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The Influence of Technology-enhanced Learning on English Vocabulary Learners' Motivation—Take Baicizhan and Ernie for Example

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Abstracts

Technology enhanced learning is a new way of learning, which has broad prospects for development. With the continuous development and popularization of information technology, technology-enhanced learning has become a hot spot and trend in the field of education and teaching. However, there are some limitations and challenges to the impact of technology-enhanced learning on students' learning motivation. For example, students need to have a certain degree of autonomy and self-discipline. It can be seen that the study of the influence of technology-enhanced learning on English vocabulary learners' learning motivation can promote the development and application of technology-enhanced learning and promote the integration of technology and education. Finally, it can provide students with more high-quality and convenient learning experience and learning resources. Based on this, this paper studies the influence of technology-enhanced learning on English vocabulary learners' learning motivation.

Keywords: technology-enhanced learning; English vocabulary learning; Learning motivation; Impact analysis

1 INTRODUCTION

In recent years, with the continuous development and popularization of information Technology, technology-enhanced Learning (TEL) has gradually become a new way of learning and has received more and more attention. As an international language, English is widely used all over the world, and English vocabulary learning has always been an important part of English learning. Therefore, it is of great significance to study the influence of technology-enhanced learning on English vocabulary learners' learning motivation. First of all, studying the influence of technology-enhanced learning on English vocabulary learners' learning motivation can help us better understand students' learning needs and learning behaviors.The traditional way of learning English vocabulary mainly relies on classroom explanation and written exercises, but this way is monotonous and boring, and it is difficult to stimulate students' learning interest and motivation.Technology enhanced learning attracts students' attention and improves learning effect through multimedia, interaction and other means. Therefore, studying the influence of technology-enhanced learning on students' learning motivation can help teachers and researchers to better understand students' needs and behaviors, so as to better design and implement educational teaching programs. Secondly, studying the influence of technology-enhanced learning on English vocabulary learners' motivation can promote the reform and innovation of education and teaching. As a new way of learning, technology enhanced learning has great potential and advantages. By studying students' learning motivation and behavior of using technology, we can make better use of the advantages of technology to enhance learning and improve students' learning effect and satisfaction. In addition, the research results can also provide reference for education and teaching reform, and promote education and teaching innovation and reform. Finally, the study of the influence of technology-enhanced learning on the learning motivation of English vocabulary learners can also provide new ideas and methods for research in related fields. Therefore, with the continuous development and popularization of technology-enhanced learning in recent years, the research in related fields has also received more and more attention. The study of the influence of technology-enhanced learning on the learning motivation of English vocabulary learners can provide new ideas and methods for the research in related fields, and help to promote the development and progress of related fields.

In this study, "technology-enhanced learning" refers to the use of "BaiCiZhan" and "Ernie" for the enhancement of vocabulary learning. "BaiCiZhan" is a software specifically designed for English language learning, utilizing visual aids and example sentences to reinforce vocabulary memory. Personalized word memory plans can be established to automatically calculate the required number of words and days for completion. To boost user engagement, the software incorporates gamification elements, including rewards, progress tracking, and personalized learning plans. These elements encourage users to continue learning, ultimately enhancing vocabulary skills in an interactive manner. It is the most downloaded and highest-rated language learning application in the Android app store, making it an ideal choice as an active learning tool in the current research. "Ernie" is an artificial intelligence language model developed by Baidu, interpreting and responding to natural language input in a manner similar to human comprehension. It can perform various tasks such as answering questions, assisting in content creation, and providing knowledge and information. Advanced AI technology enables it to recognize and respond to a wide range of natural language inputs, making it a powerful tool for language-related learning tasks.

Based on this, the paper explores the impact of technology-enhanced learning on the motivation of English vocabulary learners, with the hope of promoting the educational development in this field.

2 LITERATURE REVIEW

2.1 Research on the motivational background of foreign language learning

In regards to research on the motivational background of foreign language learning, it can be seen that many scholars have conducted significant studies on existing instrumental and psychological motivational backgrounds, which provide considerations for variable selection in this paper. The specific literature research

contents are as follows:

Gardner, R.C. et al.(1960)found that the greatest predictors of success in second language acquisition came from language intelligence, the intensity of motivation to learn another language, the purpose of the student to learn the language, and an index of language ability. Foreign language motivation refers to the degree of personal effort in foreign language learning activities to experience satisfaction and desire for foreign language learning. Motivation can be divided into integrated motivation and instrumental motivation (Gardner & Lambert, 1960). Al-hoorie, et al. (2020)believe that Gardner and Lambert's (1959) paper "Motivational Variables in Second Language Acquisition" has had an immeasurable impact on the study of motivation in second language learning. This paper represents the beginning of work on social education models and their core, integrated motivation. It is also pointed out that few scholars in the field can match Gardner's six decades of research (Al-Hoorie & Macintyre, 2020). Gardner, R.C. Et al.(1985)believed that Gardner engaged in relevant research on foreign language learning motivation from the perspective of social psychology and believed that motivation consists of four aspects: learning goals, effort behaviors, desire to achieve learning goals, and a positive attitude towards language learning (Gardner, 1985).Macintyre, et al.(2019)concluded through research that the Attitude/Motivation Scale A/MTB, designed and modified by Gardner and Lambert, has become the most authoritative tool for measuring motivation in foreign language learning. There is significant consistency between the mean value of the AMTB scale and individual emotion, and the emotional process may be the basis of the attitude supporting the motivation of language learning (Macintyre et al., 2019).Rao, P.A. et al. (2004)proposed the concept of "language environment," which refers to the crucial role that the language environment of language learners plays in their language acquisition and use. The authors further explored the components and influencing factors of the language environment and how to create an effective language environment in teaching (Rao & Raj, 2004).Banisaeid, M. et al.(2015)put forward the "input hypothesis," that is, in the process of language learning, the input received is more important than grammatical rules and language knowledge for understanding and acquiring a new language. The authors also put forward the "fluency hypothesis" and the "perceptual filter hypothesis," suggesting that emotional and mental states are equally important to language acquisition (Banisaeid & Huang, 2015).Noels, K.A. et al.(2016)proposed the "output hypothesis," that is, language acquisition is promoted through language output activities. The author believes that language learners need to practice continuous language output in order to truly master the ability to use language. At the same time, the author also points out that language output activities play an important role in improving the self-confidence and enthusiasm of language learners (Noels et al., 2016). Bakhtiar, A. et al.(2022)proposed "The Role of Affective Factors in Language Learning," arguing that affective factors have a crucial impact on the success and persistence of language learning. The author discusses the role of affective factors in language learning from the aspects of motivation, anxiety, self-confidence, emotion, and personality, and puts forward ways to promote the establishment and maintenance of positive emotion in teaching (Bakhtiar et al., 2022).

2.2 Research on the influencing factors of foreign language learning motivation

Regarding the research on the influencing factors of foreign language learning motivation, these literatures explored various factors that affect foreign language learners' motivation, such as intrinsic and extrinsic motivation, learning interests, self-efficacy, among others. These studies have certain guiding significance for foreign language educators and students to understand the important factors that affect learning motivation. The specific literature research contents are as follows: Deci, E. et al. (1985) divided foreign language learning motivation into extrinsic and intrinsic motivation and emphasized the need to cultivate intrinsic motivation (Deci & Ryan, 1985). H.D.Brown (2002) proposed a classification of motivation into global, situational, and task motivation, explaining the different types of motivation that foreign language learners generate in different situations (H.D. Brown & Wu Yian Introduction, 2002).Danijela Šegedin, et al. (2009) pointed out that foreign language learners' beliefs have a profound impact on their learning behavior and outcomes (Danijela Šegedin & Mirjana Dukić, 2009). Dadi, S. et al. (2011) studied the factors that influence Omani L2 students' motivation to learn English and found that interest and self-efficacy were two main factors (Dadi, 2011).

Batubara, F. et al. (2020) studied the impact of Montessori teaching method on students' foreign language learning motivation and found that the teacher's presence, personal attitude, Montessori materials, classroom conditions, and friends' influence were the five factors that affect student motivation (Batubara et al., 2020).

2.3 Research on the influence of technology-enhanced learning on foreign language learning motivation

Regarding the research on the impact of technology-enhanced learning on foreign language learning motivation, these domestic and foreign literatures explored the effectiveness of technology in foreign language learning and teaching, as well as its impact on learning motivation. Many scholars' research shows that technologies such as automatic speech recognition and chatbots can have a significant impact on foreign language learning, but the evidence of their effectiveness is limited. However, activities supported by digital technology can increase student participation and motivation. The application of augmented reality technology in language education has also received attention. At the same time, these literatures also pointed out the factors that contribute to the lack of motivation in English language learners, such as language proficiency, teaching materials, and teaching equipment. In order to study the impact of technology-enhanced learning on English vocabulary learners' learning motivation, this paper will use two scales, MLQ and TUB, for empirical research. These scales will help understand students' and individuals' attitudes and behaviors towards technology-enhanced learning, which is of great significance for educational technology innovation research. The specific literature research contents are as follows:

Golonka, E. et al. (2014) reviewed the effectiveness of technology in foreign language learning and teaching, focusing on comparing empirical research on new technologies with traditional methods. The research shows that technologies such as automatic speech recognition and chatbots have a significant impact on foreign language learning, but the evidence of their effectiveness is limited (Golonka et al., 2014). Kopinska, M. et al. (2014) believe that integrating digital technology into foreign language classrooms and language proficiency is a powerful tool, and technology-supported activities can increase student participation and motivation. However, the use of ICT learning in foreign language classrooms is not common and needs more attention (Kopinska & Lasagabaster, 2014). Scrivner, O. et al. (2016) mainly focused on the application of augmented reality technology in language education. They used the Aurasma application to enhance the experience of a beginner-level Spanish course and explored the enhancement of learner motivation and the relationship between digital technology and language teaching (Scrivner et al., 2016). Akobirov, F. et al. (2017) mainly investigated the impact of technology on Uzbek EFL and American ESL students' English learning and motivation. The study found that the use of technology may have a positive impact on students' English learning, but the influencing factors are complex (Akobirov, 2017). Liu Xiaochen (2019) believes that with the rapid development of augmented reality technology, more and more auxiliary products for second language education are emerging. Researchers try to examine the role of augmented reality technology in second language learning from different perspectives, but further research is still needed (Liu Xiaochen, 2019). Li Ying & Yu Xinhua (2021) investigated the lack of English learning motivation among 254 non-English major students and found that there are multiple factors that affect students' lack of English learning motivation, including language proficiency, teaching materials, teaching equipment, etc (Li Ying & Yu Xinhua, 2021). Wang Wei (2022) pointed out in the "13th Five-Year Plan for the Development of National Education" that big data technology can provide support for promoting personalized learning for students, and the smart classroom teaching model has emerged. However, in practice, it is found that the teaching mode based on information technology is difficult to maintain students' learning motivation for a long time. Therefore, this article takes college English teaching as an example, and through the ARCS motivation model, analyzes in-depth the ways to maintain students' learning motivation and interest, explores teaching reform methods from three aspects: smart classroom teaching goals, content, and process, solves the problem of affecting students' learning motivation, and improves teaching effectiveness (Wang Wei, 2022).

To investigate the impact of technology-enhanced learning on English vocabulary learners' learning motivation, this study will comprehensively use Motivated Strategies for Learning Questionnaire (MLQ) and

Technology Use Behavior Questionnaire (TUB) to construct empirical dimensions. MLQ is a commonly used scale developed by Paul Pintrich et al. in 1991 to evaluate factors such as students' learning motivation, strategies, and effectiveness, including goal orientation and task orientation. TUB is a commonly used scale developed by Bill Davis et al. in 1989 to evaluate individuals' attitudes and behaviors towards technology use, including perceived usefulness, perceived ease of use, subjective norms, and control beliefs. By integrating these two scales, researchers will gain a better understanding of students' and individuals' attitudes and behaviors towards technology-enhanced learning, which is of great significance for educational technology innovation research (Pintrich & De Groot, 1990; Davis, 1989).

2.4 Literature evaluation

This section provides a literature review on the background of foreign language learning motivation, the factors influencing foreign language learning motivation, and the impact of technology-enhanced learning on foreign language learning motivation. Scholars have rich research experience on the research theme of this article, but there are also some shortcomings that need to be addressed.

Firstly, regarding the background of foreign language learning motivation research, current research has made some progress. Many studies have explored the foreign language learning motivation under different cultural, psychological, social, and educational backgrounds, revealing differences in students' learning motivation backgrounds. Researchers have used various methods, including questionnaires, interviews, and experiments, to gain an in-depth understanding of students' learning motivation and explore the factors that affect students' learning motivation. These studies provide important theoretical and practical references for foreign language education. However, there are still some limitations in current research. Firstly, most studies are based on case studies with small sample sizes that lack representativeness. Secondly, the research methods and tools are not unified and standardized enough, which reduces the comparability and reliability of the results. Finally, there are differences in the definition and measurement of motivation in research, which also needs further consensus and standardization.

Secondly, regarding the factors influencing foreign language learning motivation research, in recent years, more and more studies have explored the factors that affect foreign language learning motivation. These factors include personal factors, socio-cultural factors, and educational factors, etc. Researchers have used various methods, including questionnaires, experiments, and interviews, to explore the influence of different factors on students' learning motivation. These studies reveal multiple factors that affect students' learning motivation, providing important theoretical and practical references for foreign language education. However, there are still some limitations in current research. Firstly, the relationship and mechanism of action between different factors are inconsistent in research results and need further exploration and verification. Secondly, research methods and tools are not unified and standardized enough, reducing the comparability and reliability of the results. Finally, there are differences in the definition and measurement of motivation in research that need further consensus and standardization.

Thirdly, regarding the impact of technology-enhanced learning on foreign language learning motivation research, more and more studies have explored the impact of technology-enhanced learning on foreign language learning motivation. These studies have used various technological means, including virtual reality, gamification, online learning platforms, etc., to improve students' learning motivation and learning outcomes. Researchers have used various methods, including questionnaires, experiments, and interviews, to explore the impact of technology-enhanced learning on students' learning motivation. However, current research still has some limitations. On the one hand, the research objects and sample sizes are limited, lacking representativeness and universality. On the other hand, research methods and tools are not unified and standardized enough.

In summary, although there are no more precise scales directly available for this article based on the literature review of technology-enhanced learning on foreign language learning motivation research, the guidance from these literature review contents can provide good inspiration for this study.

3 Research design

3.1 Research question design

The core purpose of this study is to test whether technology-enhanced learning has a significant impact on the learning motivation of English vocabulary learners. To this end, the following two hypotheses related to learning motivation are proposed:

Hypothesis 1: The technology-based enhanced learning environment has a significant impact on the learning motivation of all experimental classes;

Hypothesis 2: Based on the technology-enhanced learning environment, the learning motivation of students at different achievement levels has different significant effects.

3.2 Research object design

To test the impact of technology-enhanced learning on English vocabulary learners' learning motivation, two experimental classes will be set up, each with 50 students, for a total of 100 students. These students are second-year high school students from the High School Department of Hangzhou Experimental Foreign Language School. This study will not differentiate between gender differences and will focus on exploring the impact of technology-enhanced learning on English vocabulary learners' learning motivation.

3.3 Research tool design

On the one hand, this paper mainly uses SPSS.26 version to conduct pre-test and post-test analysis of English vocabulary learning motivation in data-enhanced learning. Generally, descriptive statistical analysis and correlation analysis will be carried out. On the one hand, descriptive statistical analysis is first carried out in descriptive statistical analysis to understand the basic situation of samples and data distribution. In general, operations such as frequency statistics, mean value, standard deviation calculation and normality test are selected to obtain the basic characteristics and data distribution of samples. In correlation analysis, on the other hand, it is possible to understand the relationship between variables. Therefore, SPSS software can be used to calculate correlation coefficient and significance test to determine whether the relationship between variables is significant. For example, we can calculate the correlation coefficient and significance level between learning motivation and technology-enhanced learning.

On the other hand, in this paper, the five-component Likert scale method will be used for empirical research. Because Likert Scale is a commonly used measurement tool, it is mainly used for the quantitative evaluation of respondents' attitudes and opinions in a specific field. The method usually adopts a five-level evaluation method, that is, a value of 5-1, representing the choice of the most consistent with the respondents' views from the five levels of "strongly agree" to "strongly disagree". In this paper, in the empirical analysis of before and after test of English vocabulary learning motivation in technology-enhanced learning, the five-component Likert scale method can be used to measure respondents' attitudes and views on English vocabulary learning motivation, and the comparison between before and after test can be used to understand whether their learning motivation is enhanced. The specific use ideas are as follows:

(1) Design questions: According to the purpose of the study, design questions related to English vocabulary learning motivation, such as: "Are you willing to spend more time and energy on learning English vocabulary?"

(2) Questionnaire preparation: The questions are prepared in the form of questionnaires, and the five-level evaluation method is used, that is, from the five levels of "strongly agree" to "strongly disagree", the choice that most accords with the respondents' views is selected.

(3) Pre-test: Before learning, the interviewees are pre-tested to understand their motivation and attitude towards learning English vocabulary.

(4) Teaching technology-enhanced learning: the use of technology-enhanced learning methods, such as Take Baicizhan and Ernie for example, can provide practical help for the subsequent post-test of English vo-

cabulary learning in technology-enhanced learning.

(5) Post-test: After the teaching and learning of technology-enhanced learning, the post-test is conducted on the respondents, and their motivation to learn English vocabulary is measured again, and the results are compared with the pre-test results.

(6) Data analysis: The results of pre and post test were statistically analyzed to compare the learning motivation of the respondents and whether they had been enhanced. SPSS statistical software can be used for data processing and analysis.

Through the above steps, the five-component Likert scale method can be used to conduct a quantitative evaluation of the empirical analysis of the pre-and-post test of English vocabulary learning motivation in technology-enhanced learning, to understand whether the learning motivation has been enhanced, and to provide a basis for the overall improvement of subsequent teaching.

3.4 Study the measurement scale

Technology-enhanced learning refers to a kind of learning mode that utilizes various modern technological means to assist and enhance learning effect and learning experience. These technological means can include electronic devices, software applications, online platforms, virtual reality, etc., through these means, learners can obtain knowledge and information more efficiently and conveniently, and also enhance the fun and interactive learning. Technology-enhanced learning has been widely used in modern education, especially in the distance education across time and space, which is of great significance. Therefore, the research topic of "The impact of technology-enhanced Learning on the learning Motivation of English vocabulary learners" involves two aspects: learning motivation and technology use behavior, and the combined study of learning Motivation Questionnaire (MLQ) and technology Use Behavior Questionnaire (TUB) can be considered. The Learning Motivation Questionnaire (MLQ) is a scale used to assess an individual's motivation to learn, developed by Covington et al., Hamburg University, Germany, in 2001. MLQ contains multiple sub-dimensions, which can comprehensively understand learners' motivation from different perspectives, such as self-efficacy, task orientation, achievement orientation, etc. The Technology Use Behavior Questionnaire (TUB) is a scale used to assess an individual's behaviors and attitudes when using technology. It was developed in 2007 by Schwarzer et al., of the University of Hamburg, Germany, to study individual behaviors and attitudes regarding the use of technologies such as computers and the Internet.

Therefore, in this section, from the Learning Motivation Questionnaire (MLQ) scale and the Technology Use Behavior Questionnaire (TUB) scale, the questionnaire questioning dimensions that fit the research theme of "The impact of technology-enhanced learning on English vocabulary learners' learning motivation" were selected, and a five-part Likert scale was constructed for investigation. Each is shown in Table 1 below:

Table 1 Motivational factors measurement scale of English vocabulary learning in technology-enhanced learning

Evaluation dimension	ID	Description
Intrinsic motivation		
self-efficacy	Q1	I believe that using technology-enhanced learning can improve my English vocabulary level.
learning interest	Q2	I am very interested in learning English vocabulary through technology-enhanced learning.

Learning satisfaction	Q3	When I achieve good results using technology-enhanced learning, I feel satisfied and proud.
learning experience	Q4	When using technology-enhanced learning to learn English vocabulary, I feel very happy and enjoy it.
New knowledge exploration	Q5	I will explore new learning methods and strategies in technology-enhanced learning.
Extrinsic motivation		
Technology Use Intention	Q6	I am willing to spend time and effort using technology-enhanced learning to learn English vocabulary.
Technology Acceptance	Q7	I think using technology-enhanced learning to learn English vocabulary is a cool way.
Task Goal Orientation	Q8	My main goal in using technology-enhanced learning is to improve my English vocabulary level.
Sense of Control	Q9	I believe that I can control the time and way of using technology-enhanced learning.
Technical Ability	Q10	I believe that using technology-enhanced learning can help me better master English vocabulary knowledge.

3.5 Data processing, collection and analysis

In this study, 100 learners were randomly divided into two experimental classes with 50 students in each class. Among them, both experimental class A and Experimental class B use technology-enhanced learning methods to teach English vocabulary, but there are differences in technical tools. In the process of data collection and processing, the data of learners' learning motivation under technology enhancement will be recorded, and the synthesis includes the survey measurement content summary using the dimensions selected in the MLQ and TUB scales. Finally, the data obtained from the survey will be input into SPSS software for processing and analysis. A total of 100 valid questionnaires were received in this survey. All effective recovery, effective recovery rate of 100%. There are two requirements for data collection, processing and analysis, and the specific analysis is as follows:

On the one hand, in terms of data collection time, there are two time nodes, which are described as follows:

(1) On April 1, 2023, the first English vocabulary test will be conducted. Class A uses the APP " Baicizhan" to assist the teaching, Class B uses " Ernie" to assist the teaching, which is the pre-test of the experiment. This test will preliminarily issue questionnaires to observe and analyze their views on the influencing factors of English vocabulary learning motivation before using technology to enhance learning.

(2) On June 10, 2023, the English vocabulary achievement test after technology-enhanced learning was carried out. Class A uses " Baicizhan" APP to assist the teaching, Class B uses " Ernie" to assist the teaching, which is the post-test of the experiment. This test will focus on observing and analyzing their differences in influencing factors of English vocabulary learning motivation after technology-enhanced learning.

On the other hand, in terms of data collection differences, the vocabulary learning test after technology-enhanced learning will be conducted, and class A and Class B will be used as the objects of comparison. The emphasis is on the analysis of the difference between internal and external influences of learning motivation after obtaining the technical enhanced learning performance two months later. Therefore, for the difference in the influence of learning motivation of different student groups, it is necessary to divide all students in the two classes into achievement intervals for empirical evaluation, and set them into three vocabulary learning achievement levels respectively to observe the differences, which are as follows: The three types of good performance, medium performance and poor performance respectively represent the top 1/3, 1/3 to 2/3, and the bottom 1/3. Then, based on the comparative analysis of vocabulary learning objects after the technology-enhanced learning, the paper analyzes how English vocabulary learning in the technology-enhanced learning environment will have different internal and external influences on the learning motivation of students with different grades.

4 Research results and Suggestions

4.1Research results

(1)Comparison analysis of the overall significant effects of pre-test and post-test learning motivation between two class groups

1)Comparison analysis of the overall significant effects of pre-test learning motivation between two class groups

Based on the research theme of the influence of technology-enhanced learning on the learning motivation of English vocabulary learners, this paper designs 10 questions (Q1-Q10), and conducts an independent sample test on the pre-test scores of both internal and external learning motivation of students in class A and Class B. Since the P-value is greater than the significance level (usually 0.05), the difference between the two sets of data is not significant. Then, after the independent sample t test as shown in Table 2, it is found that there is no significant difference in the pre-test scores of students in class A and Class B in all dimensions of learning motivation. This data conclusion indicates that before the experiment, technology-enhanced learning has the same influence on English vocabulary learning motivation for students in class A and Class B, which provides comparability and reliability for the subsequent experimental results.

Table 2 Analysis results of independent sample t test of pre-test data of Class AB students

Internal and external learning motivation	Class	Number of people	Mean value	Standard deviation	t	df	p
self-efficacy	A	50	4.00	1.010	-1.261	87.800	0.211
	B	50	4.22	0.708			
learning interest	A	50	4.28	0.607	1.305	93.330	0.195
	B	50	4.10	0.763			
Learning satisfaction	A	50	3.70	0.814	0.636	97.461	0.526
	B	50	3.60	0.756			
learning experience	A	50	3.98	0.742	-0.924	97.836	0.358
	B	50	4.12	0.773			
New knowledge exploration	A	50	3.98	0.685	-0.401	95.468	0.689
	B	50	4.04	0.807			

Technology Use Intention	A	50	3.86	0.700	-0.619	92.293	0.537
	B	50	3.96	0.903			
Technology Acceptance	A	50	4.06	0.712	0.434	97.646	0.665
	B	50	4.00	0.670			
Task Goal Orientation	A	50	4.06	0.652	0.682	93.843	0.497
	B	50	3.96	0.807			
Sense of Control	A	50	4.08	0.724	0.426	97.699	0.671
	B	50	4.02	0.685			
Technical Ability	A	50	3.70	0.814	0.636	97.461	0.526
	B	50	3.60	0.756			

2) Comparison analysis of the overall significant effects of post-test learning motivation between two class groups

After two months of experimental teaching, a research investigation was conducted on the influence of technology-enhanced learning on English vocabulary learners' learning motivation. In order to more accurately analyze the influence of technology-enhanced learning on the learning motivation of English vocabulary learners, the method of covariance analysis was adopted to exclude the influence of learning motivation before the experiment on the score of the post-test. Specifically, the pre-test score of learning motivation is taken as a covariate, the class as a fixed factor, and the post-test score of learning motivation as a dependent variable. The specific analysis is as follows:

As shown in Table 3, on the one hand, based on the influence of technology-enhanced learning on the intrinsic motivation of English vocabulary learners, the P-values of self-efficacy and learning interest are both less than 0.01, indicating that they have a significant impact on learning motivation. However, the P-values of learning satisfaction, learning experience and new knowledge exploration are all high, indicating that these factors have no significant influence on learning motivation. In terms of extrinsic motivation, the P-value of task goal orientation is less than 0.01, indicating that it has a significant impact on learning motivation. However, the P-values of technology use intention, technology acceptance, sense of control and technology ability are all high, indicating that these factors have no significant influence on learning motivation. On the other hand, based on the influence of technology-enhanced learning on the external motivation of English vocabulary learners, the P-value of task goal orientation is less than 0.01, indicating that it has a significant impact on learning motivation. However, the P-values of technology use intention, technology acceptance, sense of control and technology ability are all high, indicating that these factors have no significant influence on learning motivation.

After comprehensive analysis of the results, we can find that both intrinsic motivation and extrinsic motivation have an impact on students' learning. Specifically, self-efficacy and learning interest are the factors that affect learning motivation to a large extent and significantly, while the influence of learning satisfaction, learning experience and new knowledge exploration is relatively small and not significant. In terms of extrinsic motivation, the influence of task goal orientation on learning motivation is large and significant, while the influence of other dimensions on learning motivation is small and not significant. Therefore, in the teaching process, teachers should pay attention to stimulating students' internal motivation, as well as external motivation factors such as task goal orientation. Teachers can take corresponding measures to improve students' learning motivation in view of the factors that have a greater influence.

Table 3 Results of covariance analysis of post-test data of Class AB students

Internal and external learning motivation	source	Class III sum of squares	df	mean square	F	P
self-efficacy	Covariates - pre-test data	0.795	1	0.795	6.454	0.002
	category - Two classes	9.374	1	9.374		
learning interest	Covariates - pre-test data	0.126	1	0.126	7.001	0.001
	category - Two classes	11.677	1	11.677		
Learning satisfaction	Covariates - pre-test data	0.006	1	0.006	0.468	0.628
	category - Two classes	1.216	1	1.216		
learning experience	Covariates - pre-test data	0.078	1	0.078	0.150	0.861
	category - Two classes	0.223	1	0.223		
New knowledge exploration	Covariates - pre-test data	0.016	1	0.016	0.388	0.679
	category - Two classes	0.496	1	0.496		
Technology Use Intention	Covariates - pre-test data	0.010	1	0.010	0.017	0.983
	category - Two classes	0.009	1	0.009		
Technology Acceptance	Covariates - pre-test data	1.113	1	1.113	0.905	0.408
	category - Two classes	0.064	1	0.064		
Task Goal Orientation	Covariates - pre-test data	0.415	1	0.415	10.673	0.000
	category - Two classes	14.038	1	14.038		
Sense of Control	Covariates - pre-test data	0.586	1	0.586	0.455	0.636
	category - Two classes	0.111	1	0.111		
Technical Ability	Covariates - pre-test data	0.006	1	0.006	0.033	0.967
	category - Two classes	0.038	1	0.038		

(2) A comparative analysis of the overall significant impact of pre-test and post-test of learning motivation in two classes based on grades

In this section, a comparison analysis of the overall significant effects of pre-test and post-test learning motivation based on grades in two class groups will be conducted. To further analyze the differences among different student groups, a comparison analysis of the significant effects of pre-test and post-test learning motivation among students in different score ranges will be carried out. Specifically, the scores of students with ranking numbers from 1 to 16 (16 students), 17 to 32 (16 students), and 33 to 50 (18 students) were stratified analyzed, in order to further explore the impact of technology-enhanced learning on the learning motivation of English vocabulary learners.

1) Comparison analysis of the overall significant effects of pre-test and post-test scores between two class groups

According to the data in Table 4 for paired sample t-test, the following analysis and evaluation can be made:

On the one hand, for students in class A, there is a significant difference between their vocabulary test scores before and after the experiment. From the paired sample t-test table, it can be seen that the average score of the pre-test in class A is 57.14 points, and the average score of the post-test is 71.00 points. At the same time, according to the calculation rule of mean difference in paired sample t-test, which refers to the average difference between the second sample and the first sample in each pair of paired samples, it can be known that the average difference in class A is 13.86 points. In addition, the paired sample t-test results show that there is a significant difference between the vocabulary test scores before and after the experiment, with a t-value of 13.667, degrees of freedom of 99, and a two-tailed p-value of 0.000. This means that the difference in vocabulary test scores before and after the experiment is statistically significant.

On the other hand, for students in class B, there is also a significant difference between their vocabulary test scores before and after the experiment. From the paired sample t-test table, it can be seen that the average score of the pre-test in class B is 59 points, and the average score of the post-test is 69.44 points. At the same time, according to the calculation rule of mean difference in paired sample t-test, it can be known that the average difference in class B is 10.56 points. In addition, the paired sample t-test results show that there is a significant difference between the vocabulary test scores before and after the experiment, with a t-value of 8.694, degrees of freedom of 99, and a two-tailed p-value of 0.000. This means that the difference in vocabulary test scores before and after the experiment is statistically significant for class B as well.

In conclusion, this experiment shows that there is a change in vocabulary test scores before and after the experiment, and there is a significant difference in both classes. The degree of change is similar between the two classes, but class A has a greater increase in test scores while class B has a smaller increase.

Table 4 Comparison of significant differences between pre-test and post-test of overall learning performance of the two classes

Paired sample test

Comparison item		paired difference					t	degree of freedom	Sig.
		Mean value	Standard deviation	Mean standard error	Difference 95% confidence interval				
					Lower	upper limit			
Pairing 1	Class A pre-test score - Class A post-test score	13.860	10.141	1.014	11.848	15.872	13.667	99	.000
Pairing 2	Class B pre-test score - Class B post-test score	10.560	12.147	1.215	8.150	12.970	8.694	99	.000

2)Comparison analysis of the significant effects of pre-test and post-test learning motivation among students in different score ranges

aComparison analysis of students with better grades

As shown in Table 5, the results of T-test analysis of independent sample of pre-test data for Class AB and Class AB, on the one hand, it can be seen that the mean and standard deviation between class A and class B are not significantly different in all aspects of learning motivation based on the influence of technology-enhanced learning on English vocabulary learners' learning motivation. This indicates that students in the two classes have similar levels of learning motivation, and there is no significant difference in self-efficacy, learning interest, learning satisfaction, or task goal orientation. This may be because the students in the two classes have similar backgrounds and educational experiences, or because they have received similar educational content and methods, resulting in similar performance of learning motivation. On the other hand, there is no

significant difference between class A and class B in the pre-test of learning motivation of students with good grades. This showed that even among the higher-achieving students, there was no significant difference in motivation between the two classes.

Table 5 The independent sample t-test analysis results of the pre-test data of the students with better learning performance in Class A and Class B

Internal and external learning motivation	Internal and external learning motivation	Class	Number of people	Mean value	Standard deviation	t	df
self-efficacy	A	16	3.56	0.727	-1.698	30.000	0.100
	B	16	4.00	0.730			
learning interest	A	16	4.31	0.479	1.532	23.581	0.139
	B	16	3.94	0.854			
Learning satisfaction	A	16	3.44	0.727	1.151	29.688	0.259
	B	16	3.13	0.806			
learning experience	A	16	4.31	0.602	0.800	29.105	0.430
	B	16	4.13	0.719			
New knowledge exploration	A	16	4.19	0.544	0.574	28.618	0.570
	B	16	4.06	0.680			
Technology Use Intention	A	16	4.19	0.544	0.530	26.949	0.601
	B	16	4.06	0.772			
Technology Acceptance	A	16	4.31	0.602	0.800	29.105	0.430
	B	16	4.13	0.719			
Task Goal Orientation	A	16	4.13	0.719	0.926	29.613	0.362
	B	16	3.88	0.806			
Sense of Control	A	16	4.13	0.719	0.522	29.522	0.605
	B	16	4.00	0.632			
Technical Ability	A	16	3.75	0.683	0.425	27.129	0.674
	B	16	3.63	0.957			

According to the results in Table 6, all p-values of learning motivation factors are greater than 0.05, indicating that there is no significant difference between these learning motivation factors among high-performing students in class A and B. Therefore, we can conclude that in this experiment, there is no significant difference in learning motivation among high-performing students in class A and B overall.

Table 6 Results of covariance analysis of post-test data of students with good academic performance in Class AB

Internal and external learning motivation	source	Class III sum of squares	df	mean square	F	P
self-efficacy	Covariates - pre-test data	0.300	1	0.300	2.833	0.075
	category - Two classes	4.079	1	4.079		

learning interest	Covariates - pre-test data	0. 435	1	0. 435	0. 418	0. 662
	category - Two classes	0. 032	1	0. 032		
Learning satisfaction	Covariates - pre-test data	0. 072	1	0. 072	0. 692	0. 509
	category - Two classes	2. 071	1	2. 071		
learning experience	Covariates - pre-test data	0. 285	1	0. 285	0. 961	0. 394
	category - Two classes	1. 316	1	1. 316		
New knowledge exploration	Covariates - pre-test data	0. 001	1	0. 001	1. 832	0. 178
	category - Two classes	3. 077	1	3. 077		
Technology Use Intention	Covariates - pre-test data	0. 263	1	0. 263	1. 389	0. 265
	category - Two classes	1. 013	1	1. 013		
Technology Acceptance	Covariates - pre-test data	0. 086	1	0. 086	0. 060	0. 942
	category - Two classes	0. 047	1	0. 047		
Task Goal Orientation	Covariates - pre-test data	1. 889	1	1. 889	1. 827	0. 179
	category - Two classes	0. 014	1	0. 014		
Sense of Control	Covariates - pre-test data	1. 728	1	1. 728	21. 04	0. 315
	category - Two classes	0. 426	1	0. 426		
Technical Ability	Covariates - pre-test data	0. 193	1	0. 193	0. 327	0. 723
	category - Two classes	0. 245	1	0. 245		

bComparison analysis of students with average grades

According to the results in Table 7, it can be observed that there is a significant difference ($p < 0.05$) in the mean values of self-efficacy and learning interest between class A and B, indicating that students in class A and B perform better in these two areas.

Table 7 The independent sample t-test analysis results of the pre-test data of the students with average learning performance in Class A and Class B

Internal and external learning motivation	Internal and external learning motivation	Class	Number of people	Mean value	Standard deviation	t	df
self-efficacy	A	16	4.69	0.602	4.223	23.402	0. 000
	B	16	3. 38	1. 088			
learning interest	A	16	3. 13	1. 025	−3. 995	26. 884	0. 000
	B	16	4. 38	0. 719			
Learning satisfaction	A	16	3. 44	0. 727	−0. 259	29. 431	0. 797
	B	16	3. 50	0. 632			
learning experience	A	16	3. 81	0. 834	−0. 769	29. 085	0. 448
	B	16	4. 06	0. 998			

New knowledge exploration	A	16	3. 63	0. 806	−0. 767	28. 426	0. 449
	B	16	3. 88	1. 025			
Technology Use Intention	A	16	3. 63	0. 719	−0. 179	24. 592	0. 859
	B	16	3. 69	1. 195			
Technology Acceptance	A	16	3. 94	0. 772	−0. 758	28. 651	0. 455
	B	16	4. 13	0. 619			
Task Goal Orientation	A	16	4. 00	0. 632	−0. 844	29. 969	0. 406
	B	16	3. 94	0. 929			
Sense of Control	A	16	3. 81	0. 655	−1. 059	29. 958	0. 298
	B	16	4. 06	0. 680			
Technical Ability	A	16	3. 44	0. 727	−0. 259	29. 431	0. 797
	B	16	3. 50	0. 632			

According to the results in Table 7, we can see that there is a significant difference ($p < 0.05$) in the pre-test scores of self-efficacy and learning interest between class A and B's average-performing students. To eliminate the influence of pre-test scores on the post-test data, covariance analysis was conducted on the post-test learning motivation scores of average-performing students in both classes, as shown in Table 8. The results showed that there was a significant difference ($p < 0.05$) in the post-test scores of "learning interest" between the two classes' average-performing students, while there was no significant difference ($p > 0.05$) in self-efficacy. Therefore, we can conclude that in this experiment, after controlling for the influence of pre-test scores, there is still a significant difference in learning interest between the average-performing students in class A and B, indicating that learning interest may be an important factor affecting the learning motivation of average-performing students, and that class A's average-performing students perform better in learning interest.

Table 8 The covariance analysis results of the post-test data of the students with average learning performance in Class A and Class B

Internal and external learning motivation	source	Class III sum of squares	df	mean square	F	P
self-efficacy	Covariates - pre-test data	0.152	1	0.152	1. 986	0. 155
	category - Two classes	0.551	1	0. 551		
learning interest	Covariates - pre-test data	0. 001	1	0. 001	7. 291	0. 003
	category - Two classes	7. 447	1	7. 447		
Learning satisfaction	Covariates - pre-test data	2. 170	1	2. 170	1. 131	0. 337
	category - Two classes	0. 005	1	0. 005		
learning experience	Covariates - pre-test data	2. 764	1	2. 764	1. 813	0. 181
	category - Two classes	0. 053	1	0. 053		
New knowledge exploration	Covariates - pre-test data	0. 074	1	0. 074	0. 082	0. 921
	category - Two classes	0. 045	1	0. 045		
Technology Use Intention	Covariates - pre-test data	0. 558	1	0. 558	0. 400	0. 673
	category - Two classes	0. 002	1	0. 002		

Technology Acceptance	Covariates - pre-test data	0. 000	1	0. 000	0. 105	0. 901
	category - Two classes	0. 124	1	0. 124		
Task Goal Orientation	Covariates - pre-test data	4. 839	1	4. 839	3. 730	0. 036
	category - Two classes	1. 460	1	1. 460		
Sense of Control	Covariates - pre-test data	0. 029	1	0. 029	0. 017	0. 983
	category - Two classes	0. 001	1	0. 001		
Technical Ability	Covariates - pre-test data	0. 148	1	0. 148	0. 157	0. 855
	category - Two classes	0. 038	1	0. 038		

cComparison analysis of students with poor grades

Based on the results in Table 9, an independent sample t-test analysis was conducted on the pre-test data of low-performing students in class A and B. It can be observed that there is no significant difference in the mean and standard deviation of all learning motivation factors based on technology-enhanced learning between class A and B. This suggests that the two classes of students have similar levels of motivation in learning, with no significant differences in self-efficacy, learning interest, learning satisfaction, or task orientation. This may be due to similar backgrounds and educational experiences of the students in both classes, or because they were exposed to similar educational content and methods, resulting in similar performance in learning motivation. Moreover, there is also no significant difference in the pre-test score of learning motivation among low-performing students in class A and B. Thus, it can be concluded that even among low-performing students, there is no significant difference in learning motivation between the two classes.

Table 9 The independent sample t-test analysis results of the pre-test data of the students with poorer learning performance in Class A and Class B

Internal and external learning motivation	Internal and external learning motivation	Class	Number of people	Mean value	Standard deviation	t	df
self-efficacy	A	18	4.28	0.895	−0. 621	32. 231	0. 539
	B	18	4. 44	0. 705			
learning interest	A	18	4. 50	0. 514	1. 230	28. 830	0. 229
	B	18	4. 22	0. 808			
Learning satisfaction	A	18	3. 89	0. 963	0. 797	30. 714	0. 431
	B	18	3. 67	0. 686			
learning experience	A	18	3. 83	0. 707	−1. 506	33. 406	0. 142
	B	18	4. 17	0. 618			
New knowledge exploration	A	18	4. 11	0. 583	−0. 257	32. 807	0. 799
	B	18	4. 17	0. 707			
Technology Use Intention	A	18	3. 78	0. 732	−1. 419	33. 789	0. 165
	B	18	4. 11	0. 676			

Technology Acceptance	A	18	4.00	0.840	−0.212	33.291	0.833
	B	18	4.06	0.725			
Task Goal Orientation	A	18	4.06	0.639	0.000	33.470	1.000
	B	18	4.06	0.725			
Sense of Control	A	18	4.28	0.752	1.097	33.987	0.280
	B	18	4.00	0.767			
Technical Ability	A	18	3.89	0.963	0.797	30.714	0.431
	B	18	3.67	0.686			

Based on the independent sample t-test analysis results in Table 9 and covariance analysis results in Table 10, we can draw the following conclusions: before the start of the experiment, there was no significant difference in the pre-test scores of learning motivation between low-performing students in class A and B, indicating that the two classes of low-performing students had similar levels of learning motivation. However, in the post-test data, only task orientation showed significant differences ($p < 0.05$) between the two groups, indicating that there were significant differences in this factor between low-performing students in class A and B. In addition, there were no significant differences in other learning motivation factors between low-performing students in class A and B. Therefore, it can be concluded that in this experiment, low-performing students in class A and B had similar levels of learning motivation in most learning motivation factors, with the only significant difference being task orientation. This may be related to the teaching environment, teaching methods, and personal backgrounds of students in the two classes.

Table 10 The covariance analysis results of the post-test data of the students with poorer learning performance in Class A and Class B

Internal and external learning motivation	source	Class III sum of squares	df	mean square	F	P
self-efficacy	Covariates - pre-test data	0.102	1	0.102	0.194	0.825
	category - Two classes	0.396	1	0.396		
learning interest	Covariates - pre-test data	0.000	1	0.000	1.318	0.281
	category - Two classes	2.650	1	2.650		
Learning satisfaction	Covariates - pre-test data	1.350	1	1.350	0.867	0.429
	category - Two classes	1.725	1	1.725		
learning experience	Covariates - pre-test data	1.452	1	1.452	0.685	0.511
	category - Two classes	0.896	1	0.896		
New knowledge exploration	Covariates - pre-test data	0.014	1	0.014	0.351	0.707
	category - Two classes	0.451	1	0.451		
Technology Use Intention	Covariates - pre-test data	3.895	1	3.895	1.692	0.200
	category - Two classes	0.218	1	0.218		
Technology Acceptance	Covariates - pre-test data	0.662	1	0.662	0.588	0.561
	category - Two classes	0.001	1	0.001		

Task Goal Orientation	Covariates - pre-test data	9. 573	1	9. 573	7. 915	0. 002
	category - Two classes	13. 444	1	13. 444		
Sense of Control	Covariates - pre-test data	0. 014	1	0. 014	0. 011	0. 989
	category - Two classes	0. 003	1	0. 003		
Technical Ability	Covariates - pre-test data	0. 133	1	0. 133	0. 345	0. 711
	category - Two classes	0. 373	1	0. 373		

4.2 Research suggestions

This article presents a study on the impact of technology-enhanced learning on the learning motivation of English vocabulary learners. Based on the empirical study, the following key research conclusions are summarized and suggestions for further development are provided:

(1) In the comparison of overall significant effects of learning motivation pre-test and post-test between the two groups, two notable results were observed. On the one hand, in the analysis of the overall significant effect of learning motivation post-test between the two groups, with respect to the impact of technology-enhanced learning on the learners' intrinsic motivation, both self-efficacy and learning interest had P-values less than 0.01, indicating a significant impact on learning motivation. On the other hand, with respect to the impact of technology-enhanced learning on the learners' extrinsic motivation, task orientation had a P-value less than 0.01, indicating a significant impact on learning motivation.

(2) In the comparison of overall significant effects of learning motivation pre-test and post-test based on academic performance between the two classes, two notable conclusions were drawn. On the one hand, in the analysis of students with average grades, students from class A and B performed better in self-efficacy and learning interest, respectively. However, in the covariance analysis of post-test learning motivation scores of students with average grades, there was a significant difference in the "learning interest" factor between the two classes. On the other hand, in the analysis of low-performing students, only task orientation showed a significant difference in the post-test data.

At the same time, through the research results, the view of hypothesis 2 is verified to meet the requirements of the conjecture. Therefore, this paper finally believes that suggestions should be put forward from the following four aspects for development control, and the specific analysis is as follows:

First, strengthen teacher training and professionalization. Teachers play a very important role in education and teaching, and their professional level and teaching quality have a crucial impact on students' learning effect and learning motivation. Especially based on the empirical results, self-efficacy and learning interest are the concerns of students. Therefore, we should strengthen the training and professionalization of teachers, improve their technical level and the intrinsic educational guidance and control ability of learning motivation. Specifically, we can help teachers understand the theory and practice of technology-enhanced learning, master relevant teaching strategies and methods, and improve teaching quality and effect by organizing specialized training courses, setting up relevant courses and seminars. Ultimately, teachers can use their professional abilities to help students build more self-efficacy and interest in learning.

Secondly, strengthen the stimulation and cultivation of students' motivation. Students' learning motivation is an important factor affecting learning effect and learning quality. Especially based on the empirical results, learning interest is the focus of middle students. Therefore, we should strengthen the stimulation and cultivation of students' motivation, and improve their interest and enthusiasm for learning. Specifically, students can be guided to actively participate in learning through the design of interesting, challenging and interactive curriculum content and teaching activities to enhance their self-confidence and sense of accomplishment. At the same time, it can also stimulate students' learning motivation and enthusiasm through reward system and feedback mechanism.

Thirdly, strengthen the construction and optimization of technology-enhanced learning platform. Technology enhanced learning platform is an important part of technology enhanced learning, which not only provides learning resources and learning environment for students, but also provides teaching tools and assessment means for teachers. Especially based on the empirical results, task goal orientation is the concern of students with poor performance. Therefore, we should strengthen the construction and optimization of technology-enhanced learning platform to improve its function and ease of use. Specifically, by introducing advanced technology, optimizing user interface and improving data security, the quality and effect of the technology-enhanced learning platform can be improved to ultimately help students complete the basic goal-oriented task requirements of English vocabulary learning.

Finally, strengthen the combination of research and practice. Research and practice are two important aspects of technology-enhanced learning development. Research can provide theoretical support and guidance for practice, and practice can help researchers better understand the practical applications and effects of technology-enhanced learning. Therefore, we should strengthen the combination of research and practice, and promote the mutual promotion and development of theory and practice. Specifically, it can promote the exchange and cooperation of research and practice by conducting empirical research, promoting successful cases, and establishing practice exchange platforms, so as to promote the development and innovation of technology-enhanced learning.

In general, with the continuous development and popularization of information Technology, technology-enhanced Learning (TEL) has gradually become a new way of learning and has received more and more attention. English vocabulary learning is an important part of English learning, and technology enhanced learning also has an important impact on the learning motivation of English vocabulary learners. In order to promote the development of this field, we should strengthen the training and specialization of teachers, strengthen the stimulation and cultivation of students' motivation, strengthen the construction and optimization of technology-enhanced learning platforms, and strengthen the combination of research and practice. Only in this way can we better play the advantages of technology to enhance learning, improve students' learning effect, improve students' internal and external learning motivation, and ultimately improve teaching satisfaction.

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