Vol. 7, No. 1, 2026, pp. 790-799
DOI: https://doi.org/10.29210/08jces691900

Contents lists available at Journal ELORA

Journal of Counseling, Education and Society
ISSN: 2716-4896 (Print) , ISSN 2716-4888 (Electronic)

Journal homepage: https://jces.eloracenter.org/jces



The effect of website-based learning on english vocabulary mastery with learning motivation as a moderator variable among vocational high school students

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Article Info

Article history:

Received Sept 11th, 2026
Revised Oct 21th, 2026
Accepted Nov 17th, 2026

Keyword:

Website-based learning,
Learning motivation,
Vocabulary mastery,
Factorial design,
Vocational english education

ABSTRACT

English vocabulary mastery is an important component of language proficiency, yet vocational high school students often experience difficulties in developing adequate vocabulary knowledge. This study examined the effect of website-based learning on English vocabulary mastery, considering learning motivation as a potential moderating variable among tenth-grade Computer and Network Engineering (TKJ) students at SMK Negeri 1 Rao Selatan. A quantitative quasi-experimental study employing a 2 × 2 factorial design was conducted with 63 students from two intact classes, selected through cluster random sampling. The experimental group received website-based instruction, while the control group received conventional instruction without a website. Data from 61 students with available posttest scores were included in the primary analysis. Learning motivation was measured using a 24-item questionnaire based on Self-Determination Theory, while vocabulary mastery was assessed through a 40-item multiple-choice test based on Nation's form-meaning-use framework. The findings showed comparable initial vocabulary performance between the groups ($t = 0.114$, $p = .910$). Two-way ANOVA revealed a significant main effect of learning method ($F = 96.04$, $p < .001$, $\eta p^2 = .628$), with higher posttest scores in the website-based group. The main effect of learning motivation was significant in the parametric analysis ($F = 8.77$, $p = .004$) but not in the non-parametric comparison ($p = .195$), requiring cautious interpretation due to violations of statistical assumptions. The interaction between learning method and learning motivation was not statistically significant ($F = 1.82$, $p = .183$, $\eta p^2 = .031$). These findings suggest that website-based learning is a promising approach to supporting English vocabulary mastery among vocational students, although the moderating role of learning motivation remains inconclusive.

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Introduction

Digital technology has become an essential component of contemporary education, providing flexible learning opportunities, improving student engagement, and supporting independent learning (Irzawati, 2024). Technology-supported learning environments also enable students to access learning materials at their own pace (Meşe & Sevilen, 2021). One form of technology-based instruction is website-based learning, which integrates instructional materials, interactive exercises, multimedia resources, online quizzes, and immediate feedback within a single accessible platform. Unlike standalone videos or static digital materials, websites allow students

to interact with learning content and practice independently. These features make website-based learning a relevant approach to vocabulary instruction, particularly in providing contextual practice and continuous feedback. Previous studies have discussed the potential of technology-supported instruction in facilitating vocabulary learning (Alhers, 2020). Hsu et al. (2021) examined technology-supported learning approaches, while Arifah et al. (2023) discussed the implementation of website-based learning in instructional activities.

Vocabulary mastery is a fundamental component of English language proficiency because it supports reading, writing, listening, and speaking skills. Students with broader vocabulary knowledge are generally better equipped to understand texts and communicate ideas effectively (Lawrence et al., 2021). Alqahtani (2015) also emphasized the importance of vocabulary knowledge in language learning and communication. In this study, vocabulary mastery refers to students' receptive knowledge of English word forms and meanings in general everyday contexts. It will be measured using the Vocabulary Size Test (VST) developed by Nation and Beglar (2007), which assesses learners' ability to recognize word meanings. This instrument provides a measurable basis for evaluating students' vocabulary knowledge before and after instruction.

However, the effectiveness of technology-based instruction may vary according to individual learner characteristics, particularly learning motivation. Motivation influences students' participation, learning goals, and persistence when facing difficulties (Dörnyei, 2005). Gardner (2010) also highlighted its importance in second language learning. Students with higher motivation may demonstrate greater engagement and consistency in completing learning activities (Motevalli et al., 2020). In website-based learning, motivation may influence how actively students explore materials, complete exercises, and utilize feedback. Therefore, this study positions learning motivation as a moderator variable to examine whether students' motivation levels influence the effectiveness of website-based learning on vocabulary mastery.

Previous studies have generally emphasized the direct effects of digital learning media on vocabulary achievement, while the interaction between instructional methods and learning motivation requires further investigation. Research involving vocational high school students, particularly those in the Computer and Network Engineering (Teknik Komputer dan Jaringan/TKJ) program, also remains limited. This is important because English vocabulary knowledge supports vocational students' academic and future professional communication (Muallim et al., 2024). Preliminary observations at SMK Negeri 1 Rao Selatan indicated that tenth-grade TKJ students experienced difficulties in understanding and using English vocabulary. These difficulties were associated with conventional teaching practices emphasizing memorization and translation, limited interactive learning resources, and low classroom participation. This situation highlights the need for more interactive vocabulary instruction that accommodates students' different motivation levels.

To investigate these issues, this study employs a quasi-experimental design using a pretest–posttest nonequivalent control group approach. This design is appropriate for the existing school setting, where students are organized into established classes and individual random assignment is difficult to implement. The study compares an experimental group receiving website-based vocabulary instruction with a control group receiving conventional instruction. Both groups complete pretests and posttests to assess changes in vocabulary mastery. Learning motivation is measured using a questionnaire and categorized into high and low levels. The study applies a 2 × 2 factorial framework to examine the main effects of instructional method and learning motivation, as well as their interaction. Although the use of pretests and a comparison group helps address initial differences between groups, the absence of individual random assignment requires consideration of potential selection-related threats to internal validity.

This study focuses on general English vocabulary rather than technical vocabulary specific to the TKJ field. Based on the identified research gap, it addresses three research questions: (1) Is there a significant difference in English vocabulary mastery between students receiving website-based instruction and those receiving conventional instruction? (2) Is there a significant difference in vocabulary mastery between students with high and low learning motivation? and (3) Is there a significant interaction between instructional method and learning motivation in influencing vocabulary mastery? This study aims to provide empirical evidence concerning the moderating role of learning motivation in website-based vocabulary instruction. The findings are expected to contribute to technology-enhanced language learning research and provide practical insights for vocational English teachers in developing more interactive and learner-oriented instructional strategies.

Method

This study employed a quantitative quasi-experimental approach using a pretest–posttest nonequivalent control group design. A 2 × 2 factorial design was applied to examine the main effects of learning method and learning motivation, as well as their interaction on students' English vocabulary mastery. Learning method consisted of two levels: website-based learning (A1) and conventional learning without a website (A2). Learning motivation

was categorized into high motivation (B1) and low motivation (B2), resulting in four analytical groups: A1B1, A1B2, A2B1, and A2B2. The quasi-experimental design was selected because the study was conducted in an existing school setting where students were organized into established classes, making individual random assignment impractical. The use of pretest measurements and a comparison group was intended to identify differences in students' vocabulary knowledge before and after the instructional intervention while considering their initial performance.

Table 1. 2x2 Factorial Research Design

Learning Motivation	Website-Based Learning (A1)	Non Website-Based Learning (A2)
High Motivation (B1)	A1B1	A2B1
Low Motivation (B2)	A1B2	A2B2

The participants consisted of 70 tenth-grade students enrolled in the Computer and Network Engineering (Teknik Komputer dan Jaringan/TKJ) program at SMK Negeri 1 Rao Selatan. The participants were drawn from two existing classes, namely Class X TKJ 4 (35 students) and Class X TKJ 3 (35 students). The classes were selected using cluster random sampling from the available tenth-grade TKJ classes. Class X TKJ 4 was designated as the experimental group, while Class X TKJ 3 served as the control group. The allocation was conducted at the class level rather than through individual random assignment. Therefore, the study retained the characteristics of a quasi-experimental design. An a priori statistical power analysis was planned using G*Power to estimate the sample size required for the 2 × 2 factorial analysis, considering an illustrative medium effect size (f = 0.25), an alpha level of .05, and statistical power of .80. The adequacy of the available sample of 70 students was considered in relation to the resulting power analysis. Nevertheless, the use of only one class for each instructional condition was acknowledged as a potential limitation when interpreting the findings.

Two instruments were used to collect the research data: a vocabulary mastery test and a learning motivation questionnaire. Vocabulary mastery was measured using a 40-item multiple-choice test developed based on Nation's (2001) framework, covering three dimensions of vocabulary knowledge: word form, meaning, and use. The test was administered as a pretest and posttest to assess students' vocabulary knowledge before and after the instructional intervention. Content validity was examined through expert judgment involving three experts in English language teaching and assessment. A pilot test was conducted with 30 tenth-grade students from a comparable vocational school who were not included in the main study. Item analysis was performed to examine item difficulty, item discrimination, and internal consistency. For illustrative reporting purposes, the pilot test produced a Cronbach's alpha coefficient of .86, with item difficulty indices ranging from .30 to .80 and item discrimination indices ranging from .30 to .65. These results indicated acceptable internal consistency and item characteristics for the intended assessment purpose. The learning motivation variable was measured using a 24-item questionnaire developed based on Self-Determination Theory, covering autonomy, competence, and relatedness. Responses were recorded using a five-point Likert scale, ranging from strongly disagree to strongly agree. The questionnaire was also examined through expert judgment and pilot testing, with an illustrative Cronbach's alpha coefficient of .89. Students' motivation scores were subsequently categorized into high and low levels based on a predetermined classification criterion.

The instructional intervention was conducted over four weeks, with two sessions per week. Before the intervention, both groups completed the vocabulary pretest and learning motivation questionnaire. The experimental group received vocabulary instruction through a website specifically designed to support English vocabulary learning through interactive materials, contextual vocabulary exercises, multimedia resources, online quizzes, and immediate feedback. Meanwhile, the control group received conventional vocabulary instruction without using the website-based platform. Both groups received comparable vocabulary content and instructional time to maintain consistency between the learning conditions. At the end of the intervention, both groups completed the vocabulary posttest to evaluate their learning outcomes. The pretest and posttest results were then used to examine differences in students' vocabulary mastery across the instructional conditions and motivation levels.

The collected data were analyzed using descriptive and inferential statistics. Descriptive statistics, including means and standard deviations, were calculated to summarize students' vocabulary mastery scores across the four analytical groups. Before hypothesis testing, data normality was examined using the Shapiro–Wilk test, while homogeneity of variance was assessed using Levene's test. A two-way analysis of variance (ANOVA) was conducted to examine the main effects of learning method and learning motivation, as well as their interaction, on students' vocabulary mastery. When statistically significant effects were identified, appropriate post hoc comparisons using Tukey's HSD test were considered. If the assumptions of parametric analysis were not satisfied, suitable alternative analytical procedures were considered according to the data characteristics and research hypotheses. Effect sizes were also considered to indicate the magnitude of the observed effects. All

statistical analyses were conducted at a significance level of .05, and the findings were interpreted in consideration of the quasi-experimental design and its methodological limitations.

Results and Discussios

Data Description

The study initially involved 63 tenth-grade students, comprising 32 students from Class X TKJ 4 as the website-based learning group and 31 students from Class X TKJ 3 as the conventional learning group. Five students had incomplete pretest or posttest records. Consequently, 60 students with available pretest scores were included in the baseline comparison, while 61 students with available posttest scores were included in the primary hypothesis testing. The posttest sample consisted of 30 students in the website-based learning group and 31 students in the conventional learning group.

Before the instructional intervention, both groups demonstrated relatively similar vocabulary mastery. The website-based learning group obtained a pretest mean of 24.50 (SD = 6.76, n = 30), while the conventional learning group obtained a mean of 24.30 (SD = 6.82, n = 30). An independent-samples t-test indicated no statistically significant difference between the groups ($t = 0.114$, $p = .910$). This result was also supported by the Mann–Whitney U test ($U = 461.0$, $p = .876$). These findings suggest that no statistically detectable difference in initial vocabulary performance was observed between the two groups.

Learning motivation was measured using a 24-item questionnaire, with each item scored on a four-point scale, resulting in a possible total score ranging from 24 to 96. The mean motivation score was 78.31 (SD = 8.72, n = 32) in the website-based learning group and 81.23 (SD = 4.59, n = 31) in the conventional learning group. The overall mean motivation score was 79.75, which was used as the classification threshold. Students obtaining scores equal to or above this value were categorized as highly motivated, whereas those scoring below it were classified as having low motivation.

Table 2. Descriptive Statistics of Posttest Scores per Cell of the 2x2 Factorial Design

Group	n	Posttest M	Posttest SD	Min	Max
Website x High Motivation (A1B1)	18	35.89	2.49	30	38
Website x Low Motivation (A1B2)	12	33.42	3.32	27	38
Non Website x High Motivation (A2B1)	22	23.64	7.52	11	38
Non Website x Low Motivation (A2B2)	9	17.22	5.43	9	24

The descriptive results showed that the website-based learning group achieved a higher posttest mean (M = 34.90, SD = 3.06, n = 30) than the conventional learning group (M = 21.77, SD = 7.50, n = 31). When categorized by motivation level, highly motivated students obtained a mean score of 29.15 (SD = 8.44, n = 40), while students with low motivation obtained a mean score of 26.48 (SD = 9.23, n = 21). At the factorial cell level, the website-based group demonstrated relatively similar scores across motivation categories, with a difference of 2.47 points between highly and less motivated students. In contrast, the conventional learning group showed a larger difference of 6.42 points between the two motivation categories.

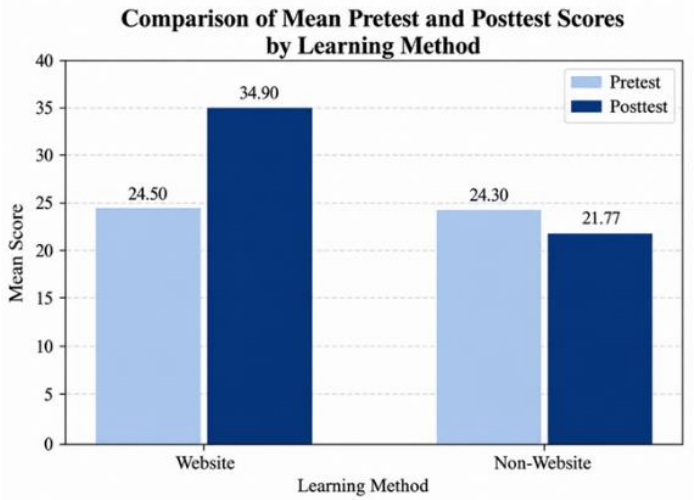


Figure 1. Comparison of Mean Pretest and Posttest Scores by Learning Method

Before conducting hypothesis testing, the normality and homogeneity of variance assumptions were examined. The Shapiro–Wilk test on the residuals of the two-way ANOVA model indicated a deviation from normality ($W = 0.957$, $p = .031$). At the factorial cell level, three groups satisfied the normality assumption: conventional learning with low motivation ($W = 0.865$, $p = .109$), conventional learning with high motivation ($W = 0.970$, $p = .721$), and website-based learning with low motivation ($W = 0.922$, $p = .300$). However, the website-based learning group with high motivation did not meet the normality assumption ($W = 0.825$, $p = .004$). Levene's test also indicated a violation of the homogeneity of variance assumption ($F = 5.85$, $p = .002$), reflecting differences in score variability across the four groups.

Because the normality and homogeneity assumptions were not fully satisfied, the parametric results were interpreted cautiously and accompanied by non-parametric comparisons. The Mann–Whitney U test was used to compare two independent groups, while the Kruskal–Wallis test was used to examine overall differences among the four factorial groups. These non-parametric analyses provided complementary evidence but were not considered direct substitutes for testing the interaction between learning method and learning motivation.

Hypothesis Testing

The first hypothesis (H1) examined whether there was a significant difference in English vocabulary mastery between students receiving website-based learning and those receiving conventional instruction. The two-way ANOVA revealed a statistically significant main effect of learning method ($F = 96.04$, $p < .001$, partial $\eta^2 = .628$), indicating a large effect size. This finding was also supported by the Mann–Whitney U test ($U = 865.5$, $p < .001$). Descriptively, students in the website-based learning group achieved a substantially higher posttest mean ($M = 34.90$) than those in the conventional learning group ($M = 21.77$). Therefore, H1 was supported, demonstrating a significant difference in vocabulary mastery between the two instructional conditions.

Table 3. Summary of the Two-Way ANOVA on Posttest Scores (n = 61)

Source of Variance	df	F	Sig. (p)	Partial Eta Squared
Learning Method (A)	1	96.04	<0.001	0.628
Learning Motivation (B)	1	8.77	0.004	0.133
Interaction A x B	1	1.82	0.183	0.031
Residual	57	-	-	-

The second hypothesis (H2) investigated whether vocabulary mastery differed significantly between students with high and low learning motivation. The two-way ANOVA indicated a statistically significant main effect of learning motivation ($F = 8.77$, $p = .004$, partial $\eta^2 = .133$). However, the Mann–Whitney U test comparing the two motivation categories did not reveal a statistically significant difference ($U = 505.5$, $p = .195$). This discrepancy indicates that the evidence concerning the main effect of learning motivation was not consistent across the two statistical procedures. Consequently, although the parametric analysis indicated a significant effect, the non-parametric comparison did not provide sufficient evidence to confirm the difference independently. H2 was therefore considered partially supported and requires further investigation.

The third hypothesis (H3) examined whether there was a significant interaction between learning method and learning motivation in influencing students' English vocabulary mastery. The two-way ANOVA showed that the interaction effect was not statistically significant ($F = 1.82$, $p = .183$, partial $\eta^2 = .031$). A Kruskal–Wallis test across the four factorial groups indicated an overall statistically significant difference ($H = 37.68$, $p < .001$). However, this result only established that differences existed among the four groups and did not specifically demonstrate an interaction effect. Therefore, H3 was not supported.

Nevertheless, the descriptive results revealed a noteworthy pattern. In the website-based learning group, the difference between highly and less motivated students was only 2.47 points (35.89 versus 33.42). In comparison, the difference in the conventional learning group was 6.42 points (23.64 versus 17.22). Tukey's HSD comparisons indicated that the difference between motivation categories was not statistically significant within the website-based group ($p = .609$), whereas it was significant within the conventional learning group ($p = .020$). These comparisons provide additional descriptive insight into the differences between motivation categories within each instructional condition. However, they do not establish a statistically significant interaction, particularly given the non-significant A × B result in the factorial ANOVA.

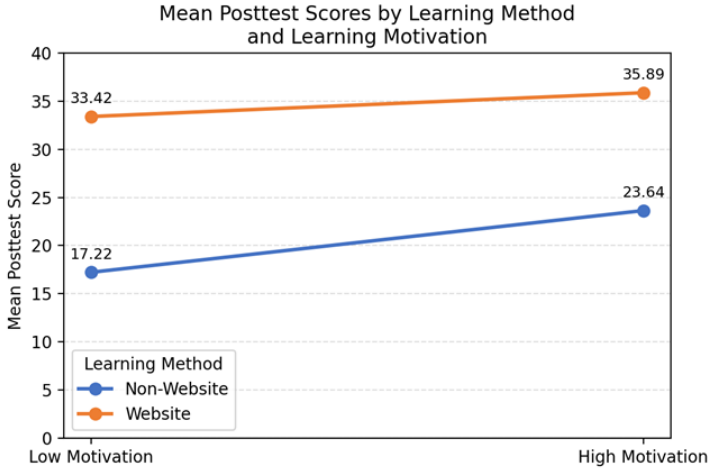


Figure 2. Mean Posttest Scores by Learning Method and Learning Motivation

The findings of this study indicate that website-based learning was associated with substantially higher English vocabulary mastery than conventional instruction, supporting H1. Although both groups demonstrated relatively similar initial vocabulary performance, their posttest results revealed a considerable difference. Students in the website-based learning group obtained a mean score of 34.90, compared with 21.77 in the conventional learning group. This finding suggests that website-based instruction provided learning opportunities that were associated with better vocabulary performance among tenth-grade TKJ students. The result is consistent with Aswad et al. (2022), who investigated web-based language instruction among Indonesian EFL learners and reported greater vocabulary gains in the experimental group than in the conventional learning group. Their study provides particularly relevant evidence because it also examined website-based vocabulary instruction within the Indonesian educational context.

Further support is provided by Bashori et al. (2024), who examined the use of language learning websites equipped with automatic speech recognition technology. Their findings demonstrated that website-based instruction supported improvements in students' receptive vocabulary knowledge. Unlike conventional materials, the websites provided opportunities for vocabulary practice through interactive activities and immediate feedback. These features offer a relevant explanation for the higher scores obtained by students in the present study, as interactive exercises and repeated exposure may help learners recognize and understand vocabulary more effectively. Similarly, Kazu and Kuvvetli (2023) demonstrated the potential of digital game-based language learning to improve vocabulary acquisition through interactive learning activities. Their findings suggest that digital learning environments can create opportunities for active participation and repeated vocabulary practice, which are important components of vocabulary development.

The effectiveness of technology-supported vocabulary learning is also supported by broader research evidence. Hao et al. (2021), through a meta-analysis of 45 studies involving 2,374 EFL learners, reported a large overall effect of technology-assisted vocabulary learning compared with traditional instructional approaches ($g = 0.845$). Their findings also indicated that technology-assisted learning could support long-term vocabulary retention. This broader evidence strengthens the interpretation of the present findings by demonstrating that the benefits of technology-supported vocabulary instruction have been observed across different educational settings and learner populations. Furthermore, Zakian et al. (2022), in a study involving 86 university EFL students, found that mobile-assisted vocabulary learning through digital flashcards produced significantly better vocabulary development than conventional word-list learning, including improvements observed in a delayed posttest. These findings indicate that digital learning tools can extend vocabulary practice beyond classroom activities and provide additional opportunities for repeated exposure to target words.

Other studies also emphasize the importance of multimedia and mobile-assisted learning features in vocabulary acquisition. Nikbakht and Mazdayasna (2024) found that multimedia glosses incorporating audio and video produced significantly better vocabulary test performance than conventional clarification methods. Mohammadi et al. (2024) similarly demonstrated that digital flashcards supported both receptive and productive academic vocabulary development among university EFL students, although the improvement in receptive vocabulary was greater than that in productive vocabulary. These findings are relevant to the present study because they suggest that the effectiveness of digital learning is associated not merely with the use of technology itself, but also with the instructional features through which vocabulary is presented, practiced, and reinforced.

In this regard, interactive materials, contextual exercises, multimedia resources, and immediate feedback may have contributed to the higher vocabulary scores observed in the website-based learning group.

However, the findings concerning learning motivation present a more complex picture. The two-way ANOVA indicated a significant main effect of learning motivation, suggesting that motivation contributed to differences in vocabulary mastery when considered within the factorial model. Nevertheless, the Mann–Whitney U test did not identify a statistically significant difference between highly and less motivated students. This inconsistency indicates that the relationship between motivation and vocabulary achievement requires cautious interpretation. One possible explanation is that the contribution of motivation may vary according to the learning environment and the opportunities provided by the instructional method. Students' motivation may influence their willingness to participate, persist in completing learning activities, and practice vocabulary independently. However, these motivational characteristics do not necessarily translate into significantly different vocabulary scores in every instructional context.

This interpretation is consistent with Wang et al. (2020), who investigated a self-directed mobile learning approach involving 55 university students. Their findings showed that students in the technology-supported learning group achieved better immediate vocabulary posttest results, but the differences in delayed vocabulary retention and second language motivation were not statistically significant. This suggests that improvements in vocabulary achievement do not automatically produce corresponding improvements in learning motivation. Furthermore, Simonnet et al. (2025), through a systematic literature review of 44 studies on technology-assisted vocabulary learning, identified generally positive effects of digital learning tools on vocabulary acquisition, motivation, flow, and engagement. However, their review also highlighted methodological differences across studies and the influence of learning context and instructional design on the observed outcomes. Therefore, the non-significant Mann–Whitney result in the present study does not necessarily contradict the importance of motivation in language learning, but indicates that its relationship with vocabulary achievement may be more context-dependent than initially expected.

Regarding the interaction between learning method and learning motivation, the results did not provide statistically significant evidence that the effectiveness of website-based learning differed according to students' motivation levels. Nevertheless, the descriptive findings revealed a smaller achievement gap between highly and less motivated students in the website-based group than in the conventional learning group. The difference between motivation categories was 2.47 points in the website-based group, compared with 6.42 points in the conventional learning group. This pattern suggests that website-based learning may provide a more structured environment for vocabulary practice, allowing students to access learning materials, complete exercises, and receive feedback regardless of their initial motivation level. However, because the interaction effect was not statistically significant, this pattern should be interpreted as a descriptive tendency rather than evidence that website-based learning reduces the influence of learning motivation.

Previous studies provide useful perspectives for understanding this pattern. Ghafram Al Shihri et al. (2025) found that integrating multiple mobile-assisted language learning applications, including Kahoot, Quizlet, and WhatsApp, significantly improved academic vocabulary acquisition among EFL university students. Their findings also indicated positive student experiences with interactive and flexible learning activities. Similarly, Kazu and Kuvvetli (2023) reported that digital game-based vocabulary learning generated positive learning experiences through interactive features. Simonnet et al. (2025) further emphasized that technology-assisted vocabulary learning can support learner engagement and motivation, particularly when learning tools provide opportunities for autonomous and interactive practice. Taken together, these findings suggest that digital learning environments may offer additional support for students with different motivational characteristics. However, the extent to which such support reduces differences in vocabulary achievement requires further investigation through research designs with adequate statistical power and balanced participant groups.

The findings also highlight the importance of distinguishing between the main effects of instructional method, the main effects of learning motivation, and their interaction. The significant main effect of learning method indicates that vocabulary performance differed considerably between website-based and conventional instruction. The main effect of motivation, however, was not consistently supported by the parametric and non-parametric analyses. Meanwhile, the non-significant interaction indicates that the study did not establish a statistically reliable combined effect of instructional method and motivation. This distinction is important because a significant difference among the four factorial groups, as indicated by the Kruskal–Wallis test, does not necessarily demonstrate that the relationship between learning method and vocabulary mastery changes according to motivation level. Therefore, the three hypotheses should be interpreted separately rather than assuming that the significant effect of website-based learning automatically confirms the moderating role of learning motivation.

Several methodological limitations should also be considered when interpreting the findings. First, the violations of normality and homogeneity of variance may have affected the reliability of the parametric comparisons, particularly because the factorial cells had unequal sample sizes. Second, the relatively small number of students in the conventional learning and low-motivation group (n = 9) may have reduced the stability of the statistical estimates and the ability to detect interaction effects. Third, five students had incomplete pretest or posttest records, resulting in different sample sizes across the baseline and posttest analyses. Fourth, the use of only one intact class for each instructional condition limits the ability to distinguish the effect of learning method from differences associated with individual class characteristics. Consequently, the observed posttest differences should be interpreted within the limitations of the quasi-experimental design rather than as definitive causal evidence. Future research should involve a larger sample, multiple classes in each instructional condition, more balanced factorial groups, and appropriate statistical procedures for handling unequal variances and initial differences in vocabulary performance. In addition, future studies could incorporate delayed posttests and separate assessments of receptive and productive vocabulary to examine both immediate learning outcomes and long-term vocabulary development. These improvements would provide stronger evidence regarding the effectiveness of website-based vocabulary instruction and the role of learning motivation in vocational English education.

Conclusions

This study found that website-based learning was associated with significantly higher English vocabulary mastery among tenth-grade TKJ students compared with conventional instruction. The two groups demonstrated comparable initial vocabulary performance, while the website-based group achieved substantially higher posttest scores. Therefore, H1 was supported by the findings. However, the results concerning learning motivation were less conclusive. Although the two-way ANOVA indicated a significant main effect of learning motivation, the Mann–Whitney U test did not identify a significant difference between highly and less motivated students. Consequently, H2 received inconsistent statistical support. Furthermore, the interaction between learning method and learning motivation was not statistically significant, indicating that the study did not establish a significant moderating effect of learning motivation on the relationship between instructional method and vocabulary mastery. Thus, H3 was not supported. The interpretation of these findings, particularly for H2 and H3, should consider the unequal distribution of participants across the four factorial groups: website-based learning with high motivation (n = 18), website-based learning with low motivation (n = 12), conventional learning with high motivation (n = 22), and conventional learning with low motivation (n = 9). The relatively small and unbalanced cell sizes, together with violations of normality and homogeneity of variance, may have reduced the statistical power to detect interaction effects and increased the possibility of a Type II error. Therefore, the non-significant interaction result should not be interpreted as definitive evidence that no interaction exists. The available results do not establish the achieved statistical power for detecting the interaction effect, and further power or sensitivity analysis is necessary to determine the extent to which the study could detect an effect of practical importance. Practically, the findings suggest that website-based learning can be a promising alternative for supporting English vocabulary instruction in vocational high schools. Interactive materials, contextual exercises, and immediate feedback may provide students with additional opportunities to practice vocabulary independently. English teachers may therefore consider integrating website-based activities into classroom instruction while maintaining appropriate instructional guidance and support for students with different learning characteristics. Future research should involve larger and more balanced samples, multiple classes in each instructional condition, complete pretest and posttest records, and validated assessment instruments. More robust statistical procedures should also be considered to address unequal variances and potential differences in initial performance. These improvements are necessary to provide stronger evidence concerning the effects of website-based learning and the potential moderating role of learning motivation in English vocabulary acquisition.

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