

RESEARCH ARTICLE

Improving learning outcomes and learning interest among vocational students majoring in motorcycle technology through web-based learning

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ABSTRACT

Background: The integration of digital technology into vocational education provides opportunities to improve the quality of learning, particularly in Motorcycle Engineering and Business (TBSM) competency instruction. However, the continued use of conventional teaching approaches may limit students' learning interest and achievement.

Purpose: This study aimed to examine the effect of web-based learning on students' learning interest and learning outcomes in TBSM competency instruction at SMKN 2 Bangkalan.

Method: A quantitative approach with a quasi-experimental pretest-posttest control group design was employed. The participants were 60 students selected through total sampling, consisting of 30 students in Class X TBSM 1 as the experimental group and 30 students in Class X TBSM 2 as the control group. Data were collected using a learning interest questionnaire and learning outcome tests. Data analysis involved prerequisite testing and independent samples t-tests.

Findings: The results demonstrated a statistically significant difference in learning interest between the experimental and control groups ($\text{Sig.} = 0.024 < 0.05$). The experimental group obtained a higher mean learning interest score (52.27) than the control group (46.40). A significant difference was also found in learning outcomes ($\text{Sig.} = 0.000 < 0.05$), with the experimental group achieving a higher posttest mean score (86.67) than the control group (65.67).

Implication: These findings provide empirical evidence that web-based learning is more effective than conventional instruction in improving both learning interest and academic achievement in TBSM competency instruction.

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INTRODUCTION

Vocational education is currently undergoing a digital transition that requires educational institutions to modify their teaching methodologies in accordance with

technological advancements and industry needs (Hermansah et al., 2025). This transformation is highly relevant for Vocational High Schools, especially in the Motorcycle Engineering and Business program, because the competencies of graduates are influenced not only by practical skills in the workshop but also by their ability to understand concepts, analyze work procedures, interpret technical information, and independently use digital learning resources (Kamaludin et al., 2024; Wahyudi, K.S., et al., 2021; Wijaya et al., 2023). In Indonesia, the potential for implementing web-based learning is increasingly developing along with the growing access to public internet (Arya & Rekha, 2025). Hargittai (2025) shows that vocational high school students typically operate within a digital ecosystem that facilitates more efficient web-based learning implementation.

Although internet access is increasing, the quality of vocational education has not yet reached optimal results (Silvana et al., 2021). This condition shows that the presence of technology does not inherently guaranty improved learning outcomes unless combined with engaging, meaningful, and contextually relevant instructional design (Hafidh et al., 2026). In the field of Motorcycle Engineering and Business, education often faces obstacles due to the theoretical and procedural nature of the material. Noviyana et al. (2021) suggest that online learning in the Motorcycle Engineering and Business program contributes to improving students' theoretical understanding by providing more interactive and meaningful learning experiences. However, this has not fully replaced practical learning due to constraints related to equipment, network access, time, and the availability of tools and practice materials. These findings indicate that web-based learning should not be considered a substitute for workshop practice, but rather as an enhancement of theoretical learning, procedural visualization, material enrichment, formative exercises, and preparatory activities before practice (Sugiarto et al., 2023).

Previous studies highlight that the use of technology in vocational education creates more engaging learning experiences, encouraging students to become more motivated and achieve better learning outcomes. Idroes et al. (2024) provide evidence that web-based constructivist learning environments facilitate the development of vocational students' academic performance while encouraging active cognitive involvement in the learning process. Rossydi et al. (2026) demonstrate that web-based interactive learning media significantly improve the motivation and academic performance of vocational high school students. Hardison et al. (2025) show that web applications in vocational automotive education can enhance student interest, teamwork, and theoretical exam results. Efendi et al. (2021) highlighted the effectiveness of mixed reality technology in automotive vocational schools improves students' academic performance compared to traditional non-technology-based learning methods. This collection of studies supports the premise that

digital technology, particularly web-based learning, significantly enhances the quality of vocational education, especially when tailored to vocational training needs.

However, several research gaps remain to be addressed. Previous studies have demonstrated the potential of digital learning in vocational education by supporting student engagement, learning achievement, and access to instructional materials. Research in automotive education has also examined the use of advanced digital technologies, including mixed reality and other technology-enhanced learning environments. Nevertheless, empirical studies specifically examining web-based learning among Grade 10 students in the Motorcycle Engineering and Business program at public vocational high schools remain limited. In addition, previous studies have often examined learning outcomes, motivation, engagement, or learning interest as separate indicators. Research that examines learning interest and learning outcomes simultaneously as primary indicators of instructional effectiveness is comparatively limited. Methodologically, several studies have employed developmental research, survey approaches, or one-group pretest–posttest designs, which provide useful evidence but offer more limited comparisons between instructional conditions. Therefore, further quasi-experimental research involving experimental and control groups is needed to provide stronger empirical evidence regarding the effectiveness of web-based learning in motorcycle vocational education. This research gap is important because learning interest reflects students' affective involvement in learning, whereas learning outcomes provide an indication of the extent to which instructional activities support the acquisition of knowledge and skills. Previous findings have shown that technology-supported learning can positively influence students' learning engagement and achievement, although its effectiveness may vary according to the learning context, instructional design, and characteristics of the learners. Accordingly, examining these two outcomes together can provide a more comprehensive understanding of the contribution of web-based learning to vocational education.

Learning interest and learning outcomes are particularly relevant in Motorcycle Engineering and Business education because theoretical understanding provides an essential foundation for subsequent practical activities. Initial observations at SMKN 2 Bangkalan indicate that students in the Motorcycle Engineering and Business program require learning media that can increase their interest in instructional materials, strengthen conceptual understanding before practical application, and provide flexible access to learning resources beyond regular classroom hours. Classroom instruction that relies predominantly on teacher explanations may not fully accommodate differences in students' learning needs, particularly in topics involving motorcycle components, mechanisms, and operational systems that require clear visualization. Web-based learning provides an alternative by organizing instructional materials in an accessible digital environment and

incorporating visual explanations, instructional videos, practice activities, and feedback. These features allow students to review learning materials repeatedly and access them according to their individual learning needs. In this context, web-based learning has the potential to connect theoretical concepts with practical applications while supporting both students' interest in learning and their academic achievement.

Based on these considerations, this study aims to examine the effect of web-based learning on students' learning interest and learning outcomes in Motorcycle Engineering and Business education. Specifically, the study seeks to compare students' learning interest and learning outcomes between students who receive web-based learning and those who receive conventional instruction, and to determine the effectiveness of web-based learning in improving both outcomes. The findings are expected to provide empirical evidence for the use of web-based learning as an instructional approach in vocational motorcycle education and to contribute to the development of more flexible, accessible, and learner-oriented vocational instruction.

METHODS

This study employed a quantitative approach using a quasi-experimental design with a pretest–posttest control group framework. This concept is used because the class formation was pre-existing, making individual randomization impossible. This study was conducted at SMKN 2 Bangkalan, involving tenth-grade students enrolled in the Motorcycle Engineering and Business program (TBSM) during the current academic semester. Two classes underwent a pretest and a learning interest questionnaire, followed by different treatments: web-based learning for the experimental class and conventional learning for the control class. Next, the same posttest and questionnaire were administered to assess changes in students' learning outcomes and interest in learning.

The target population consisted of all students enrolled in the tenth-grade Motorcycle Engineering and Business (TBSM) program at SMKN 2 Bangkalan, which consists of two classes with a total of 60 students, each comprising 30 students from the X TBSM (Motorcycle Engineering and Business) 1 class and 30 students from the X TBSM (Motorcycle Engineering and Business) 2 class. The sampling technique used is total sampling, thus encompassing the entire population as the research sample. One class was designated as the experimental group, while the other class served as the control group. Both classes were given identical materials, learning durations, and assessments, with the only difference being that the experimental class used web-based learning media, whereas the control group received conventional instruction.

The research instruments consist of a learning interest questionnaire and a learning outcome assessment. The questionnaire uses a Likert scale to assess students' learning

interest, including interest, attention, engagement, and motivation to learn. The assessment of learning outcomes evaluates knowledge of TBSM material thru pretests and posttests. The instrument includes an observation sheet to facilitate the implementation of learning, ensuring uniformity in treatment in both courses.

Data analysis was performed using both descriptive and inferential statistical techniques methods. Descriptive statistics were used to analyze the mean scores and changes observed between the pretest and posttest measurements, along with the learning interest questionnaire. Inferential analysis begins with preparatory assessments, including tests of normality and homogeneity. Hypothesis testing uses an independent samples t-test was employed to evaluate whether significant differences existed between the experimental and control groups. The analysis was performed using IBM SPSS Statistics with the significance level established at 0.05 ($\alpha = 0.05$). This study employed a quantitative approach using a quasi-experimental pretest–posttest control group design. This design was selected because the research participants were organized into pre-existing classes, making individual randomization impractical in the school setting. Quasi-experimental designs are appropriate for evaluating the effects of an intervention when random assignment cannot be fully implemented. The study was conducted at a Vocational High School in Bangkalan, Indonesia, involving Grade 10 students enrolled in the Motorcycle Engineering and Business (TBSM) program during the academic semester of the study. Two intact classes participated in the research. Both groups completed a pretest and a learning interest questionnaire before the intervention. The experimental group received web-based learning, whereas the control group received conventional instruction. After the intervention, both groups completed the same posttest and learning interest questionnaire to identify changes in learning outcomes and learning interest.

The population consisted of all Grade 10 students enrolled in the Motorcycle Engineering and Business program at the selected Vocational High School, comprising 60 students distributed across two classes. Class X TBSM 1 consisted of 30 students, while Class X TBSM 2 consisted of 30 students. Total sampling was used because the entire accessible population was included as the research sample. Total sampling involves including all members of a population when the population is relatively limited and accessible to the researcher. One class was assigned as the experimental group and the other as the control group. Both groups received the same learning materials, instructional duration, learning objectives, and assessment procedures. The difference between the groups was limited to the instructional approach, with the experimental group using web-based learning and the control group receiving conventional instruction.

Data were collected using a learning interest questionnaire and a learning outcome test, supported by an observation sheet to monitor the implementation of the learning

activities. The learning interest questionnaire used a Likert scale and covered four indicators: interest in the learning material, attention during learning activities, engagement in learning, and motivation to learn. The learning outcome test consisted of objective questions based on the Motorcycle Engineering and Business material taught during the intervention. The test was administered as a pretest and posttest to measure changes in students' knowledge. The instrument indicators were developed according to the learning objectives and competencies addressed in the instructional material. Before the instruments were used in the main study, their quality was examined through validity and reliability procedures. Content validity was assessed through expert judgment to determine the relevance, clarity, and suitability of the items with the research variables and learning objectives. Empirical item validity was subsequently examined to identify items that adequately measured the intended constructs. Reliability testing was conducted to determine the internal consistency of the instruments. Validity indicates the extent to which an instrument measures the intended construct, whereas reliability refers to the consistency of the measurement results. The final instruments consisted only of items that met the predetermined validity and reliability criteria.

The data analysis involved descriptive and inferential statistical procedures. Descriptive statistics were used to summarize the pretest and posttest scores and learning interest measurements, including the mean and standard deviation. Before hypothesis testing, normality and homogeneity tests were conducted as prerequisite analyses for the use of parametric statistical procedures. The normality test was used to determine whether the data were normally distributed, while the homogeneity test examined the equality of variances between the experimental and control groups. An independent-samples t-test was subsequently used to determine whether significant differences existed between the experimental and control groups in terms of learning interest and learning outcomes. The independent-samples t-test is appropriate for examining differences in the means of two independent groups when the relevant assumptions are satisfied. Statistical significance was determined at an alpha level of 0.05 ($\alpha = 0.05$), and the analysis was performed using IBM SPSS Statistics.

RESULT AND DISCUSSION

Results

Descriptive statistical analysis was employed to examine the baseline and post-intervention conditions of students in the experimental and control groups. The analysis of pretest and posttest scores provides an overview of the effectiveness of website-based learning media in enhancing students' learning interest and learning outcomes. The findings are presented in [table 1](#).

Tables 1.

Descriptive Statistics of Student Learning Interest and Learning Outcomes

Variable	Class	N	Pretest Mean	Posttest Mean	Mean Difference	Std. Deviation	Std. Error Mean
Student	Experiment	30	33,43	52,27	18,84	9,303	1,699
Interest	Control	30	29,80	46,40	16,6	10,251	1,872
Learning	Experiment	30	51,83	86,67	34,84	16,556	3,023
outcomes	Control	30	49,00	65,67	16,67	24,415	4,458

Descriptive analysis showed improvements in both learning interest and learning outcomes in the experimental and control groups, with greater gains observed in the experimental group. Learning interest in the experimental group increased from a mean score of 33.43 in the pretest to 52.27 in the posttest, representing an increase of 18.84 points. This improvement indicates that students demonstrated greater interest, attention, engagement, and motivation during the learning process after receiving web-based instruction. In comparison, the control group increased from 29.80 to 46.40, with a gain of 16.60 points.

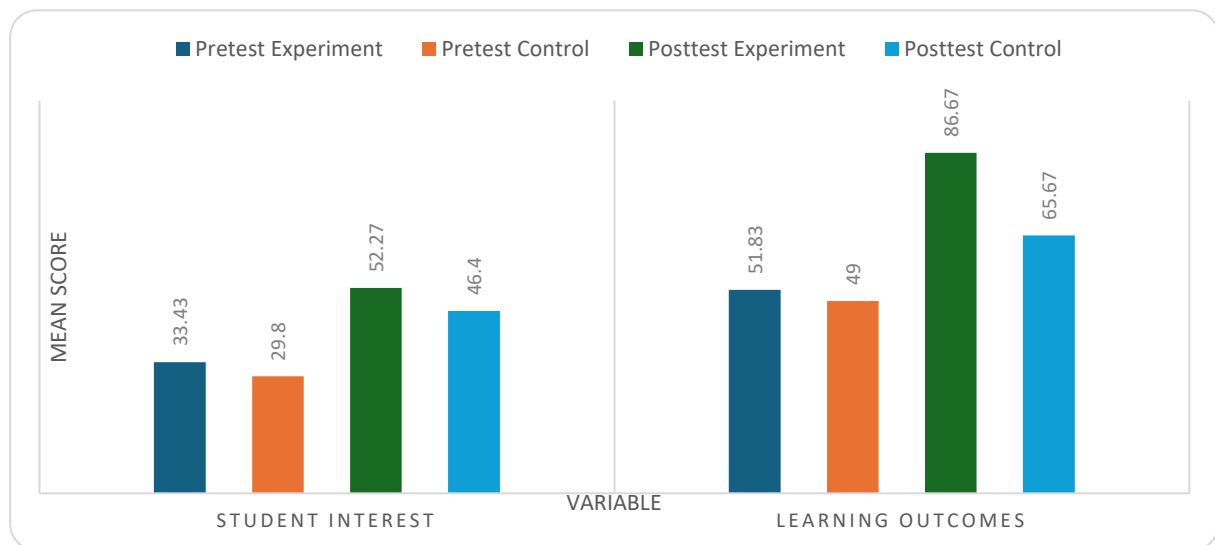
A more pronounced improvement was observed in learning outcomes. The experimental group increased from a mean pretest score of 51.83 to a posttest score of 86.67, representing a gain of 34.84 points. This improvement reflects better mastery of the Motorcycle Engineering and Business material following the intervention. The control group also showed improvement, increasing from 49.00 to 65.67, with a gain of 16.67 points. Thus, the increase in the experimental group was more than twice that observed in the control group. In addition, the standard deviation of learning outcomes in the experimental group (16.556) was lower than that of the control group (24.415), indicating that the post-intervention scores in the experimental group were relatively more homogeneous. Overall, the descriptive findings show that web-based learning was associated with improvements in both students' learning interest and learning outcomes, with the most notable improvement occurring in academic achievement. A graphical comparison of the pretest and posttest results for both variables is presented in the following figure.

The normality prerequisite test using Shapiro-Wilk and the homogeneity test using Levene's Test for the variables of student interest and learning outcomes can be seen in the [table 2](#). The assumption tests confirmed that the research data met the requirements for parametric analysis. The Shapiro-Wilk normality test indicated that all data distributions were normal, with significance values exceeding 0.05. Specifically, the learning interest variable obtained p-values of 0.200 for the posttest and 0.119 for the pretest, while the learning outcomes variable showed p-values of 0.210 for the pretest and 0.161 for the

posttest. Furthermore, Levene's test results demonstrated that the data variances were homogeneous, with significance values of 0.083 and 0.161 for learning outcomes in the pretest and posttest, respectively, and 0.167 and 0.815 for learning interest in the pretest and posttest, respectively. Since all significance values exceeded the 0.05 threshold, the data satisfied the assumptions of normality and homogeneity of variance. Therefore, the data were considered appropriate for further analysis using the independent samples t-test as a parametric statistical procedure

Figure 1.

Graphical Representation of Changes in Learning Interest and Academic Performance in the Experimental and Control Groups



Tables 2.

Normality and Homogeneity Test Results for the Research Data

Variable	Treatment time	Shapiro-Wilk test	Description	Levene's Test	Description
Student Interest	Pretest	0,119	Normal	0,167	Homogen
Interest	Posttest	0,200	Normal	0,815	Homogen
Learning outcomes	Pretest	0,210	Normal	0,083	Homogen
	Posttest	0,161	Normal	0,161	Homogen

Tables 3.

Results of the Independent Samples t-Test on Students' Learning Interest and Academic Outcomes

Variabel	Treatment time	t	df	Sig. (2-tailed)	Description
Student Interest	Pretest	-1.492	58	0,141	insignificant
	Posttest	2.321	58	0,024	significant
Learning outcomes	Pretest	0,419	58	0,667	insignificant
	Posttest	3.899	58	< 0,001	significant

The results of the independent samples t-test (table 3) indicated that there were no statistically significant differences between the experimental and control groups prior to the intervention. The pretest analysis showed significance values of 0.667 for learning outcomes and 0.141 for learning interest, both exceeding the 0.05 threshold, suggesting that the two groups had comparable baseline characteristics. However, significant differences emerged in the posttest results following the intervention, with a significance value of $p < 0.001$ for learning outcomes and 0.024 for learning interest. These findings indicate that web-based learning was more effective than conventional instructional approaches in improving students' learning interest and academic achievement.

Tables 4.

Effect Size of Web-Based Learning on Students' Learning Interest and Learning Outcomes

Variabel	Cohen's d	Description
Student Interest	0,599	Medium Effect
Learning outcomes	1,007	Large Effect

The effect size analysis showed (table 4) that web-based learning had a medium effect on students' learning interest ($d = 0.599$) and a large effect on learning outcomes ($d = 1.007$). These findings indicate that the intervention produced a more substantial effect on students' academic achievement than on their learning interest. The effect size results therefore complement the hypothesis testing by demonstrating not only whether differences occurred between the groups but also the magnitude of those differences.

Discussion

The hypothesis testing results based on the independent samples t-test revealed that no significant differences existed between the experimental and control groups at the pretest stage, both in students' learning interest ($p = 0.141$) and learning outcomes ($p = 0.667$). These findings indicate that both groups had comparable baseline conditions prior to the intervention. However, the posttest analysis demonstrated significant differences between the two groups after the implementation of web-based learning, with significance values of $p = 0.024$ for learning interest and $p < 0.001$ for learning outcomes. Furthermore, the effect size analysis showed that web-based learning had a moderate effect on students' learning interest (Cohen's $d = 0.599$) and a large practical effect on learning outcomes (Cohen's $d = 1.007$). Therefore, the research hypothesis was supported, indicating that web-based learning effectively contributes to improving students' learning interest and academic achievement in vocational education.

The findings suggest that web-based learning provides a more effective learning experience than conventional instructional approaches. The improvement in the experimental class is evident not only from the difference in average posttest scores but also from the strength of the influence measured by the effect size value. This shows that the use of the web in motorcycle vocational education serves as a learning tool that helps students absorb information in a more flexible, visual, and repetitive manner (Widiaty et al., 2019). These findings are consistent with previous research conducted by Permatasari & Hardyanto (2019), which found thru meta-analysis that web-based learning and blended learning consistently produce better learning outcomes compared to conventional learning. Students benefit from the possibility of more flexible learning, more time to study the content, and the ability to access learning materials whenever they need them (Wachid et al., 2019). Thus, using the web not only serves as a means to provide information but also enhances the overall quality of the learning experience (Chairil Imran, 2022).

Students' interest in the experimental class can increase as a result of more engaging and accessible web-based learning. Motorcycle vocational content involves technical features that require visualization, specific examples, and repetition (Setyawan et al., 2024). Students can independently access information, photos, videos, or activities thru the internet, giving them a better opportunity to understand the topic at their own pace (Sawiji, 2024). This condition can enhance students' attention, interest, and engagement in the learning process. The findings of this study are consistent with the research by Alfath et al. (2025), which found that web-based learning can enhance students' motivation, satisfaction, and engagement by providing easier access to materials, better communication, and more opportunities for independent learning. In line with this, Tumasius (2022) stated in their systematic review that the use of learning technology adds to the increase in student engagement, as evidenced by heightened student attention, active participation, and perseverance throughout the learning process.

Web-based learning demonstrated a moderate effect on students' learning interest. These results indicate that students' interest in learning is not only influenced by the use of digital media but also by their personal motivation, study habits, teacher assistance, classroom environment, and the relevance of the material to their needs (van Aswegen & Pendergast, 2023). To increase student interest, web-based learning should be built interactively while also involving the role of the teacher (Karcher et al., 2025). The findings of the present study are corroborated by previous research demonstrating that Mahesa et al. (2025), which indicates that the effectiveness of online learning is influenced not only by technological implementation but also by teachers' pedagogical approaches, the quality of learning interactions, and the structure of activities designed to facilitate active engagement.

In other words, using technology alone is not enough to increase learning interest unless it is combined with the right pedagogical approach (Bagaskara et al., 2023).

The variable of learning outcomes has a stronger impact. This shows that web-based learning is more successful in helping students master the content (Pantoja & Aguayo, 2022). Before the evaluation, students in the experimental class can study the content, review previously unclear ideas, and reinforce their understanding. This is important in Motorcycle Engineering and Business learning because students must first understand the ideas, components, functions, and work procedures before engaging in real tasks. Web-based learning enhances students' conceptual and procedural understanding (Herlambang et al., 2024).

This finding supports the view that learning technologies can contribute to improving instructional quality when they are applied appropriately and aligned with educational objectives and learner needs (Ismaniati et al., 2023). Web-based learning makes the learning process more adaptive, open, and not limited to the classroom. However, its success still depends on the design of the materials, teacher engagement, availability of devices, and students' readiness to utilize technology (Basori et al., 2023; Carney et al., 2020). Therefore, the use of the web in vocational education should be positioned as a pedagogical method rather than merely a means of delivering digital content (Bashori et al., 2022).

The findings highlight the potential for vocational schools to establish more systematic web-based learning frameworks, especially within productive disciplines that demand the integration of theoretical concepts and technical practices (Chaipidech et al., 2022; Ye et al., 2022). Teachers can use the internet to provide additional resources, learning videos, practice questions, summaries, and brief assessments that students can access outside of class hours (Tira Erlangga, 2022; Zeng et al., 2022). As a result, face-to-face time might be better used for discussions, demonstrations, error explanations, and hands-on practice in the workshop (Purnomo et al., 2023). Overall, this study provides evidence that web-based learning facilitates improvements in student engagement and academic performance, demonstrating a stronger effect on students' learning outcomes. Web-based learning has been proven to enhance students' knowledge, improve access to learning, and facilitate a more flexible vocational learning process (Ramdhani et al., 2025). Therefore, the integration of web-based learning into Motorcycle Engineering and Business education represents an effective alternative instructional approach for improving the quality of vocational education (Purnomo & Fatkhurahman, 2023).

One strength of this study lies in its quasi-experimental pretest–posttest control group design, which allows changes in learning interest and learning outcomes to be examined in relation to different instructional approaches. The inclusion of both learning interest and learning outcomes also provides a broader perspective on instructional effectiveness by

considering affective and academic dimensions simultaneously. In addition, the calculation of Cohen's d complements the significance testing by showing the practical magnitude of the differences between the experimental and control groups. The study is also situated in a specific vocational context, namely Motorcycle Engineering and Business education, which provides empirical evidence that is directly relevant to the implementation of web-based learning in technical and practice-oriented subjects.

Several limitations should nevertheless be acknowledged. First, the study involved only 60 Grade 10 students from two existing classes at one Vocational High School in Bangkalan. The limited sample and single-school setting may restrict the generalizability of the findings to other vocational schools, regions, grade levels, or study programs. Second, the use of intact classes without individual randomization means that potential pre-existing differences between students cannot be completely eliminated, although the pretest results indicated comparable baseline conditions. Third, the intervention was conducted within a relatively limited instructional period, so the findings primarily reflect short-term changes and do not establish whether the observed improvements in learning interest and learning outcomes can be sustained over a longer period. Finally, the study focused on learning interest and learning outcomes and did not examine other factors that may influence the effectiveness of web-based learning, such as digital literacy, learning motivation, teacher competence, availability of technological facilities, internet access, and students' independent learning habits.

Despite these limitations, the findings provide useful empirical support for the integration of web-based learning into Motorcycle Engineering and Business education. Future studies could involve larger and more diverse samples, multiple vocational schools, longer intervention periods, and more rigorous group assignment procedures. Further research could also examine how teacher support, digital literacy, learning motivation, and the quality of web-based instructional materials influence the effectiveness and sustainability of technology-supported vocational learning.

CONCLUSIONS

Based on the research objectives and hypotheses, the findings indicate that web-based learning contributes to improving students' learning interest and academic outcomes in Motorcycle Engineering and Business vocational education. The research hypothesis was supported, as significant differences were identified between the experimental and control groups after the intervention. Compared with conventional instructional approaches, web-based learning demonstrated greater effectiveness, particularly in enhancing students' learning outcomes. These findings suggest that the integration of web-based learning in vocational education extends beyond its role as a supplementary instructional tool; it

represents an innovative learning approach that facilitates broader access to learning resources, promotes deeper conceptual understanding, and supports students' independent learning. The primary contribution of this study lies in reinforcing the implementation of digital learning practices within vocational education, particularly in the Motorcycle Engineering and Business field, while encouraging the development of adaptive, contextual, and student-centered learning environments in response to the demands of the digital era.

Based on these findings, vocational teachers are encouraged to use web-based learning as a complement to face-to-face learning, especially to provide materials, videos, exercises, and assessments that can be independently accessed by students. Schools should also promote the availability of digital facilities, teacher training, and the creation of web-based learning content that is consistent with the features of productive topics. This study can be expanded with a larger sample size, a longer treatment period, and other factors such as learning motivation, practical skills, digital literacy, or students' readiness to use learning technology.

DECLARATIONS

Author Contribution

Rahmadani, H., contributed to the conceptualization, methodology, data collection, analysis, interpretation of findings, manuscript preparation, and critical revision of the final manuscript. **Hartati, S.J.**, contributed to the conceptualization, methodology and manuscript preparation. **Huda, N.**, contributed to the manuscript preparation, and critical revision of the final manuscript.

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Conflicts of Interest

The authors declare that they have no competing interests.

Declaration of AI Use

No artificial intelligence tools were used in the preparation or revision of this manuscript. The authors are fully responsible for its content and integrity.

REFERENCE

Alfath, Q. N., Ruslan Rizki Hidayat, Zainul Hakim, & Sri Rahayu. (2025). Development of a Web-Based Interactive E-Learning Platform for a Vocational High School. *Bit-Tech*, 8(1), 738–746. <https://doi.org/10.32877/bt.v8i1.2683>

- Arya, A. A. R., & Rekha, R. V. (2025). Digital inclusion in higher education: A web content accessibility evaluation of best Asian university library websites. *The Journal of Academic Librarianship*, 51(5), 103120. <https://doi.org/10.1016/J.ACALIB.2025.103120>
- Bagaskara, R. S., Itsnaini, A. U., 'Azmi, S. M., & Dewanti, N. A. (2023). Development of an integrated vocational interest website for high school students' career interest assessment. *Psychological Research and Intervention*, 6(2), 58–68. <https://doi.org/10.21831/pri.v6i2.67709>
- Bashori, M., van Hout, R., Strik, H., & Cucchiarini, C. (2022). Web-based language learning and speaking anxiety. *Computer Assisted Language Learning*, 35(5–6), 1058–1089. <https://doi.org/10.1080/09588221.2020.1770293>
- Basori, B., Sajidan, S., Akhyar, M., & Wiranto, W. (2023). Blended learning model towards vocational students' learning outcomes: A scoping review. *International Journal of Evaluation and Research in Education*, 12(1), 205–215. <https://doi.org/10.11591/ijere.v12i1.22986>
- Carney, M., Webster, B., Alvarado, I., Phillips, K., Howell, N., Griffith, J., Jongejan, J., Pitaru, A., & Chen, A. (2020). Teachable machine: Approachable web-based tool for exploring machine learning classification. *Conference on Human Factors in Computing Systems - Proceedings*, 115, 82–95. <https://doi.org/10.1145/3334480.3382839>
- Chaipidech, P., Srisawasdi, N., Kajornmanee, T., & Chaipah, K. (2022). A personalized learning system-supported professional training model for teachers' TPACK development. *Computers and Education: Artificial Intelligence*, 3, 100064. <https://doi.org/10.1016/J.CAEAI.2022.100064>
- Chairil Imran, M. (2022). Using BBC Web-Based Learning Courses to Improve Vocational High School (VHS) Students' Speaking Skill. *Education, Language and Culture Journal*, 2(1). <https://jurnal-eureka.com/index.php/edulecj>
- Efendi, R., Lesmana, L. S., Putra, F., Yandani, E., & Wulandari, R. A. (2021). Design and Implementation of Computer Based Test (CBT) in vocational education. *Journal of Physics: Conference Series*, 1764(1). <https://doi.org/10.1088/1742-6596/1764/1/012068>
- Hafidh, Z., Zahra, N. F., & Ayyumna, T. N. (2026). Digital Technology Integration in Vocational Education. *INCARE, International Journal of Educational Resources*, 6(5), 662–679. <https://doi.org/10.59689/incare.v6i5.1349>
- Hardison, H., Mukhaiyar, R., Muskhair, M., Waskito, W., & Luthfi, A. (2025). Designing a Web-Based Internship Information System for Vocational High Schools. *Jurnal Penelitian Pendidikan IPA*, 11(2), 642–653. <https://doi.org/10.29303/jppipa.v11i2.10227>
- Hargittai, E. (2025). Survey measures of web-oriented digital literacy. *Social Science Computer Review*, 23(3), 371–379. <https://doi.org/10.1177/0894439305275911>

- Herlambang, A. D., Ririn, & Rachmadi, A. (2024). The flipped-classroom effect on vocational high school students' learning outcomes. *International Journal of Evaluation and Research in Education*, 13(3), 1807–1815. <https://doi.org/10.11591/ijere.v13i3.26757>
- Hermansah, B., Setywati, H., Nasuka, N., & Setiawaty, E. (2025). Enhancing Digital Competencies through Technology Integration in Vocational Education. *Jurnal MENTARI: Manajemen, Pendidikan Dan Teknologi Informasi*, 4(1), 40–51. <https://doi.org/10.33050/mentari.v4i1.906>
- Idroes, R., Afidh, R. P. F., Zahriah, Z., Noviandy, T. R., Sugara, D. R., Ahsya, Y., Amirah, K., Baihaqi, B., & Dharma, A. (2024). Development of a Web-Based Educational Management System for a Technology Vocational High School in Banda Aceh, Indonesia. *Journal of Educational Management and Learning*, 2(2), 64–73. <https://doi.org/10.60084/jeml.v2i2.230>
- Ismaniati, C., Muhtadi, A., Cobena, D. Y., & Soeparno, P. L. (2023). Effectiveness of Flipped Classroom on Students' Learning Outcome in Vocational High School: A Meta-Analysis. *International Journal of Instruction*, 16(1), 589–604. <https://doi.org/10.29333/iji.2023.16133a>
- Kamaludin, M., Setyadin, A. S., Mulyana, T., Hafid, D., Eko Saputro, B., & Bayu Nugraha, N. (2024). The Need Mapping of Motorcycle Automotive Industry & LSP-P1 Certification: A Collaboration between Professional Certification Institutions Vocational High School (SMK-LSP) to Improve the Competitiveness of TVET Graduates in West Java Province. *VANOS Journal Of Mechanical Engineering Education*, 9(2).
- Karcher, E. L., Bogdanic, D. M., & Cloft, S. E. (2025). Enhancing high school students' interest, motivation, and knowledge through poultry science workshops. *Poultry Science*, 104(7), 105200. <https://doi.org/10.1016/J.PSJ.2025.105200>
- Mahesa, R., Mardiono, R., & Teja Kusuma, C. (2025). Development of Social Media Applications as a Website-Based Discussion Place to Increase Student Learning Interest at the Vocational Level. *Letters in Information Technology Education (LITE)*, 8(2), 90–98. <https://doi.org/10.17977/um010v8i22025p90-98>
- Noviyana, K., Komaro, M., Adam, R., Noor, M., & Ilyasa, A. N. (2021). Implementation Of Online Learning In Productive Subjects Of Motorcycle Engineering And Business. *Journal of Mechanical Engineering Education*, 8(1). <https://doi.org/10.17509/jmee.v8i1.33697>
- Pantoja, A., & Aguayo, B. B. (2022). Vocational Interests of Students in an International Network Learning Environment. *REICE. Revista Iberoamericana Sobre Calidad, Eficacia y Cambio En Educacion*, 20(3), 185–203. <https://doi.org/10.15366/reice2022.20.3.010>

- Permatasari, G. A., & Hardyanto, W. (2019). Online Web-Based Learning and Assessment Tool in Vocational High School for Physics. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, 5(1). <https://doi.org/10.21009/1>
- Purnomo, S., & Fatkhurahman, P. N. (2023). Development of Motorcycle Brake System Tutorial Media for Vocational High School. *The 5 Th International Conference on Technology, Education and Sciences*.
- Purnomo, S., Pamungkas, T., & Bintoro Johan, A. (2023). Implementation of Android Application-Based Learning Media on Motorcycle Electrical Maintenance Materials in Vocational High Schools. *VANOS Journal Of Mechanical Engineering Education*, 8(2).
- Ramdhani, R., Noor, R. A. M., Sriyono, S., Fal, N. J., Munawar, W., & Gifari, M. M. Al. (2025). Bridging theory and practice: Implementation of hybrid motorcycle prototypes as learning media in vocational automotive education. *Jurnal Pendidikan Teknologi Kejuruan*, 8(4), 241–250. <https://doi.org/10.24036/jptk.v8i4.47323>
- Rossydi, A., Wanner, P. J., Al As'ary, M., Kurnianto, B., & Fahmadi, A. E. (2026). Bridging Skills and Language: Developing Web-Based English Learning Platforms for Vocational Education. *International Journal of Language Education*, 10(1), 21–37. <https://doi.org/10.26858/ijole.v10i1.83709>
- Sawiji, H. (2024). Determining factors influencing teachers' intention to use web-based e-learning platforms in vocational secondary schools in Indonesia. *Cogent Education*, 11(1). <https://doi.org/10.1080/2331186X.2024.2355830>
- Setyawan, H., Sukardi, Risfendra, Jalinus, N., Mardizal, J., & Ananda, G. F. (2024). Effectiveness of E-Learning-Based Learning in the Era of Digital Transformation: A Meta-Analysis. *Indonesian Journal of Educational Research and Review*, 7(2), 333–346. <https://doi.org/10.23887/ijerr.v7i2.76166>
- Silvana, T. S., Ekohariadi, Buditjahjanto, I. G. P., Rijanto, T., Munoto, & Nurlaela, L. (2021). Study of the implementation of online learning models in vocational schools. *Journal of Physics: Conference Series*, 1810(1). <https://doi.org/10.1088/1742-6596/1810/1/012066>
- Sugiarto, T., Syahril, Syah, N., & Muslim. (2023). The Impact of Trends in the Opening of Automotive Engineering Study Program (Light Vehicle and Motorcycle) in Vocational High Schools. In *9th International Conference on Technical and Vocational Education and Training*, 215–223. https://doi.org/10.2991/978-2-38476-050-3_24
- Tira Erlangga, D. (2022). Student problems in online learning: Solutions to keep education going on. *Journal of English Language Teaching and Learning (JELTL)*, 3(1).
- Tumasis, J. B. (2022). Web-Based Platform for Don Bosco High School – Senior High School – Technical Vocational Education Track in Adoption of Hybrid Learning.

- Proceedings of The International Halal Science and Technology Conference*, 14(1), 47–55. <https://doi.org/10.31098/ihatec.v14i1.485>
- van Aswegen, E. C., & Pendergast, D. (2023). The impact of interest: an emergent model of interest development in the early years. *Early Child Development and Care*, 193(13–14), 1335–1349. <https://doi.org/10.1080/03004430.2023.2245575>
- Wachid, N., Majid, A., Ridwan, T., Fauzi, A., & Hikmawan, R. (2019). Integrating of E-learning to Improve Students Competence in Vocational School. *Advances in Social Science, Education and Humanities Research*, 5(1).
- Wahyudi, K. S., Sulisty, B., Budiman, A., & Arifin, Z. (2021). The competency of vocational graduates in the fields of mechanics and workshop management according to the needs of the automotive motorcycle industry. *Journal of Physics: Conference Series*, 1833(1). <https://doi.org/10.1088/1742-6596/1833/1/012014>
- Widiaty, I., Septem Riza, L., Gafar Abdullah, A., Abdullah, M., & Rifqi Mubaroq, S. (2019). Web-based digital learning application of iconic batik in batik learning at vocational high school. *Journal of Engineering Science and Technology*, 14(5), 2475–2484.
- Wijaya, M. B. R., Suwahyo, S., Kurniawan, A., Kurniawan, M., Nugroho, A. Y., & Satyawiguna, T. (2023). Application of Competency Test Materials Standard Motorcycle Business Techniques with SKKNI Level II Scheme Standards for Excellent and Competitive Vocational High Schools Graduates. *Proceedings of the 4th Vocational Education International Conference (VEIC 2022)*, 33–45. https://doi.org/10.2991/978-2-494069-47-3_6
- Ye, J. H., Wu, Y. T., Wu, Y. F., Chen, M. Y., & Ye, J. N. (2022). Effects of Short Video Addiction on the Motivation and Well-Being of Chinese Vocational College Students. *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.847672>
- Zeng, Q., He, Y., Li, J., Liang, Z., Zhang, M., Yi, D., & Quan, J. (2022). Hope, future work self and life satisfaction among vocational high school students in China: The roles of career adaptability and academic self-efficacy. *Personality and Individual Differences*, 199, 111822. <https://doi.org/10.1016/J.PAID.2022.111822>