



Contents lists available at [Journal IICET](https://journal.iicet.org)  
**Jurnal EDUCATIO (Jurnal Pendidikan Indonesia)**  
ISSN: 2502-8103 (Print) ISSN: 2477-8524 (Electronic)  
Journal homepage: <https://jurnal.iicet.org/index.php/jppi>



## The improvement students learning achievement by applying work based learning combined with teaching factory concept

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### Article Info

#### Article history:

Received Nov 12<sup>th</sup>, 2023

Revised Dec 20<sup>th</sup>, 2023

Accepted Jan 23<sup>th</sup>, 2024

#### Keywords:

Work-based Learning Model

Teaching factory

Automotive

Vocational students

### ABSTRACT

The preliminary analysis results indicate that the quality of automotive vocational learning is not optimal. This study aims to develop a work-based learning model that incorporates the Teaching Factory concept (WBL-TEFA) with the goal of enhancing the learning achievement of automotive vocational students. Research and Development (R&D) with the 4D model were implemented in this study. The results indicate that the WBL-TEFA learning model introduced novel elements to the model syntax through the following activity steps: (1) initiation, (2) receiving orders, (3) gathering necessary information, (4) generating and sorting possible solutions, (5) executing orders, (6) quality control, and (7) assessment. To implement this syntax, various supporting materials were developed, including model handbooks, lecturer and student manuals, and textbooks. Following the implementation, the experimental class demonstrated a significantly higher learning achievement gain score of 51.62 compared to the control class, which achieved a gain score of 42.52. Additionally, there was an improvement in task management abilities, work environment skills, interpersonal skills, workplace learning skills, and student critical thinking. In summary, the utilization of the WBL-TEFA learning model proved effective in enhancing students' academic performance, as evidenced by a statistically significant.



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## Introduction

The propositions and defiance of teaching in vocational education and training (TVET) are diverse from those of prevalent education, so they necessitate dissimilar responses in problem solving. In the implementation of competency discovery, it could constantly be reformed as soon as with technological developments and their connection with industry (Moldovan, 2019). Technology in industry is changing dynamically with the rapid pace of technological development, it has required vocational teacher education and training to focus on efforts to prepare graduates to play an adequate role in the digital millennial 4.0 (Yulando et al., 2019).

In the context of the fourth industrial revolution, it is imperative to exercise supervision and control over acts of destruction. Furthermore, it can be inferred that the responsibility of education and training is to cultivate individuals who possess the ability to express informed opinions, conduct themselves appropriately, and exhibit creative behavior in order to effectively navigate unforeseen disruptions within a context of generally stable organizational structures (Himmetoglu et al., 2021) and (Guile, 2019). According to (Huang

& Wang, 2021) during the industrial age, the primary objective of education was to mold and instruct individuals in a specific set of behaviors, with the aim of fulfilling the requirements of a standardized production process. In the context of the digital era, sometimes referred to as the Millennial 4.0, specific patterns of behavior exhibit a notable degree of ambiguity. As stated in (Mourtzis et al., 2018) and (Jones & Jones, 2018) it is imperative for educational and training institutions to provide individuals with the skills necessary to engage in critical thinking, problem-solving, and adaptability in response to unexpected events in life.

Previous research has indicated that the quality of education during the technology era plays a crucial role in producing individuals who possess the necessary skills to successfully enter a highly competitive job market, which is further intensified by the ongoing globalization process (Karre et al., 2019) and (Treviño-Elizondo & García-Reyes, 2022). In addition, as explained in (Dierdorff et al., 2021) and (Sewasew & Koester, 2019) emphasized the significance of education quality as a fundamental factor in the advancement of a nation's human resources and overall national development (Keator, 2020) and (Rossi, 2023). Furthermore, it has been noted by (Morineau et al., 2016) that vocational education plays a crucial role in developing a skilled workforce capable of enhancing productivity, efficiency, and competitiveness in the global labor market during the era of globalization. In the context of vocational education, students are expected to possess proficiency, knowledge, and behavioral alignment. In order to ensure that alumni are well-prepared and educated for entry into the workforce, it is important to foster their potential and innovation. This will enable them to not only seek employment opportunities, but also to become successful entrepreneurs (Jackson et al., 2022) and (Shvetsova, O.A. & Kuzmina, 2018)

The teaching method is one of the essential and primary elements in sustaining at the learning activity (Jones & Jones, 2018) and (Rossi, 2023). Thus, it is notable to repair utilization and superintendence, in order to the intended objectives can be attained. The learning tactics is a scheme that is implemented as a guide in planning experiences in the classroom. Furthermore, the period of learning method shapes to a particular oncoming to guidance that belong its goals, syntax, learning atmosphere, and management element (Joyce, B., Weil, M., & Calhoun, 2015). This is in line from the point of view of (Bayerlein, 2023) that the learning model provides a framework and direction for lecturers to teach.

The aim of this study is to develop a teaching model incorporating Work-Based Learning combined with the Teaching Factory Concept (WBL-TEFA) in automotive vocational education. As highlighted by (Maksum & Purwanto, 2019) and (Chrysosouris et al., 2016) the TEFA principles emphasize the linkage and alignment between industrial practices and school teaching activities. The WBL-TEFA model is specifically designed for university learning activities that address the evolving requirements of automotive vocational graduates. These graduates should not only possess technical skills but also demonstrate capabilities in critical thinking, self-expression, and creative, metacognitive engagement (Bayerlein, 2023). The development of the WBL model was initiated based on the process outlined by (Baker et al., 2017). Additionally, the formulation of the Teaching Factory drew inspiration from the models proposed by (Maksum et al., 2022) and (Mavrikios et al., 2018). The WBL-TEFA learning approach seamlessly integrates theoretical learning with practical application within a unified learning system. This model represents a groundbreaking approach in the Department of Automotive Engineering at FT UNP Padang. Traditionally, the separation of theory and practice into distinct credit systems, learning venues, and schedules, often involving different instructors, has resulted in a lack of continuity between the theoretical learning and its practical application. Therefore, the WBL-TEFA model is a solution to overcome this problem

In accordance with the challenges of graduates majoring in automotive, the WBL-TEFA learning model is the right choice for creating learning that is directly related to the world of work because this learning model presents an industrial atmosphere of learning in the classroom. The developed model uses a job shadowing approach, namely providing learning experiences to students through direct experience working with automotive industry standards (Baker et al., 2017). For the implementation of the model, we creating the model book, teacher and student handbook, and syntax with 7 stage, then applied to the experimental class. at the final stage to see the success of the model, a comparison is made with the control class with the method usually applied to the learning class in the automotive department. Moreover, for task skill assessment carried out during the model implementation process. So that at the end of this study, the learning model with WBL-TEFA and its effect on student Learning Achievement were obtained.

## Method

The type of research conducted is a mixed-methods approach, combining "Research and Development" with a quantitative approach (Creswell et al., 2007). This study employs a development procedure (Gall et al., 2007)

and (Cohen, L., Manion, L., & Morrison, 2018). The development procedure for the WBL-TEFA model involves using the 4D development procedure, which includes defining, designing, developing, and disseminating. The validity of the model is determined through expert validation using a Focus Group Discussion (FGD). Effectiveness testing is conducted through a Quasi-Experimental Design, with the effectiveness level measured by the improvement in student learning outcomes. The experimental research trial involves 16 participants in the control group and 16 participants in the experimental group. Data analysis is performed using Aiken's V test.

The effectiveness test begins with a pretest quasi-experimental step between the control group and the experimental group. Data collection and the implementation of the experimental research are completed within 10 working weeks. In the first week, a pretest activity is conducted for both the control and experimental groups. Subsequently, for the next eight weeks, the experimental procedure is carried out. In the experimental group, the WBL-TEFA model learning module is implemented, while the control group follows Teacher-Based Instruction. After completing the experimental procedure, a posttest is conducted, measuring the Learning Achievement attained by students after ten weeks of learning (Figure 1).

To assess the improvement in students' academic achievement, a learning achievement test instrument is developed to measure the extent to which students have achieved the learning objectives. The researcher develops a learning achievement test with 10 items for each learning outcome, resulting in a total of 40 items. After validating the content of the test instrument with three experts, five items require revision and improvement. The test instrument is then pilot-tested with 30 Automotive Engineering students to obtain the Difficulty Level and Discrimination Index of the test items. The results show that two test items have a Discrimination Index below 0.30, and one item in the learning achievement test has an inappropriate Difficulty Level, leading to its exclusion from the test instrument. The final pilot test results indicate a total of 37 Learning Achievement Test questions that meet the requirements—valid, reliable, with an average Discrimination Index of 0.47, an average Difficulty Level of 0.58, and an average Coefficient of Internal Consistency of 0.81. The Learning Achievement Test instrument is used for measuring students' pre-test, post-test, and delayed post-test performances.

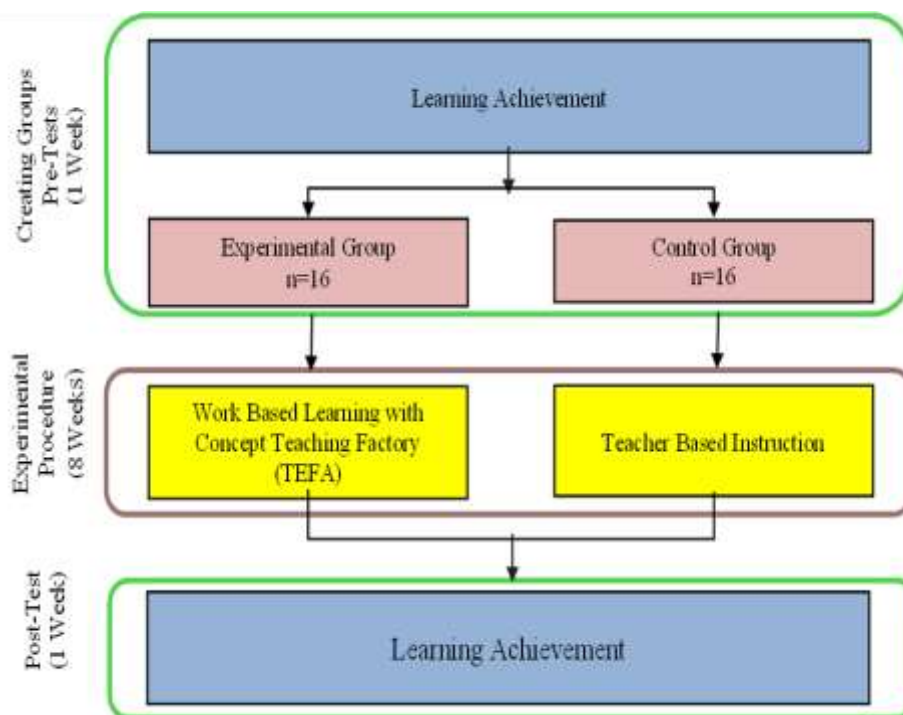


Figure 1 <Experimental Design of WBL-TEFA Model Effectiveness Test Procedure>

## Results and Discussions

### Need analysis results

Need analysis was deduced to determine the effectiveness of classroom learning in the automotive vocational course, revealing that it has not been totally effective. The findings indicate that the degree of competency

achievement among students pursuing a Diploma III in automotive engineering at vocational institutions is deemed satisfactory, as per the perspectives of both current students and alumni. Based on the examination of the questionnaire, it was found that there is a discrepancy of 21.7% in terms of competency between the predicted and present condition. The significant variation arises from the dynamic nature of automobile electronic technology. The lack of preparedness among graduating students is a concern in the automotive engineering department. The tremendous advancement of automotive technology has been evident in recent decades. However, it is evident that the effectiveness of the automotive vocational learning process in terms of quality attainment has not been satisfactory, as indicated by the opinions of graduates and students. Upon analysis of the items, a significant disparity in the attainment of the learning process is evident between the present state and anticipated outcomes. Specifically, the discrepancy amounts to 18.19% as per the perspective of graduates, and 21.19% as per the viewpoint of students. Based on the above description, it is advisable to enhance the learning model in automotive vocational education in order to bridge the existing disparity between the quality of the teaching and learning process and the desired outcome.

In the present state of classroom learning, pupils exhibit a passive demeanor as they attentively listen to the teacher's explanations. In order to create an optimal learning environment, it is imperative that students engage actively in their education and participate in student-centered learning approaches. The role of the instructor is primarily that of a facilitator, whose purpose is to assist students in comprehending the subject matter being taught. The WBL-TEFA model is deemed suitable for implementation in the context of automotive vocational education. Furthermore, it is anticipated that the enhancement of students' and graduates' abilities can be achieved through the implementation of link and match-based patterns inside the classroom setting. Moreover, pupils are able to engage in the exploration of diverse information from various sources.

### Product development

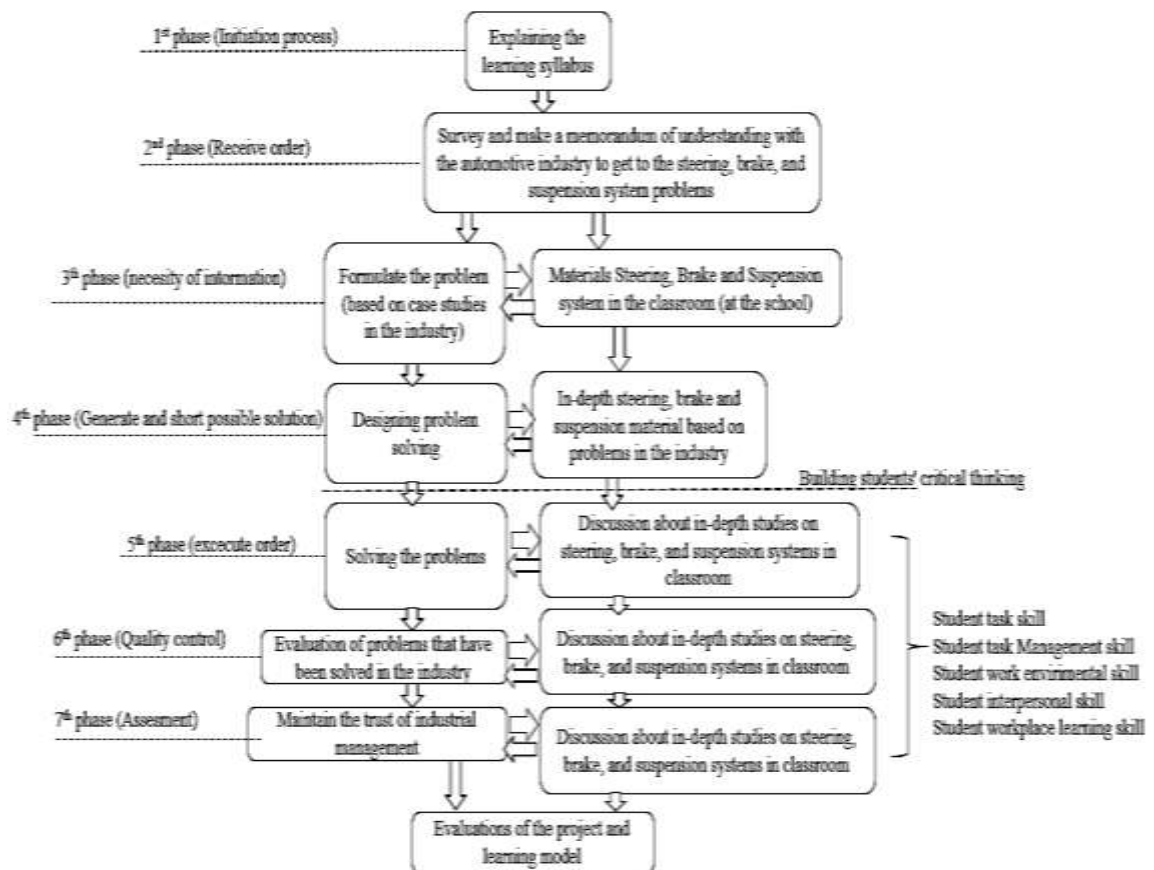


Figure 2 <Syntax Model of WBL-TEFA>

The WBL-TEFA learning model was developed in accordance with the Ministry of Education of the Republic of Indonesia. This model incorporates several key principles, including: (a) beginning with concrete examples, (b) providing flexibility and adaptability based on students' individual circumstances, (c) fostering a sense of enthusiasm among students, (d) achieving competency indicators, and (e) encouraging the exploration

of students' abilities. Hence, the development process is driven by the caliber of information and materials. Several handbooks have been developed, including learning model books, teacher and student handbooks, syntax books, practical classroom handbooks, and learning modules.

The teacher handbook comprises three main components: a model implementation guide, learning program modules, and learning evaluation tools. The assessment of the learning program unit is conducted on its constituent elements, including the component aspects, content, and language. According to the regulations set by the Indonesian government, the necessary components that should be included in the lesson plan are as follows: identification, program learning outcomes, indicators of soft skills, program learning objectives, descriptions of teaching materials, allocated time, teaching techniques, teaching activities, assessment models, and references. The validation data of the constituent unit conducted by the expert indicates that all the generated elements are in compliance with the standards established by the Ministry of Education of the Republic of Indonesia. Furthermore, it can be inferred that the program falls under the legitimate category.

### Validation of WBL-TEFA model

To ensure the appropriateness of the Work-Based Learning Teaching, Evaluation, and Feedback Approach (WBL-TEFA) for students in the Department of Automotive Engineering, a validation model of the WBL-TEFA was implemented. According to (Creswell et al., 2007) and (Cohen, L., Manion, L., & Morrison, 2018), a group discussion known as a focus group can be utilized to invite five experts to serve as validators. Eighteen experts were closely involved in evaluating the construct validity. The findings indicate that the Aiken's V value obtained is 0.947, which falls within the range of 0 to 1. Based on the findings of previous research (Ross, 2006), Aiken's V can be considered valid when the parameter score exceeds 0.60, indicating a high level of validity. Hence, based on the expert validation results on the content validity of the model, it can be concluded that the Aiken's V coefficient of 0.947 falls within the valid range.

The construct validity of the model was assessed through the utilization of confirmatory factor analysis. The findings indicate that the WBL-TEFA model, consisting of six components, satisfies the criteria for assessing the adequacy of model fit. The construct validity is considered to be valid. The correlation coefficient exhibits a value greater than 0.60. In addition, there are six variables that exhibit a significant relationship with the learning model. Hence, the parameters fulfill the criteria established by Mayers (S.Meyers & Guarino, 2006) and Khattree & Naik (Khattree, R. & Naik, 1999), which pertain to the goodness-of-fit models and the acceptance of  $(\chi^2/df) < 2$  as an indicator of validity.

Table 1 <Syntax Constructs Validation of WBL-TEFA Model>

Syntax Indicators	Chi Square > 0	P-value > 0.05	RSME <0.05	$\frac{\chi^2}{df} < 2$	Corelation Index	Criteria
Initiation	14.44	.349	.078	1.103	$\geq .3$	Valid/Fit
Receive Order	.4	.875	0	.168	$\geq .3$	Valid/Fit
Necessity of Information	11.32	.425	.093	1.447	$\geq .3$	Valid/Fit
Generate and Short the Possible Solution	30.56	.069	.159	1.328	$\geq .3$	Valid/Fit
Execute Order	18.58	.309	.087	1.029	$\geq .3$	Valid/Fit
Quality Control	3.4	.638	0	.68	$\geq .3$	Valid/Fit
Assessment	20.74	.065	.192	1.624	$\geq .3$	Valid/Fit
Syntax Model of WBL-TEFA	3.97	.813	0	1.323	$\geq .3$	Valid/Fit

Table 1 presents the results pertaining to the construct validity of the WBL-TEFA syntax model, which has seven steps and encompasses a total of 56 indicators. Based on the table, it can be observed that all syntax and indicators conform to the criteria established by (S.Meyers & Guarino, 2006) and (Stevens, 2009), particularly with regards to the condition of  $(\chi^2/df) < 2$ . Furthermore, the model demonstrates a satisfactory level of fit. Figure 2 depicts the syntax employed in the present study. The assessment of the overall model can be obtained by evaluating the fit of the model developed using LISREL. The Chi-Square value is the determination index of the most prevalent model. Furthermore, it is important to consider the loading factor value, which indicates the strong association between the indicator and its underlying construct. A loading factor value of 0.50 is widely regarded as a robust indicator for elucidating the latent component. The validity of the Syntax model was assessed by the utilization of Confirmatory Factor Analysis (CFA).

### The effectiveness of the WBL-TEFA model on cognitive aspects

Table 2 presents the post-test value data pertaining to the utilization of the WBL-TEFA model in the experimental and control classes, specifically for students enrolled in the Diploma III automotive engineering program. The findings indicated that the implementation of the WBL-TEFA learning paradigm yielded positive outcomes in enhancing students' cognitive abilities. The findings from the independent t-test indicate that the cognitive aspect between the control class and the experimental class was less than 0.05. This suggests that there are significant differences in the cognitive domain of learning achievement between the experimental class (utilizing WBL-TEFA) and the control class (following conventional methods).

Table 2 <The Value of Learning Achievements in Effectiveness Trials>

Score Indicator	Control Class	Experimental Class
Total of Student	16	16
Mean	79.63	88.66
Std. Error of Mean	0.658	0.69
Median	79.6	88.68
Mode	79.1	88.68
Std. Deviation	2.63	2.77
Variance	6.93	7.66
Range	8.9	9.39
Minimum	75.1	84.19
Maximum	84	93.58
Sum	1274	1418.59

According to the data presented in Table 3, there is a notable disparity in the efficacy of the WBL-TEFA model in enhancing students' cognitive learning results between the experimental and control groups. The occurrence can be attributed to the implementation of the WBL-TEFA learning model in the experimental group.

Table 3 <Improved Learning Achievements>

Meeting class	Control Class	Experimental class
Pretest	37.11	37.04
Posttest	79.63	88.66
Gain Score	42.52	51.62

In the cognitive domain, the results of this study are in line with research conducted by (Rahdiyanta et al., 2019) that work based learning is effective in increasing students' understanding through work. Furthermore, (Jakobson et al., 2014) also concluded that the students work through direct practical actions and trained cognitive abilities related to their work. Moreover, based on (Moldovan, 2019) that produced the Arizona WBL concept which involves learning in three zones, namely the involvement of students, educational institutions, and the industrial which in line with the previous opinion. Then, possible improve the cognitive aspects of students through continuous work. Learning Achievement are work skill that are built by four components, scilicet task management skills, work environment skills, interpersonal skills, and workplace learning skills. Accordingly, Learning Achievement are work skills that are built that they can show someone's competence according to their field of expertise. Based on (Guile, 2019) competence is indicated by the existence of knowledge, skills and willingness. If someone has the knowledge, skills and willingness, it can be said that someone is considered to have competence (Sewasew & Koester, 2019).

In the practice of automotive engineering, interpersonal skills have a great opportunity to be developed independently by students. For example, conducting active communication with consumers who will be served, providing comprehensive information related to the progress of the maintenance and repair of motorized vehicles to consumers, communicating with superiors if there is a problem with the vehicle that cannot be solved, communicating with colleagues to obtain information about vehicle trouble records (Huang & Wang, 2021). An intermediate expert in automotive engineering is expected to have effective communication skills in carrying out his duties as an expert. This ability is not only assessed from verbal communication but also non-verbal communication. Someone is expected to have sensitivity in responding to communication, for example giving an expression of nodding his head when working conditions do not allow him to talk, or giving certain signals through his eyes if there is a communication that is confidential but

should be communicated without the knowledge of others around him (Tushar & Sooraksa, 2023) and (Welsh et al., 2020).

Learning achievement are also influenced by external factors in the work environment such as the characteristics of co-workers, individual personalities, social interactions, time and the ability to learn in the workplace itself (Rahdiyanta et al., 2019). The research findings are in line with a study entitled (Bajinath et al., 2023), which was conducted on university graduates to prevent high unemployment rates in South Africa through collaboration with the work industry with on-the-job training methods. The results prove that the education and training of university graduates is effective in preparing them for direct entry into the world of work (Mourtzis et al., 2021) and (Imants & van Veen, 2022).

The limitation of the WBL-TEFA learning model research has not been tested in a broader context, namely outside the automotive engineering study program and beyond the UNP campus. This is crucial to assess the effectiveness of this learning model in a more comprehensive manner. The recommendation for further research is the need for more extensive development studies, especially regarding the WBL-TEFA model in vocational learning across other skills.

## Conclusions

This research has successfully developed the WBL-TEFA Learning Model in accordance with established criteria. The findings indicate that the WBL-TEFA learning model incorporates innovative features in model syntax through a sequence of activities: (1) initiation, (2) receiving orders, (3) identification of information needs, (4) generation and refinement of potential solutions, (5) execution of orders, (6) quality control, and (7) assessment. The results affirm the validity of the WBL-TEFA Learning Model, both in terms of content and construct validity. This is based on the outcomes of the validity tests utilizing Aiken's V formula, Structural Equation Modeling (SEM), and Confirmatory Factor Analysis (CFA), with Chi-Square and  $\chi^2/df$  values of 3.97 and 0.813, respectively. Consequently, the model passes the goodness-of-fit model test. To implement this syntax, supporting products such as model books, lecturer and student handbooks are utilized. The novelty of the research lies in successfully developing a learning model capable of integrating theoretical and practical learning within a unified learning system. The WBL-TEFA Learning Model is declared highly practical, as indicated by the practicality assessment results, with an average response from lecturers at 90.17% and from students at 90.21%, falling into the 'Very practical' category. The use of the WBL-TEFA Learning Model is declared significantly effective in improving students' academic achievement in automotive engineering learning (2-tailed Sig. value less than 0.05).

## Acknowledgments

The authors would like to thank Lembaga Penelitian dan Pengabdian Kepada Masyarakat Universitas Negeri Padang for funding this work with a contract number 1328/UN.35.15/LT/2023.

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