schemes. Theory assessment is carried out with mid-semester and final semester exams. Practical assessment is carried out with practical exams at the end of the semester. Assessment criteria and standard references are not provided so they are not known by students. Practical facilities and infrastructure are adequate in quantity, but inadequate in quality. The condition of the vehicle object that is not fully operational makes some practical activities less than optimal. The existing model can be seen in Figure 1.

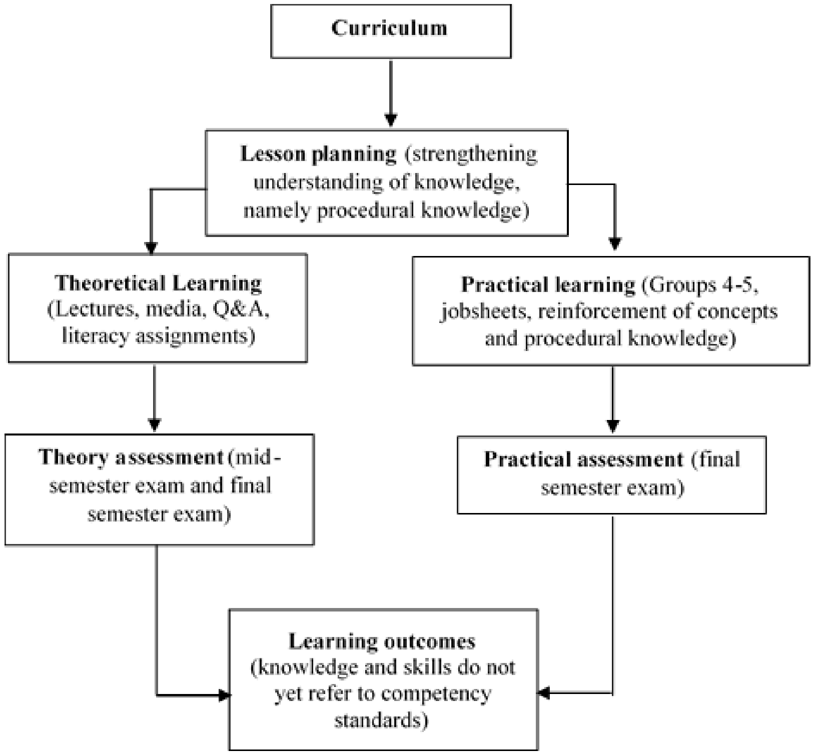

Figure 1.
Existing model.

The stages of learning with the 2D-LoA instructional model are:

a. Introduction
   1. Orientation (topic, objectives, 2D-LOA). Educators can introduce learning topics, learning objectives, and learning model concepts that will be applied with the 2D-LOA model.
   2. Providing material systematically and structured (direct learning) including displays or demonstrations. Educators deliver material directly and in an organized manner, can be through displays or demonstrations to provide initial understanding to students.
   3. Formation of discussion/practice groups. Forming discussion or practice groups to facilitate in-depth understanding through interaction and discussion between students.

b. Core
   4. Giving assignments (theory or practice). Educators give assignments that can be in the form of theory or practice to encourage students to apply the knowledge they have learned.
   5. Working on assignments in groups. Students work in their groups to complete assignments that allow them to learn from each other and exchange ideas.
   6. Individual drill and practice involving feedback or feedforward from educators or peer assessment. Students do repeated drills individually to hone their skills, involving the use of feedback or feedforward from fellow students (peer assessment).
   7. Monitoring, evaluation and supervision (involving feedback or feedforward through formative assessment). Educators monitor, evaluate and supervise the learning process, including providing feedback or feedforward through formative assessment to improve students' understanding and performance.

c. Closing
   8. Reflection (conclusion of the achievement of objectives and implementation of LOA). Students and educators reflect to evaluate the achievement of learning objectives and the

implementation of this 2D-LOA model. In the context of comprehensive evaluation of learning outcomes (learning outcomes), summative assessment is used.

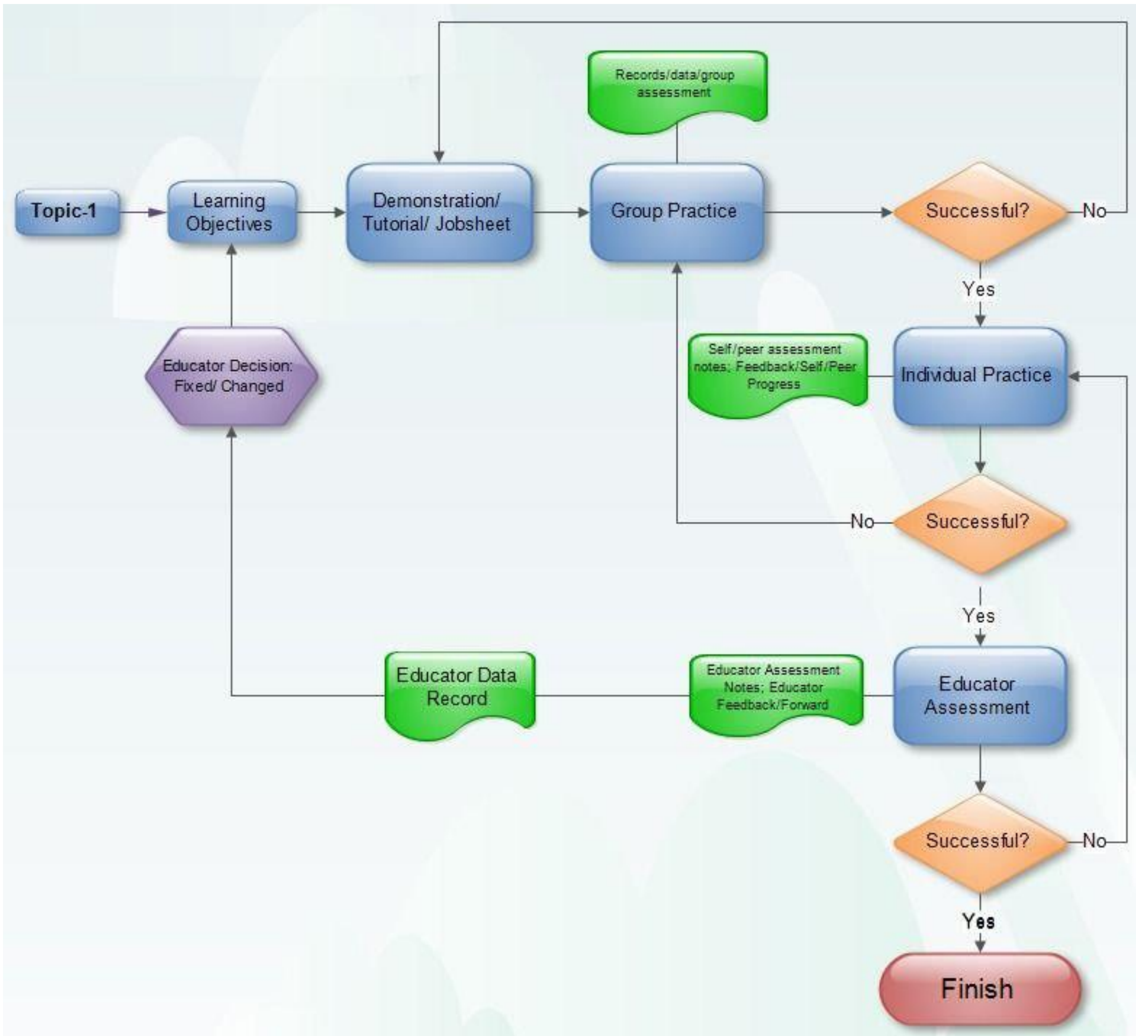

Figure 2.
Flowchart of the 2D-LOA instructional model.

The implementation of the 2D-LOA instructional model begins with the selection of a topic. The topic is described in the learning objectives. Educators can conduct demonstrations or tutorials or use jobsheets in the learning process. Furthermore, practice groups can be formed to discuss the job sheets given by educators, either to conduct research or assessment. If successful, individual practice can be continued. However, if not, then it is necessary to return to the demonstration or tutorial or job sheet stage. At the individual practice stage, students can conduct self-assessments or peer assessments. If successful, educators can then conduct assessments by providing feedback or feed forward. However, if unsuccessful, then return to the group practice stage. Educators record all data obtained during the process until the decision-making stage in terms of determining the assessment or changing the learning process. If educators have changed the learning process, then return to the stage of determining learning objectives (see Figure 2).

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4.5. Research Instruments

In this study, potential biases such as instructor bias and group dynamics were controlled by several strategic steps, namely educators involved in the learning process who were trained to apply instructional methods consistently, and researchers used assessment instruments that had been tested for validity and reliability to ensure that the measurement of learning outcomes was not affected by instructor subjectivity.

The learning outcome assessment instrument in the field work of steering, brake & suspension competency by students is used to measure competency mastery in competency units according to KKNI Level 4 in the position of Senior Chassis Technician in the Automotive field, Maintenance and Repair sub-field. The assessment refers to SKKNI Number 097-2018 in the Automotive Field, Four-Wheeled Light Vehicle Sub-field. The assessment is carried out to measure aspects of skills, knowledge, work attitudes to carry out this field work. The operational definition of learning outcomes in the explanation is the mastery of competencies by students which are measured based on knowledge, work attitudes and skills through written tests, demonstrations, practices, or simulations. The assessment is carried out by written tests, demonstrations, practices or simulations. The assessment is given on-site in theory and practice classes with instruments as shown in Table 2.

Table 2.
Learning outcome aspects.

No.	Aspect	Indicator	Instrument
1.	Knowledge	SKKNI Clause 3.1	Written test questions
2.	Skills	SKKNI Clause 3.2	• Practical assignments • Observation checklist
3.	Attitude	SKKNI Clause 4	

Based on the validity of the empirical test of the developed assessment instrument, there were 48 questions declared valid with a product moment r value > 0.1406 which were tested on 136 students. Items that met the validity were improved or revised. Meanwhile, the results of the reliability test of the assessment instrument from items declared worthy of obtaining an overall Cronbach's alpha score of 0.895 which was declared reliable with a high category.

4.6. Data Analysis

Data analysis in the field trial was carried out using the independent sample t-test assisted by IBM SPSS Statistics 26 software to determine the differences in the treatment class and control class for learning outcome variables. In conducting the independent sample t-test, a prerequisite analysis test is required, namely data that is normally distributed and homogeneous (not absolute).

The normality test was carried out using the Shapiro Wilk test and the homogeneity test using the Levene's Test. The hypothesis in the independent sample t-test is:

H_0: there is no significant difference between the experimental class and the control class

H_1: there is a significant difference between the experimental class and the control class

The conclusion in the independent sample t-test refers to the 95% significance level or the 5% significance level ($\alpha = 0.05$). If the significance <0.05 then H_0 is rejected and H_1 is accepted, while if the significance> 0.05 then H0 is accepted and H_1 is rejected.

The improvement of student learning outcomes is analyzed by Normalized gain (N-gain). The difference between pretest and posttest can be known from the standard N-Gain. The N-gain equation is stated as follows:

$$g = \frac{p_{post} - p_{pre}}{p_{max} - p_{pre}}$$

Description:

g : average gain score

p_{pre}: average score on the test before the intervention (pre-test)

p_{post}: average score on the test after the intervention (post-test)
p_{max}: maximum test score
The average gain score criteria are converted qualitatively referring to the categories in the Table 3.

Table 3.
N-gain assessment criteria [40].

Rating scale	Response rate
$g \geq 0{,}7$	High
$0{,}3 \leq g < 0{,}7$	Low
$g < 0{,}3$	Moderate

5. Results

After the intervention, the post-test results showed a significant increase in learning outcomes in the treatment group compared to the control group. The average posttest score of the treatment group was higher than the control group, indicating that the implementation of 2D-LOA was effective in improving student learning outcomes. This finding is consistent with previous studies showing that formative feedback and repeated practice can improve student learning outcomes [41, 42].

Table 4.
Comparison of the average pretest and posttest theory scores between the treatment group and the control group.

Class	Pretest (Mean ± SD)	Posttest (Mean ± SD)
Experimental	65.83 ± 8.22	76.52 ± 8.64
Control	64.87 ± 8.90	73.54 ± 9.79

5.1. Differences in Pretest-Posttest Scores of Each Group's Theoretical Learning Outcomes

The independent t-test showed that the difference between the post-test scores of the treatment group and the control group was 0.22, which showed no significant difference ($p > 0.05$), indicating that the 2D-LOA intervention had a higher impact on students' theoretical learning outcomes but was not significant (see Table 4).

Table 5.
Comparison of the average pretest and posttest practice scores between the treatment group and the control group.

Class	Pretest (Mean ± SD)	Posttest (Mean ± SD)
Experimental	73.97 ± 5.61	87.26 ± 6.95
Control	71.27 ± 7.90	75.70 ± 8.47

5.2. Differences In Pretest-Posttest Scores of Each Group's Practical Learning Outcomes

The independent t-test showed that the difference between the post-test scores of the treatment group and the control group was 1.85E-07, which indicated a significant difference ($p < 0.05$), confirming that the 2D-LOA intervention had a positive impact on students' practical learning outcomes (see Table 5).

5.3. Increased Pretest-Posttest Scores of Learning Outcomes in Each Group

Differences in learning outcomes were tested using an independent t-test. Before conducting an independent t-test, a prerequisite analysis test was conducted, namely a normality test and a homogeneity test.

Table 6.
Results of the normality test of learning outcomes.

Class	Statistic	df	Sig.
Experimental	0,978	34	0,724
Control	0,951	34	0,135

Based on the results of the Shapiro Wilk normality test, a significance value of more than 0.05 was obtained for the experimental class and the control class, so H0 was rejected and H1 was accepted, meaning that the learning outcome data of the experimental class and the control class were normally distributed. Furthermore, a homogeneity test was carried out (see Table 6).

Table 7.
Results of the homogeneity test of learning outcomes.

Test	F	Sig.
Levene's Test	0,715	0,401

Based on the results of the Levene's Test homogeneity test, a significance value of 0.401> 0.05 was obtained for the experimental class and the control class, so H0 was rejected and H1 was accepted, meaning that the learning outcome data of the experimental class and the control class were declared homogeneous. The analysis prerequisite test was met from the normality test and the homogeneity test, so a parametric hypothesis test could be carried out with the independent t-test for learning outcomes (see Table 7).

The analysis of learning outcomes was conducted by comparing the pretest and posttest scores between the treatment group and the control group. The pretest results showed that there was no significant difference between the two groups before the intervention, indicating that both groups had comparable levels of knowledge and skills at the beginning of the study.

Table 8.
Results of the independent t-test of learning theory results.

Variable	t	df	Sig. (2-tailed)
Theory learning outcomes	1,331	66	0,188

Based on the results of the t-test, the calculated t value was 1.331 <1.668 with a significance of 0.188> 0.05, so H0 is accepted and H1 is rejected, meaning there is no significant difference in theoretical learning outcomes between the experimental class and the control class (see Table 8). After the intervention, the post-test results showed a significant increase in learning outcomes in the treatment group compared to the control group. The average posttest score of the treatment group (76.52 ± 8.64) was higher than the control group (73.54 ± 9.79). Although this difference is not statistically significant (p> 0.05), these results show a positive trend that supports the effectiveness of 2D-LOA in improving theoretical learning outcomes. The increase in theoretical learning outcomes based on N-Gain in the experimental class was 0.32, which is classified as moderate, while in the control class, it was 0.26, which is classified as low.

For the practical learning outcomes, the difference in the average posttest score between the treatment group (87.26 ± 6.95) and the control group (75.70 ± 8.47) showed a significant increase (p < 0.05).

Table 9.
Results of the independent t-test of practical learning outcomes.

Variable	t	df	Sig. (2-tailed)
Practical learning outcomes	6.162	66	0.000

Based on the results of the t-test, the calculated t value was 6.162>1.668 with a significance of 0.000 <0.05, so H0 was rejected and H1 was accepted, meaning there was a significant difference in the results of practical learning between the experimental class and the control class (see Table 9). These results confirm that the implementation of 2D-LOA has a significant positive impact on students' practical learning outcomes, consistent with previous studies showing that formative feedback and repeated practice can improve students' learning outcomes [41, 42]. The increase in practical learning outcomes based on N-Gain in the experimental class was 0.52, which is classified as moderate, while in the control class, it was 0.17, which is classified as low.

Analysis of combined learning outcomes between practice and theory was conducted by comparing pretest and posttest scores between the treatment group and the control group. The post-test results showed that there was a significant difference between the two groups before the intervention.

Table 10.
Results of independent t-test learning outcomes (Practice and theory).

Variable	t	df	Sig. (2-tailed)
Learning outcomes (Practical and theoretical)	4,136	66	0,000

Based on the results of the t-test, the calculated t value was 4.136> 1.668 with a significance of 0.000 <0.05, so H0 was rejected and H1 was accepted, meaning there was a significant difference in learning outcomes (practice and theory) between the experimental class and the control class (see Table 10). The average posttest score of the treatment group (81.89 ± 6.49) was higher than the control group (74.62 ± 7.95). The increase in student learning outcomes (practice and theory) based on the N-Gain in the experimental class was 0.41, which was classified as moderate, while in the control class it was 0.19, which was classified as low (see Figure 3).

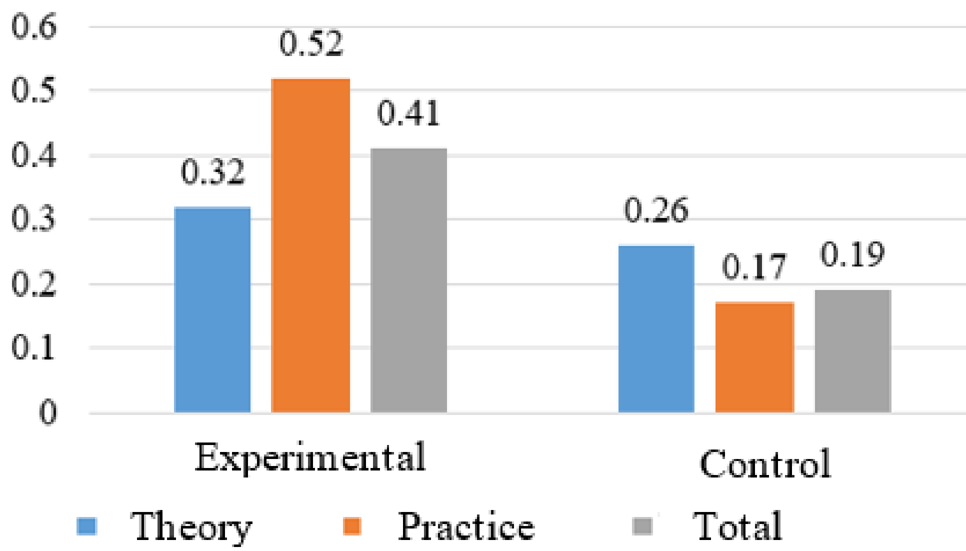

Figure 3.
N-Gain student learning outcomes.

6. Discussion

The results showed that the implementation of 2D-LOA had a positive effect on vocational students' learning outcomes in higher education. A significant increase in the posttest score for practical learning outcomes in the treatment group (87.26 ± 6.95) compared to the control group (75.70 ± 8.47), ($p < 0.05$) indicates that 2D-LOA is effective in improving students' practical skills. Formative feedback and repeated practice are essential in improving learning outcomes [41, 42]. Assessment during the learning process can significantly improve learning outcomes [43]. The insignificant increase in theoretical learning outcomes ($p > 0.05$) despite a positive trend, indicates that 2D-LOA is more effective in the context of practical learning than theory. It can be explained by the direct and applicable nature of the direct learning model and the drill and practice strategy which is more suitable for developing practical skills [44] as a learning outcomes [45]. Thus, drill and practice can improve student learning outcomes.

Dale explained the learning pyramid theory that students will remember 90% of what they do, in this case, practical activities, while students only remember 50% of what they hear and see, in this case, theoretical learning activities. The learning pyramid is also explained by the NTL Institute of Applied Behavioral Science Learning Pyramid that carrying out practical activities increases the retention rate or memory of students by 75% and can be optimized to 80% if students as prospective teachers can teach their students, while theoretical learning only increases the retention rate by up to 50% with discussion activities [46].

Practical learning is more effective because it involves a lower cognitive load than theoretical learning. In practical activities, students can see the direct application of the concepts learned, which facilitates better understanding than theoretical learning which may be more abstract and require a higher cognitive load. The findings in this study support the cognitive load theory developed by Atkinson & Shiffrin. The model describes how information is processed in human memory through three main stages, namely sensory memory, short-term memory (or working memory), and long-term memory. In theoretical learning, students tend to rely on sensory memory to remember something, in this case, learning material. Students capture information from the senses and store it in a temporary form for a short duration, only 250-500 ms. While in practical learning, students tend to rely on working memory to store information and maintain it for about 20 s or 7 ± 2 items of information at one time.

Drill and practice and continuous feedback are key in the 2D-LOA instructional model. Through these things, students can strengthen their understanding. At the vocational education level, educators can conduct real-time formative assessments to assess student progress, allowing adjustments in learning methods. Overall, the application of the 2D-LOA instructional model in vocational education has great potential to improve learning outcomes. By prioritizing constructive feedback, students can develop relevant skills and be ready to face challenges in the world of work. It makes this instructional model a valuable tool to support more effective and efficient vocational education.

7. Conclusion

The 2D-LOA model integrates direct learning with drill and practice. Students' practical learning outcomes are more effective than students' theoretical learning outcomes. This improvement can be attributed to the LOA approach that emphasizes continuous assessment and constructive feedback. Practical learning involves a lower cognitive load than theoretical learning. In practical activities, students can see the direct application of the concepts learned, thus facilitating better understanding compared to theoretical learning which is more abstract and requires a higher cognitive load.

Based on the research results, it is recommended to prioritize the use of the 2D-LOA instructional model that focuses on improving practical skills. The 2D-LOA model combines a direct learning approach that ensures students receive information clearly and in a structured manner, with a drill and practice strategy that allows students to repeat and reinforce practical skills through consistent practice. Learning-oriented assessments ensure that student evaluations are carried out continuously and integrated with learning activities, thus providing relevant feedback and supporting the improvement of students' practical skills. Thus, educators are advised to integrate the 2D-LOA model more widely, especially in learning that requires a strong mastery of practical skills, such as science, technology, vocational education, and other subjects. For the future research can improve theoretical learning outcome and testing the instructional model in other educational setting.

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Transparency:
The authors confirm that the manuscript is an honest, accurate and transparent account of the study that no vital features of the study have been omitted and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Competing Interests:
The author has no conflicts of interest to declare relevant to this article's content.

Authors' Contributions:
All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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