STUDY ON THE APPLICATION OF BLENDED LEARNING IN AUTOMOBILE PROFESSIONAL COURSES TAKING SHANDONG ENGINEERING VOCATIONAL AND TECHNICAL UNIVERSITY AS AN EXAMPLE

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STUDY ON THE APPLICATION OF BLENDED LEARNING IN AUTOMOBILE PROFESSIONAL COURSES TAKING SHANDONG ENGINEERING VOCATIONAL AND TECHNICAL UNIVERSITY AS AN EXAMPLE

Thematic Certificate

To

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Title: Study on the Application of Blended Learning in Automobile Professional Courses Taking Shandong Engineering Vocational and Technical University as an Example

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ABSTRACT

With the rapid development of educational informatization, blended learning, which combines the advantages of online and offline learning, is gradually becoming an important method in today's learning reform. To address the shortcomings of traditional learning, this study utilizes relevant educational theories such as sociocultural theory and constructivism to address the implementation issues of blended learning in automotive courses. The objective is to provide a theoretical foundation for the application of blended learning in automotive professional courses by comparing the differences in classroom theory, hands-on ability, and learning results between blended learning and traditional learning. Through this research, we aim to seek a more effective and efficient way of learning automotive professional knowledge with the support of educational technology.

After reviewing existing research findings, a quantitative study was conducted to investigate and empirically study 91 junior college students majoring in Automotive Inspection and Maintenance Technology at Shandong Vocational College of Engineering. A questionnaire survey was administered, and data collected were analyzed for reliability, validity, and other relevant statistical analyses using SPSS. The results demonstrate that blended learning, which combines the advantages of online and classroom learning, has great potential in enhancing students' theoretical understanding and practical skills in the automotive field. It also improves students' motivation and self-confidence in learning automotive professional courses while fostering their collaborative abilities. However, the effectiveness of educational technology and web-based learning activities in promoting professional knowledge acquisition relies on thoughtful integration by instructors into the automotive curriculum. Lastly, the study discusses its limitations and future research prospects.

Keywords: blended learning, educational theories, automotive professional courses, learning result

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Declaration

I, Wang Jinsheng, hereby certify that the work embodied in this independent study entitled "Study on the application of blended learning in automobile professional courses taking Shandong Engineering Vocational and Technical University as an example" is result of original research and has not been submitted for a higher degree to any other university or institution.

Wang Jinsheng

(Wang Jinsheng)

June 18, 2023

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1. Introduction

1.1 Research Background

The "2035 Plan for China's Education Modernization" has put forward the requirement to accelerate educational reforms in the era of informatization. With the nation's increasing emphasis on rapid information development, there is a focus on the intelligent construction of teaching platforms in higher education institutions, promoting smart teaching on university campuses (Gu & Teng, 2019). The government is placing more importance on transforming talent cultivation models, highlighting the role of modern science and technology and educational information technology in nurturing innovative and highly competent talents with core skills (Du, 2012).

The rapid development of information technology and the rise of artificial intelligence are quietly reshaping university students' learning approaches. Advanced internet technology and educational information technology have facilitated the sharing of abundant learning resources and the emergence of diverse learning platforms. University students' learning approaches are no longer confined to traditional face-to-face classroom learning but are increasingly diverse. As a result, their learning experiences have become more convenient, flexible, and independent (Yang, 2015).

Especially since the onset of the pandemic in early 2020, online learning has become exceptionally crucial. As a prominent province in education, Shandong province has taken the initiative to implement digitalized learning across its 150 higher education institutions. Shandong Vocational College of Engineering, being a vocational college with a focus on engineering, should particularly engage in digitalized learning to cultivate the talent required by the nation.

As one of the supporting majors at Shandong Vocational College of Engineering, the automotive discipline requires reform in informalized learning. However, in the context of automotive education, students still primarily engage in traditional classroom learning, resulting in low learning efficiency and subpar learning outcomes (Handelsman, Ebert-May, Beichner, Bruns, Chang, DeHaan, & Wood, 2004). In many instances, teachers dedicate themselves to delivering lectures, explaining new theories, providing case studies, imparting knowledge, and showcasing course materials from the lectern. However, students often sit sparsely in the back rows, engrossed in their activities, lacking the necessary attention and focus, and displaying insufficient "eyeball effect" and "engagement rate" in the classroom (Huang & Xia, 2013).

Despite the incorporation of various multimedia technologies in learning methods, the traditional "chalk and talk" approach continues to exist. The means of student learning have transformed from "chalk and blackboard" to "computers and large-screen projections," but fundamentally, it remains a shift from teacher-centered "oral transmission" to technologically enhanced multimedia transmission (Ao, Liu, & Jia, 2013).

In other words, the traditional classroom learning model has become insufficient for the acquisition of professional knowledge. Solely relying on limited classroom time is challenging to encompass the required content (Nilsson, 2008), making it inadequate

to meet the modern industry's high expectations for professional competence. Hence, there is a need to embrace new learning approaches to expand the classroom's scope, create broader avenues for learning, and harness the power of information technology to propel professional advancement and development (Lubis, Hasibuan, & Andreswari, 2022).

In pursuit of classroom learning reform, numerous scholars have embarked on exploratory research and ultimately uncovered a learning model that can harmonize with vocational education. This learning model offers greater flexibility, richness, and personalization in the learning experience, fostering active and collaborative learning among students. Simultaneously, it cultivates their information and communication technology skills (Slavich & Zimbardo, 2012). This learning approach is referred to as blended learning.

In comparison to traditional learning, blended learning refers to the combination of online learning and face-to-face learning (Bower, Dalgarno, Kennedy, Lee, & Kenney, 2015). Blended learning offers advantages such as flexible, independent, and widespread learning opportunities for students, allowing them to learn at any time and location (Verawadina, Jalinus, Krismadinata, & Simeru, 2020). Furthermore, it fosters flexible learning, increases student engagement, and enhances their self-directed learning abilities in higher education (Butz, 2014).

As the Internet evolves, classroom computers become more widespread, and broadband access increases, the viability and practicality of blended learning methods have grown. Teachers have seamlessly combined online learning and traditional classroom instruction by utilizing dedicated internet message boards created for specific classes, through which they can share lectures, tests, and assignments (Gundlach, Richards, Nelson, & Levesque-Bristol, 2015).

Blended learning is considered a powerful strategy that expands and enriches the learning experience, providing more opportunities for application, practice, and hands-on experiences (Poon, 2013). Educators and researchers recognize that this method offers various options and contributes to the development of future learning environments, empowering students to engage in meaningful learning profoundly.

1.2 Research Questions

Depending on the research context, the use of different learning methods may have positive or negative effects on students. Some studies argue that blended learning approaches are better suited to today's teaching environment than traditional learning methods. Based on the above background, the research questions of this paper are as follows:

1. In the blended learning approach, do automotive students' Mastery of theoretical knowledge better than students in traditional learning?

2. In the blended learning approach, do automotive students' hands-on skills better than students in traditional learning?

3. In the blended learning approach, do automotive students' learning result better

than traditional learning students?

1.3 Objectives of the Study

The approach of blended learning is crucial for the development of students and the development of automotive majors in higher vocational colleges. Based on the research questions of this paper, the main research objectives are as follows:

1. To analyze the differences between blended learning and traditional learning in Mastery of theoretical knowledge.

2. To analyze the differences between blended learning and traditional learning in hands-on skills.

3. To analyze the differences between blended learning and traditional learning in learning results.

1.4 Scope of the Study

To determine the theoretical scope of this paper, a search was conducted on Chinese databases such as CNKI and international platforms like Google Scholar, resulting in a total of over 10,000 articles related to hybrid learning. Subsequently, the scope was further narrowed down by searching for literature related to hybrid learning, theoretical knowledge, practical skills, and learning outcomes between January 1, 2010, and June 10, 2023. Finally, by considering factors such as citation count and download frequency, the literature was narrowed down to 70 journal articles and 35 theses. After reviewing the literature, it was found that constructivism theory and sociocultural theory were widely applied, aligning with the focus of this research. Therefore, these two theories were selected as the theoretical foundations for this paper.

Factors such as the determination of the research population, sample selection, and sample size all affect the quality of the data, which in turn affects the interpretation quality of the overall research data. This study aims to investigate the application of blended learning in automotive professional courses. From a theoretical point of view, all the students taught in the automotive professional courses and all the automotive professional courses can be regarded as the totality of the research objects. However, due to resource and time constraints, it is not possible to study all members of the population, so sample selection is required. Therefore, a representative sample will be selected in the study to represent the overall situation.

The research of this thesis adopts the quantitative research method, taking 91 students majoring in automobile maintenance technology in the 21st grade of the Transportation College of Shandong Engineering Vocational Technical University and the automobile engine structure and maintenance course as the research objects, and divided into two classes, and the data collection time is 2021-2022 The second semester of the academic year. A total of 91 questionnaires were distributed, and 91 were returned, with a recovery rate of 100%. The research results will provide a theoretical basis for the practice of blended learning in automotive professional courses and guidance for educational practice.

1.5 Research Significant

1. From a theoretical point of view, as an important trend in the field of education, blended learning has been developed for more than 20 years since the 1990s. However, its application and research in automotive professional courses are still relatively scarce. Based on pedagogical theory, research the relationship between blended learning and students' theoretical knowledge, practical ability and learning effect, draw research conclusions, enrich the research of blended learning in automotive professional courses and the theory and experience of blended learning, Strengthen the construction of curriculum informatization learning system, promoting the development of higher vocational automobile professional education and learning and deepening the learning reform (Ye, Zhou, Zhao, Li, & Zhang, 2022).

2. From a practical point of view, with the upgrading of China's auto industry, colleges, and universities need to pay attention to and adapt to the development needs of the industry, especially when cultivating talents for the auto industry, they need to pay attention to the upgrading of curriculum settings and learning methods (Wang & Huang, 2008).

2. Literatures Review

2.1 Blended Learning

The literature on blended learning shows that there is no consensus on the definition of blended learning. Driscoll (2002) defines blended learning as a combination of learning methods. In contrast, Delialioglu and Yildirim (2007) argue that the systematic and strategic integration of ICT tools into academic curricula introduces a new way of achieving learning objectives. This approach to learning has been given many names such as blended learning, mediated learning, blended learning, web-assisted learning, or web-augmented learning. That blended learning is the same as blended learning, combining the advantages of online training and classroom technology (Gulbahar & Madran, 2009). In addition, Garrison and Kanuka (2004) found through their research on the transformational potential of blended learning that blended learning environments combine the value of traditional classrooms to enhance the effectiveness of meaningful learning experiences. On the more conservative side, Bonk (2004) cites the three most common definitions of blended learning:

1. A combination of learning modes (or delivery media)
2. A combination of learning methods
3. A combination of online and face-to-face learning

Scholars, however, have embraced the third definition more. For example, Picciano (2006) pointed out that there are two important factors in defining blended learning, namely online and face-to-face learning. Moreover, Rovai and Jordan (2004) claim that blended learning is a combination of online learning and classroom learning, which incorporates some of the facilities of online courses and face-to-face

communication. Other researchers believe that so-called blended learning systems combine face-to-face learning with computer-mediated learning.

The definition of blended learning used in this study is “a blend of traditional face-to-face and online learning such that learning takes place both in the classroom and online, with the online component being a natural extension of traditional classroom learning”.

British scholar Howard and other researchers have sorted out and analyzed the most influential academic literature in this field (Halverson, Abraham, Spring, Drysdale, & Henrie, 2014). Deresta and other researchers also analyzed 205 doctoral dissertations on blended learning and academic research with high influence in the past 10 years and summarized the changes in the number of documents, research methods, and research topics of blended learning research. and theoretical research (Drysdale, Graham, Spring, & Halverson, 2013). Drew and Stephen et al. also conducted a similar literature analysis in 2013 (Torrisi-Steele & Drew, 2013).

As the use of ICT in education continues to increase, blended learning approaches can be used as a tool to help complement the face-to-face learning experience. In addition, blended learning provides a positive learning environment where students can use resources flexibly and provides teachers with more time to interact with students in groups or individually. Additionally, blended learning has the potential to transform student experiences and outcomes through learning.

Hameed, Badii, and Cullen (2008) considered efficiency issues when combining e-learning with traditional learning in their study, and they concluded that blended learning approaches offer the most flexible form of e-learning.

In a blended learning environment, the interaction between students and content has a significant positive impact on learning performance, and learning content has an important impact on students' learning performance in blended learning. First of all, whether it is in "Modern Educational Technology" or any other course, online and offline teaching and learning activities revolve around learning content (Zheng & Hu, 2023). Secondly, when rich learning resources and moderately difficult learning content are presented in front of students, the learning content not only meets the purpose of learning but also enables students to acquire the required knowledge through interactive activities with the learning content, which can help students achieve advanced interaction. Foreshadowing is conducive to improving students' learning performance (Mei, 2021).

2.2 Pedagogy Theory

2.2.1 Sociocultural Theory

Russian developmental psychologist Vygotsky’s sociocultural learning theory emphasizes the social and cultural origin of intelligence and believes that the cognitive growth of individuals is first achieved through interpersonal interaction rather than individual internalization (Kozulin, 2003). Vygotsky also proposed an important concept, the "Zone of Proximal Development" (ZPD for short), which limits the

potential of cognitive development within a certain time frame. Vygotsky defined ZPD as "the gap between the actual level of development and the potential level of development identified when problem-solving under adult guidance or in cooperation with more capable peers" (Vygotsky & Cole, 1978).

Vygotsky believed that through the guidance of a more skilled and knowledgeable teacher or through peer collaboration, the quality of thinking and range of skills of students would increase and their performance would exceed that of when they were working alone (Alexander, 2006). Vygotsky also believed that peer interaction, scaffolding, and imitation are important ways to promote individual cognitive growth and knowledge acquisition. ZPD includes the expertise of students and teachers in different fields, while also making use of physical tools such as books, computer tools, and scientific equipment. The goal of ZPD is to support meaningful learning.

Through the guidance of teachers and the cooperation of peers, students can gradually expand their ZPD in the learning process (Shabani, Khatib, & Ebadi, 2010). This interaction and cooperation help students go beyond their abilities with appropriate support and achieve cognitive development. In college classrooms, it is considered important to provide students with more opportunities to interact and collaborate with others, which can promote learning and cognitive development. By creating a collaborative learning environment, students can learn from each other, share knowledge, and leverage the experiences and skills of others to improve their learning outcomes (Yu, Cheng, & Dong, 2009).

The concept of ZPD is of great significance in blended learning research. First, it emphasizes that learning must be adapted to the learner's ZPD for effective learning. In this regard, the application of computers has proven to be very beneficial. The role of ZPD may be manifested when students teach each other in online communities or learn through the prompt and feedback mechanisms of computer software (Al-Mamun, Lawrie, & Wright, 2020).

Second, the concept of ZPD highlights the importance of interaction and cooperation in the learning process. By combining students with different abilities, each student as well as the whole group can benefit from close cooperation (Lin & Lin, 2015). Therefore, in the automotive professional classroom, we should provide students with more opportunities to interact and cooperate with other students or teachers.

All in all, the concept of ZPD in blended learning has important guiding significance for learning. Adapting to students' ZPD, using computer technology and interactive cooperation, can provide a more effective and personalized learning experience, and promote students' cognitive development and knowledge acquisition.

2.2.2 Constructivist Theory

The historical roots of the constructivist concept of learning can be traced to the work of Dewey, Bruner, Vygotsky, and Piaget. Bednar et al. proposed several influences of constructivism theory on learning developers, emphasizing that learning outcomes should focus on the process of knowledge construction, and determine learning goals

based on real tasks with clear goals (Duffy & Jonassen, 1991). Von Glassersfeld (1995) stated that learning is a process that requires self-regulation and the development of conceptual structures through reflection and abstraction, rather than a simple stimulus-response phenomenon. Constructivism manifests itself in many ways, and while there is overlap, there are also major differences.

Constructivism is an approach to learning based on the idea that cognition arises through "mental construction," that students learn by combining new information with prior knowledge, and that the learning environment and students' beliefs and attitudes influence learning (Sasan & Rabillas, 2022). Constructivism is a learning theory in psychology that explains how people acquire knowledge and learn (Chen & Zhang, 1998). In the field of education, constructivism is directly applied to learning, which emphasizes that people construct knowledge and meaning through experience.

Constructivism is not a specific approach to learning, and Piaget's constructivist learning theory has had a wide-ranging influence on learning theory and learning methods and has been at the heart of many educational reform movements (Holmes, 2019). Research support for constructivist learning techniques varies, with some research supporting these techniques and others contradicting these results.

In the field of education, constructivism is seen as an educational framework that frequently appears in studies of educational literature (Kinnucan-Welsch & Jenlink, 1998). According to this theory, learning is the process of making connections within an individual between new information and existing information. In this process, individuals do not just pile up information, but build the foundation of information by adding their comments. In this regard, the teacher plays an important role in the constructivist approach, and the core of the learning system is the learner. In this approach, the teacher does not pass information directly to the students, but instead guides and assists the learners in acquiring and constructing the information (Bryant, Kastrup, Udo, Hislop, Shefner, & Mallow, 2013). As intermediaries between students and educational programs, teachers help them learn and develop themselves (Holt-Reynolds, 2000). Teachers organize the learning process according to students' interests and needs, stimulating them to ask questions, generate new ideas, make assessments and observations, work collaboratively, and test their ideas (Kim, 2005). Related to these aspects, constructivism requires a regulated academic environment that differs from the traditional classroom environment.

Some scholars believe that through the design of the learning environment, a diverse learning environment can be created in blended learning, and rich resources and tools can be provided to stimulate students' active learning and hands-on ability (Li, Zhao, Liu, Zhang, & Sun, 2022). For example, online learning platforms provide learning theoretical knowledge and advanced mastery of operation steps, while arranging face-to-face practical activities, experiments, or projects to allow students to operate and apply what they have learned (Zhang, Liu, & Han, 2013).

Constructivism theory can encourage students to construct knowledge by asking questions, solving problems, and seeking answers. In blended learning, problem-driven

learning tasks can be designed, requiring students to apply the acquired knowledge and skills in online learning and face-to-face practice, solving real-world problems or completing practical projects (Wang & Chen, 2020).

Through research, the application of constructivism theory to the cooperation and interaction between students has a great impact on the development of knowledge construction and practical ability. important. In blended learning, students can be organized to carry out group cooperative learning, explore and practice together, and improve each other's hands-on ability through cooperative problem-solving, and sharing of views and experiences (Zheng & Cai, 2021).

The constructivist theory holds that students construct knowledge by observing and imitating the learning behaviors and strategies of others. In blended learning, multimedia resources, video learning, and model demonstrations can be used to show students the skills and methods of practical hands-on operation, so that students can imitate and practice (Du & Kirkebæk, 2014).

In conclusion, constructivism provides a different learning concept in education than the traditional classroom. It emphasizes the active participation of learners and the process of knowledge construction, in which teachers play the role of guide and supporter. Teachers stimulate students' learning interest and motivation by organizing learning activities and creating a learning environment and cultivating students' independent learning abilities.

2.3 Automotive Professional Course

Some scholars have reformed the course learning mode, starting from the design of pre-class learning activities, design of in-class learning activities, design of after-class learning activities, and evaluation plans, and relying on the Chaoxing Learning Link platform, using online and offline mixed learning modes to carry out " The teaching of the "Automobile Engine Structure" course brings great convenience to students' learning and solves the problem that difficult knowledge points are difficult to master. This student-centered learning method greatly improves the quality of learning and is conducive to the achievement of learning goals. Blended learning combines the advantages of online and offline, enabling students to study anytime and anywhere without being limited by time and space, creating a more flexible environment for learning. The practice of this learning model has achieved remarkable results in improving students' learning effects and learning quality.

Some scholars have concluded through the practice of using the blended learning mode in the learning of car modification courses that the online and offline blended learning can make the learning process of students more accurate and controllable, the learning enthusiasm of learning is improved, and students' understanding of course knowledge can be improved. The mastery is more solid and a good learning effect has been achieved. For example, when teaching chassis protection from the perspective of hands-on ability, cooperate with the chassis armor modification operation videos of some refit shops; The modification has a more comprehensive and specific

understanding, which has laid a good foundation for possible related work in the future.

According to the above literature analysis of automobile professional courses, the course of automobile engine structure and maintenance is studied. Adopt online + offline hybrid learning mode, upload knowledge points related to other courses, learning courseware, lecture videos, in-class quizzes, and extended learning content on the online learning platform in advance, arrange learning tasks, and guide students to complete the course online Pre-learning tasks (Sun, Cheng, & Zhu, 2015). The offline classroom is mainly used to explain the key content of the course and answer the difficulties encountered in online learning. This can not only cultivate students' ability to active learning but also improve the efficiency of course learning.

2.4 Learning Effects

At present, the definition of the learning effect is still not unified. Different scholars have given different connotations from different angles. Magnolia believes that learning effects include cognitive ability, personal intrinsic ability, interpersonal interaction ability, and practical ability (Wu, 2017). Eisner believes that learning effects are the results obtained after participating in learning, whether it is conscious or unconscious (Huang, 2010). The Joint Committee on Educational Evaluation Standards believes that learning outcomes are the expected results of students in specific aspects of learning, development, and performance, including cognitive understanding, attitudes, and values, as well as practical skills and behaviors (Li, 2014). That the learning effect is the growth of students' knowledge, skills, attitudes, emotions, and acquisition ability after learning, and this growth is specific and measurable (Xia, Zhou, Ye, & Sun, 2020).

Although different scholars have different definitions and classifications of learning effects, they all agree that learning effects do not only refer to academic performance but refer to the all-around changes that education brings to learners, which is the result of learners achieving their learning goals. Learning effects cover both cognitive and non-cognitive aspects. According to Bloom's classification theory of teaching objectives, educational objectives can be divided into cognitive domain, motor skill domain, and emotional domain.

To sum up, the learning effect, as the result of learning, refers to the abilities that learners acquire during a period of learning, including cognitive abilities, motor skills, emotional attitudes, and behaviors. It not only focuses on learners' knowledge acquisition but also their development in thinking, practice, and emotion.

2.5 Theoretical framework

Using social and cultural theories and constructivist theories, change the traditional course learning of automobile majors, improve students' theoretical knowledge and practical ability through blended learning, and achieve satisfactory learning results.

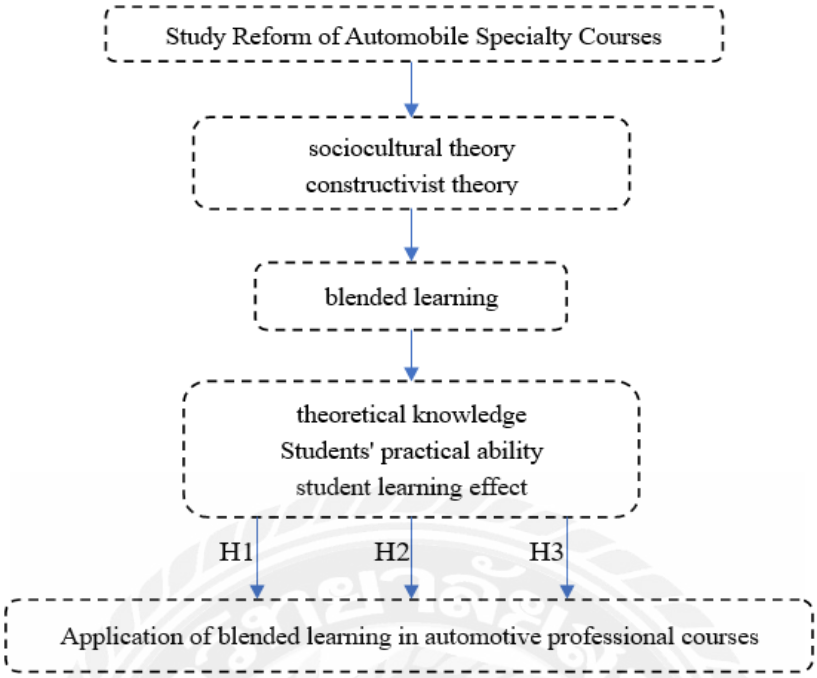

Figure 2.1 Theoretical framework

2.6 Hypotheses

H1: The implementation of blended learning in automotive professional courses is conducive to improving students' theoretical knowledge.

H2: The implementation of blended learning in automotive professional courses is conducive to improving students' hands-on ability.

H3: The implementation of blended learning in automotive professional courses is conducive to improving the learning result of students.

3. Research Methodology

According to the literature analysis, it is appropriate to use quantitative research in this paper. After reviewing the literature, it is found that some scholars use quantitative research to measure student performance, obtain accurate data, and generate research results (Brantlinger, Jimenez, Klingner, Pugach, & Richardson, 2005). Some scholars have researched autonomous learning ability, etc., and adopted similar quantitative research methods (Soleimani, 2020).

3.1 Research Variable

The research of this thesis is a quantitative research, the independent variable of the research is blended learning, the dependent variable of the research includes the students' classroom theoretical knowledge, hands-on ability and learning effect, and the learning effect includes their independent learning ability, student learning participation, students' learning attitudes, students' mutual cooperation, etc. Students' classroom theoretical knowledge is measured by their grades in the final exams of professional

courses. Students' hands-on ability is measured by their scores on engine disassembly and maintenance before the end of the course. Students' learning effects are measured by their knowledge of automobile majors. The course is measured by self-learning ability, participation, learning attitude, and mutual cooperation.

3.2 Research Object

The subjects of this study are 91 sophomore students majoring in automobile inspection and maintenance technology who participated in the second semester of the 2021-2022 academic year from the School of Transportation of Shandong Engineering Vocational and Technical University, and they were divided into two groups. The first class is an experimental class with 45 students, and the second class is a control class with 46 students, which are 65% of the total number of vocational students majoring in automobiles that year, excluding five-year students.

3.3 Research Methods

This paper adopts the questionnaire survey method and the comparative analysis method in the quantitative research method.

The questionnaire survey method uses questionnaire stars to issue pre-teaching questionnaires (91 copies) and post-teaching questionnaires (45 copies), and collect them after the survey objects (students) fill them out. Statistics and analysis provide the current basis for the research of this paper; Through purposeful and planned investigations, we can understand the problems existing in blended learning in higher vocational colleges, and propose targeted solutions based on the guidance of blended learning theory.

The method of comparative analysis usually compares two interrelated index data, quantitatively shows and explains the size of the research object, the level, the speed, and whether various relationships are coordinated. This paper uses this method to conduct a comparative analysis of students' classroom theoretical knowledge and practical ability, and selects a class that is in the same grade as the experimental class as a control class to conduct a horizontal comparative analysis of classroom theoretical knowledge and practical ability, thus summarizing and explaining the application of blended learning Effect.

3.4 Reliability and validity test of the questionnaire

This study uses SPSS software to analyze and process the data and conduct reliability and validity analysis on the overall sample data to test whether the recovered data meet the research requirements. Firstly, the reliability test is carried out on the recovered data; secondly, the validity test is carried out on the recovered data.

The reliability test of the questionnaire is mainly aimed at the authenticity and credibility of the questionnaire.

It is known that the validity coefficient of the questionnaire ranges from 0 to 1, and the higher the coefficient, the more reliable the questionnaire is. The validity test

of the questionnaire is to ensure the validity of the questionnaire. This study chooses to analyze the validity of the content and structure of the questionnaire.

The questionnaire (before this semester) has a total of 8 questions, and the corresponding items are shown in Table 3.1. Among them, questions 1 and 2 are computer ability and use learning analysis, questions 3 and 4 are learning style analysis, questions 5 and 6 are student learning Ability analysis, Questions 7 and 8 are the analysis of students' learning status, 91 questionnaires were distributed, and 91 questionnaires were returned, with a recovery rate of 100%.

Table 3.1 Dimensional analysis corresponding items (before this semester)

topic	Corresponding item
Computer Competence and Using Learning Analytics	1、2
Learning style analysis	3、4
Analysis of Students' Learning Ability	5、6
Student Learning Status Analysis	7、8

The reliability analysis of the content of the questionnaire is carried out, and the results are shown in Table 3.2:

Table 3.2 Reliability statistics

Cronbach Alpha	Cronbach's Alpha based on the normalization term	number of items
0.818	0.818	8

Reliability analysis is used to study the reliable accuracy of quantitative data; in general, when Cronbach's alpha value of the scale is greater than 0.8, it can be expressed that the internal consistency of several variables created for the rating scale is good. According to From the results of Cronbach's Alpha and several other indicators in the above table, this study can find that the Cronbach's coefficient value of the questionnaire is greater than 0.8, and the Cronbach's Alpha value based on standardized items is greater than 0.8, indicating that the quality of the questionnaire in this study is ideal. Therefore, the data results of this study passed the reliability test.

The structural validity test data of the questionnaire (before this semester) is shown in Table 3.3, which shows that the KMO value is 0.812>0.8, indicating that the conditions for factor analysis are met, and the Bartlett test p-value is less than 0.001, indicating that there is a certain correlation. Therefore, this survey is credible and valid.

Table 3.3 KMO and bartlett's test

KMO Sampling Suitability Quantity,		0.812
Bartlett's test for sphericity	Approximate chi-square	5217.8
	degrees of freedom	90
	significant	0.000

Then, on the eve of the end of the study, a blended learning questionnaire (post-test paper) survey was conducted on the students in the experimental class. The experimental group designed and implemented a post-experiment questionnaire with 8 items to collect the attitudes and attitudes of the subjects towards the blended learning activities. Participation and other data. There are 8 questions in the questionnaire, and the analysis of the corresponding items is shown in Table 3.4. Questions 1 and 2 are surveys of students' learning participation, questions 3 and 4 are surveys of students' learning attitudes, and questions 5 and 6 are surveys of students' independent learning. In the investigation of ability, questions 7 and 8 are about students' cooperation ability. This time, 45 questionnaires were distributed to the experimental class, and a total of 45 questionnaires were returned, all of which were valid.

Table 3.4 Dimensional analysis corresponding items (after this semester)

topic	Corresponding item
student engagement	1、2
students' attitude toward learning	3、4
students' independent learning ability	5、6
Teamwork ability	7、8

The reliability analysis of the content of the questionnaire is carried out, and the results are shown in Table 3.5:

Table 3.5 Reliability statistics

Cronbach Alpha	Cronbach's Alpha based on the normalization term	number of items
0.827	0.825	8

According to the results of Cronbach's Alpha and several other indicators in the above table, this study can find that the value of Cronbach's a coefficient of the questionnaire is greater than 0.8, and the value of Cronbach's Alpha based on standardized items is greater than 0.8, indicating that the quality of the questionnaire in this study is ideal. Therefore, the data results of this study passed the reliability test.

The structural validity test data of the questionnaire (before the end of this semester) is shown in Table 3.6, which shows that the KMO value is 0.832>0.8, indicating that the conditions for factor analysis are met, and the p-value of the Bartlett test is less than 0.001, indicating that it has certain Correlation. Therefore, this survey is credible and valid.

Table 3.6 KMO and bartlett's test

KMO Sampling Suitability Quantity,		0.832
Bartlett's test for sphericity	Approximate chi-square	3781.65
	degrees of freedom	44
	significant	0.000

4. Finding

4.1 Analysis of previous survey results

The following is the analysis of the previous situation investigation results. This questionnaire uses a 5-level scale.

(1) Computer ability and usage learning analysis

Questions 1 and 2 of the questionnaire are aimed at the investigation of students' computer skills and the level of using the Internet for study and research. To control for relevant variables and verify the reliability of the experiments, students' computer and Internet skills were considered. For personal computer skills, these experiences are interpreted as basic skills such as typing, online chatting, playing games, and surfing the Internet. 49.5% and 23.02% of the students think that they have mastered very good and very good computing skills. As shown in Table 4.1:

Table 4.1 Computer and internet skills

		computer skill level					Total
		very poor	poor	average	good	very good	
Total	Count	5	8	12	45	21	91
	% within Group	5.50%	8.80%	13.18%	49.50%	23.02%	100%

For computer and Internet educational experiences, this study sought to find out whether participants had information literacy to facilitate their professional learning. This study collected data and descriptive statistics (see Table 4.2), and can see that 15.38% and 6.6% of the participants know how to use search engines on the Internet to obtain useful learning resources.

Table 4.2 Experience using the internet for study and research

		Experience using the Internet for study and research					Total
		no experience	little experience	general experience	more experience	very rich experience	
Total	Count	21	35	15	14	6	91
	% within Group	23.08%	38.46%	16.48%	15.38%	6.60%	100 %

Through the above investigations on the level of computer skills and the level of learning and research using the Internet, this study found that students generally can operate computers, but they have little experience in searching professional materials and lack effective search strategies and skills. Schools and teachers provide relevant training, guidance, and practice opportunities so that students can enhance their experience and ability in professional information search, to make better use of the Internet for learning and research. This will help them achieve better results and grow in the professional field.

(2) Analysis of Learning Styles

Questions 1 and 2 of the questionnaire are investigations on the learning style and the learning effect under the original learning style. Regarding the question of which learning method students prefer, as shown in Figure 4.1, 52.74% of students choose blended learning, which shows that compared with traditional learning, learning forms that give students a certain degree of autonomy are more likely to be favored by students. Teachers should combine independent learning with traditional classroom explanations to give students more free and open learning space.

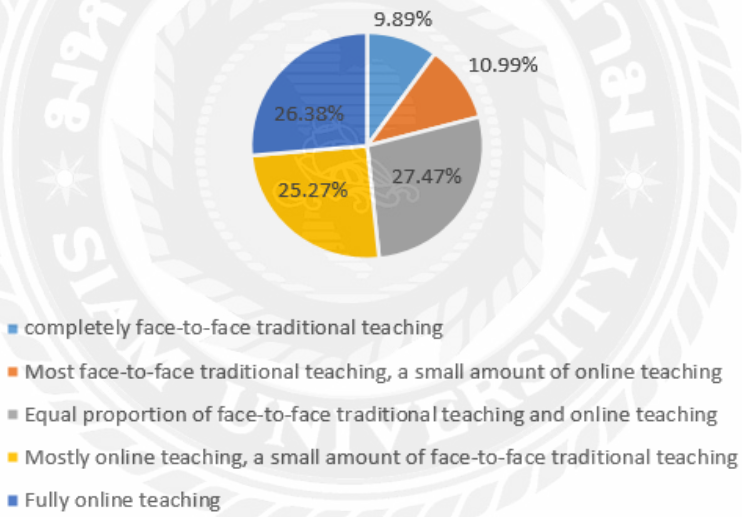

Figure 4.1 Learning method

As shown in Figure 4.2, 59.34% of the students chose the effect as poor or above, indicating that the effect of the current learning method is not very good, and the learning method does not match the learning style and preference of the students. Different students have different learning styles and needs, therefore, one general approach to learning may not meet the needs of all students. Teachers should provide more diverse learning experiences to meet students' needs and improve their learning effectiveness.

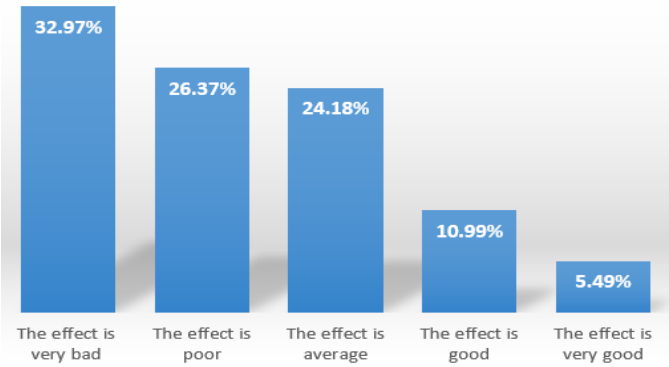

Figure 4.2 The learning effect under the original learning style

3. Analysis of students' learning ability

Questions 5 and 6 in the pre-test questionnaire are students' evaluations of their learning ability. From the results, 16.48 students think that their autonomous learning ability is not bad, while 14.29% of students choose "average", and 69.23% choose "poor" or above, indicating that most students have a high level of confidence in their autonomous learning ability. Lack of confidence, and feeling that they lack autonomy. This is because most of the higher vocational students are students with poor academic performance and lack of autonomy, and they have little pressure to enter a higher school, so they are weak in autonomous learning. If these students can make full use of their free time before class, The learning effect will be improved. As shown in Figure 4.3:

Figure 4.3 Self-learning ability

Among the self-assessment questions on students' attention, only 24.18% of them think they are very focused or concentrated, less than 1/3. This shows that students generally have poor attention and are easily distracted when studying. Because they are more susceptible to the influence of external factors, especially mobile phone online games, falling in love, and so on. When conducting online and offline blended learning, it is necessary to use mobile APPS to assist learning. At this time, teachers should play a supervisory role, supervise students' serious learning during the online learning process, and prevent students from indulging in online games. As shown in Figure 4.4:

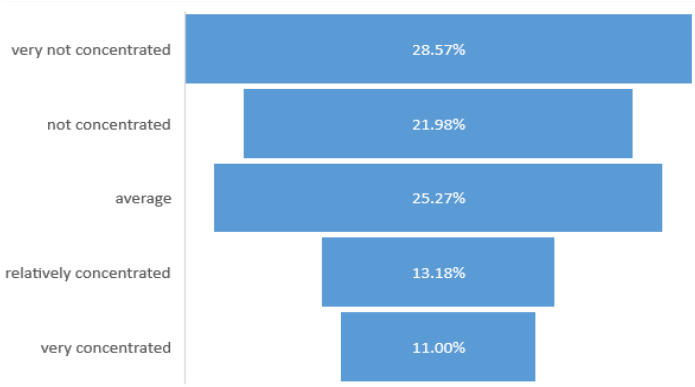

Figure 4.4 Student attention

4. Analysis of students' learning status

Questions 7 and 8 in the questionnaire are for the analysis of students' learning status. From the perspective of answering questions, only 16.49% of students can do frequent previews and reviews, and 15.38% of students occasionally preview and review. These students often preview on a whim, and more than 68% of students hardly preview. This shows that the learning situation of higher vocational students is very general, and there is almost no conscious preview and review. The reason may be that vocational students do not have enough self-control ability, spend their spare time in-game communication, and think that they can pass the exam by "clamping". Therefore, the evaluation of online and offline blended learning should be diversified, breaking the evaluation form of traditional learning that can only pass the written test. As shown in Figure 4.5:

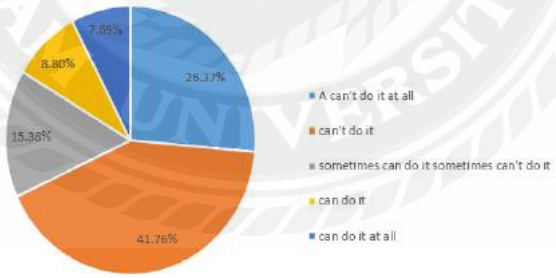

Figure 4.5 Pre-class preview and post-class review

In terms of the length of the preview and review, the survey results are even more pessimistic. It can be seen that students spend absurdly little time on preview and review. They only rely on teachers' explanations in class for tens of minutes, and knowledge is difficult to be absorbed by insiders. chemical absorption. Therefore, online and offline blended learning should make good use of students' learning time before and after class, instead of relying only on 45-minute classes. Before each class, teachers should check the review results of the previous class and the preview of this class, and urge students to strengthen the preview and review. As shown in Figure 4.6:

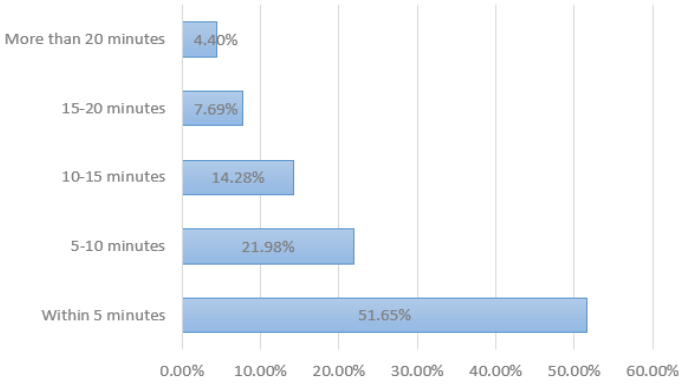

Figure 4.6 Preview and review time

4.2 Questionnaire analysis after teaching

The following is the analysis of the questionnaire survey after the end of education. This questionnaire uses a 5-level scale.

1. Analysis of student participation

Questions 1 and 2 of the questionnaire are surveys of students actively participating in discussions and asking questions and conscientiously completing homework and test questions assigned by teachers. As shown in Figures 4.7 and 4.8:

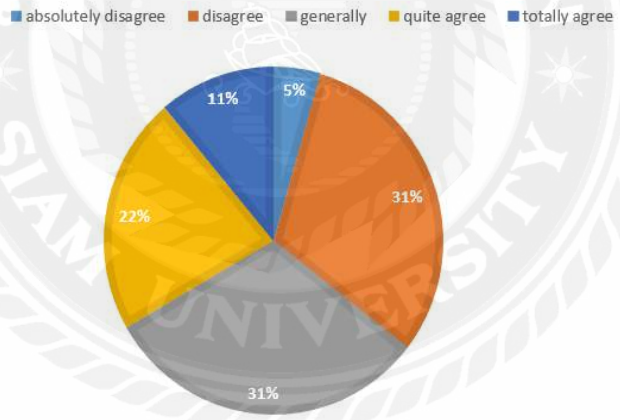

Figure 4.7 Actively participate in discussions and ask questions

From Figure 4.7, it can be found that the percentage of students who disagreed accounted for 35.56%, which was 2.23% more than the students who agreed. Explain that some students may lack motivation to participate in class, perhaps because they are skeptical about the effect of blended learning, or they may feel that they do not gain much from asking questions and participating in discussions in class; Or lack self-confidence in expressive ability, fear of facing embarrassment or criticism when asking questions in class or participating in discussions.

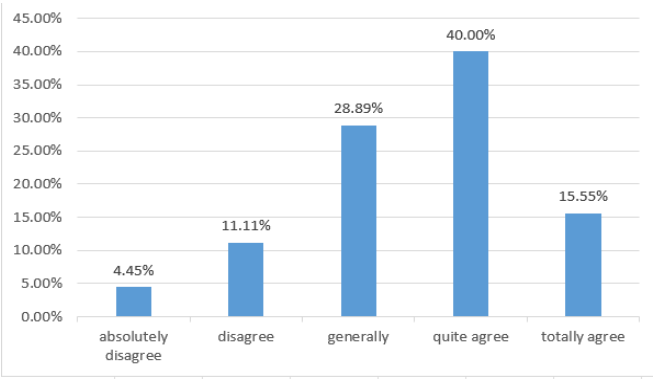

Figure 4.8 Becoming active in discussions and asking questions in class

From Figure 4.8, it can be found that the percentage of students who agree to accounts for 55.55%, which is 39.99% more than the students who disagree. Explain that blended learning provides a more flexible and convenient way of learning, enabling students to better arrange time, place, and learning rhythm so that it is easier to complete homework and test questions assigned by teachers; students may realize that by carefully completing homework and tests Questions can consolidate the knowledge learned, improve the learning effect, and get better grades.

2. Student Attitude Analysis

Questions 3 and 4 of the questionnaire are surveys of students listening carefully and taking the initiative to complete the preview and review. As shown in Figures 4.9 and 4.10:

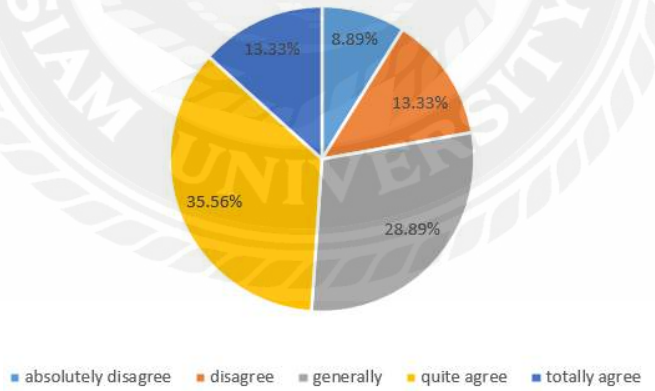

Figure 4.9 Make your study plan

From Figure 4.9, it can be found that the percentage of students who agree accounts for 48.89%, which is 26.67% more than the students who disagree. First, nearly half of the students (48.89%) became more attentive listeners after blended learning. This suggests that blended learning may provide a better learning experience or better learning outcomes for these students. These students may benefit from the flexibility and variety of learning styles in a blended learning environment, resulting in more active participation in classroom learning. Second, this data also reveals that some students hold mixed opinions about blended learning.

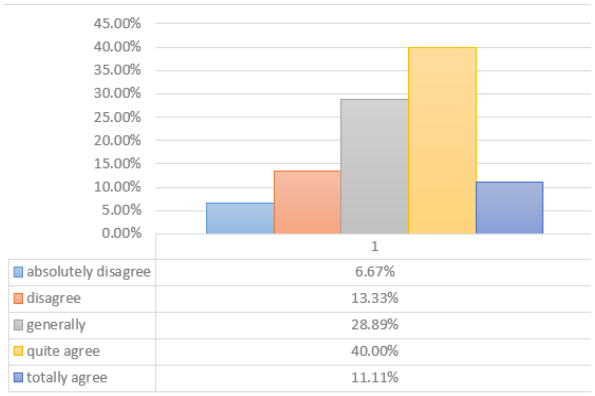

Figure 4.10 Actively complete preview and review

From Figure 4.10, it can be found that the percentage of students who agree accounts for 51.11%, which is 31.11% more than the students who disagree. First, after blended learning, half of the students (51.11%) become more active in completing preview and review. This shows that blended learning has a positive impact on students' learning motivation and initiative.

3. Analysis of students' autonomous learning ability

Questions 5 and 6 of the questionnaire are investigations on self-made learning plans and goals, self-management, and self-discipline improvement. As shown in Figures 4.11 and 4.12:

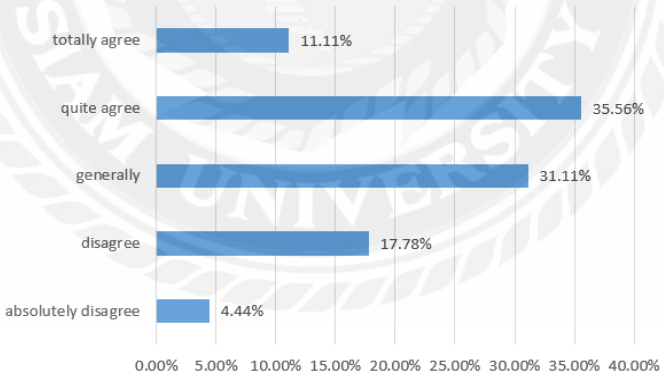

Figure 4.11 Make your study plan

From Figure 4.11, it can be found that the percentage of students who agree to accounts for 46.47%, which is 24.25% more than the students who disagree. First of all, after blended learning, nearly half of the students (46.47%) were able to make their learning plans and goals. This suggests that blended learning may have had a positive impact on developing learning autonomy and management skills for this group of students. They may realize that having a clear study plan and goals helps improve learning effectiveness and time management, an helps them better organize and schedule their study activities.

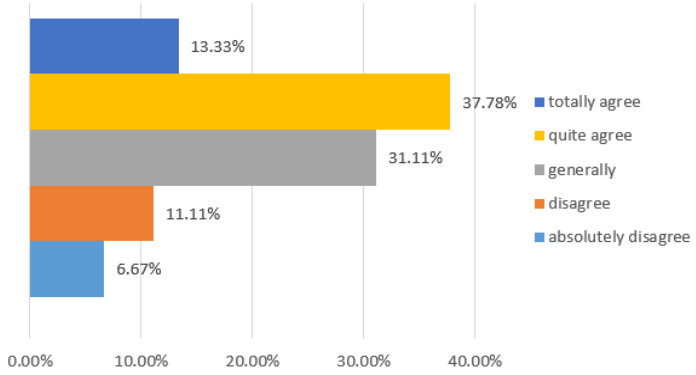

Figure 4.12 Self-management and improving self-discipline

From Figure 4.12, it can be found that the percentage of students who agree accounts for 51.11%, which is 33.33% more than the students who disagree. An increase in the percentage of students who agree with blended learning indicates that they are aware of the benefits of blended learning and are willing to actively adopt it. They may realize that through blended learning, they can take better control of their learning process, improve learning efficiency, and better balance academic and other demands.

4. Cooperation ability

The 7th and 8th questions of the questionnaire are investigations on cooperating with others to complete learning tasks and active cooperation. As shown in Figures 4.13 and 4.14:

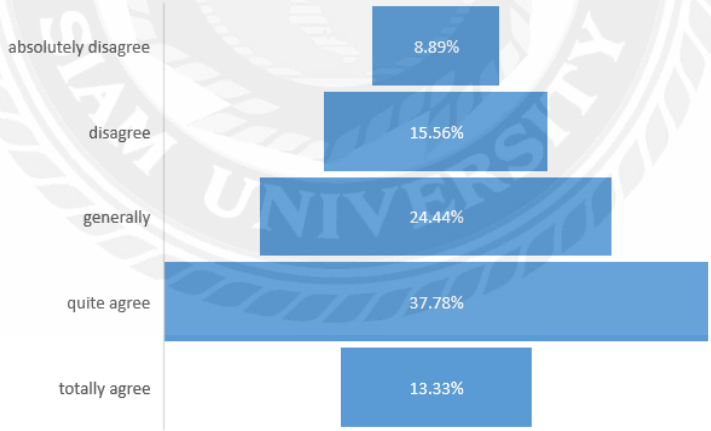

Figure 4.13 Collaborate with others to complete learning tasks

From Figure 4.13, it can be found that the percentage of students who agree accounts for 51.11%, which is 26.66% more than the students who disagree. The increase in the percentage of students who agree with blended learning shows that they realize that they can gain more learning tasks by cooperating with others Benefits and learning effects. They may realize that collaborating with others can expand their thinking and facilitate the collision and fusion of different perspectives, thereby enhancing their learning outcomes and abilities.

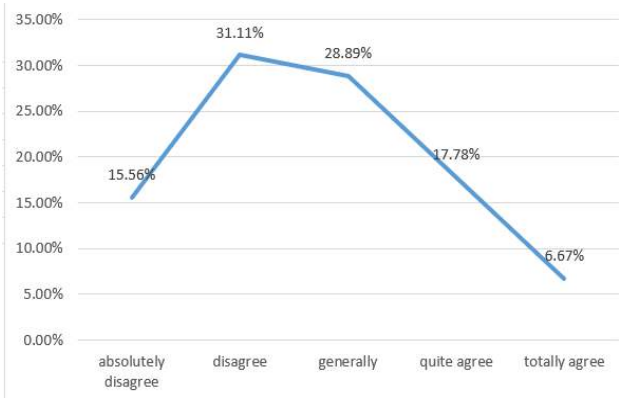

Figure 4.14 Active cooperation

From Figure 4.14, it is found that the percentage of students who do not agree on accounts for 46.67%, which is 22.22% more than the students who agree. The increase in the percentage of students who do not agree to actively cooperate indicates that some students, they may have reservations or obstacles to actively participating in cooperative learning. There may be various reasons, such as lack of trust, personal preference for independent study, communication difficulties, or low self-confidence. These factors may make them less willing or less able to actively participate in cooperative learning activities.

4.3 Analysis of students' classroom theory performance

Use SPSS software to analyze the students' final exam results, and get Table 4.3.

Table 4.3 Comparative Analysis of Final Exam Results

Item	Class	average	standard deviation	T value	P value
Final Exam Results	Experimental class (n=45)	89.14	±3.458	3.148	0.000
	control class (n=46)	83.15	±5.748		

After sorting out the theoretical final exam results of the automobile engine structure and maintenance course and analyzing the independent sample T-test, it was found that there was a significant difference in the final exam scores between the experimental class and the control class, with a P value of 0.000, which was less than the significance level of 0.05. This shows that the experimental class has obvious advantages in mastering the theoretical knowledge of automobile engine construction and maintenance after the course.

Further analysis found that this difference may be because the students in the experimental class can obtain more high-quality learning resources through the online platform, and communicate and answer questions with teachers and students through

the WeChat learning group. In contrast, traditional classroom learning mainly relies on teachers' lectures, while automotive courses pay more attention to skill learning, which may not be sufficient for students to learn theoretical knowledge. In traditional learning, students need to learn independently after class, but this is affected by students' autonomous learning ability, self-control, and ability to obtain learning resources.

4.4 Hands-on ability analysis

Use SPSS software to analyze the students' hands-on ability, and get Table 4.4.

Table 4.4 Comparative analysis of engine disassembly and maintenance skills

Item	Class	average	standard deviation	T value	P value
Disassembly problem	Experimental class (n=45)	83.14	±3.278	5.825	0.015
	control class (n=46)	80.15	±5.747		
Repair results	Experimental class (n=45)	81.48	±3.145	5.932	0.012
	control class (n=46)	78.45	±5.898		

By conducting independent sample t-tests on the data of engine disassembly and repair techniques between the blended learning experimental group and the control group, the experimental results showed that the p-value for engine disassembly was 0.015 (<0.05), and for repair was 0.012 (<0.05). The experimental results indicated a significant difference in practical skills between the blended learning experimental group and the control group, suggesting that blended learning design, compared to traditional classroom learning design, can significantly enhance students' practical skills.

Through observation and surveys of students, it was found that there were significant differences in the learning outcomes of the blended learning experimental group. The reasons for these differences can be attributed to the design of blended learning. In blended learning, students engage in pre-class independent learning, where they study the instructional materials in advance and practice imitating the upcoming motor skills. This helps them develop clear mental representations of the actions involved. In the classroom, the teacher guides students in recalling, reproducing, and reiterating the demonstrated actions, enabling students to grasp the motor skills relatively easily. Compared to traditional classroom learning, this well-designed instructional approach significantly reduces the difficulty of learning disassembly and repair skills, making it easier for students to make progress and experience a greater sense of achievement. Students develop confidence and exhibit a highly positive attitude toward learning about automobile engines.

5. Conclusion and Recommendation

Through the analysis of the results of the learning effect questionnaire and the use of SPSS software to analyze the results of students' theoretical knowledge and practical ability, the conclusion of students' theoretical knowledge, practical ability and learning effect and suggestions for the application of blended learning can be drawn.

5.1 Conclusion

After data analysis, this thesis proves that the research hypothesis is established, and draws the following conclusions about students' theoretical knowledge, practical ability and learning effect.

1. Based on the collected evidence, the following conclusion can be drawn: Blended learning has a positive impact on students' mastery of theoretical knowledge. This conclusion is supported by several factors observed during the implementation of blended learning.

Firstly, blended learning provides carefully selected and designed learning resources through online platforms. These resources include textual descriptions, visual images, and instructional videos, catering to different learning styles and preferences. By utilizing various multimedia elements, students are more likely to engage with the content and develop a deeper understanding of theoretical concepts.

Additionally, the availability of online platforms enables students to engage in self-paced learning, revisiting materials at their convenience. This is particularly beneficial for students who require additional time to grasp complex concepts. By revisiting learning resources, students can reinforce their understanding and clarify any misconceptions, thereby enhancing their mastery of theoretical knowledge.

Furthermore, blended learning facilitates interactive learning opportunities. Online platforms often foster communication and collaboration among students through discussion forums, group projects, and virtual simulations. These interactive activities promote active participation in topic-related learning and the application of theoretical knowledge in practical contexts. Through participation in discussions and collaboration with peers, students can deepen their understanding, enhance critical thinking skills, and gain valuable insights from different perspectives.

Moreover, blended learning enables teachers to monitor student’s learning progress and provide timely feedback, which is another advantage. Through online platforms, teachers can track students' performance, identify areas of weakness, and offer personalized guidance and support. This targeted feedback helps students address individual learning needs, clarify misconceptions, and make necessary adjustments to improve their mastery of theoretical knowledge.

In summary, the implementation of blended learning has proven effective in enhancing students' mastery of theoretical knowledge. The availability of rich learning resources, self-paced learning, interactive learning opportunities, and effective feedback from teachers provide students with better learning opportunities and promote the mastery of theoretical knowledge.

2. Based on the research findings, it has been determined that there is a significant difference in hands-on abilities between students who undergo blended learning and those who receive traditional instruction. Blended learning has a significant positive impact on academic performance. Specifically, in the context of automotive engine courses, blended learning addresses the issues of insufficient class time and inadequate hands-on practice in traditional teaching methods.

Blended learning emphasizes enhancing communication and interaction between teachers and students, as well as among students themselves. Students actively communicate with teachers about teaching and learning situations and provide feedback on teaching methods and approaches, enabling active reflection and adjustment of teaching methods to meet students' needs. The establishment of online platforms and WeChat study groups strengthens communication and interaction between teachers and students, ensuring timely resolution of students' learning needs and issues. This communication and interaction are particularly helpful for students who are less proficient in skill-based learning and are introverted or hesitant to communicate with teachers.

Blended learning fully takes into account the flexibility of students' time and location, as well as their personalized learning resource needs. Students can autonomously decide the time and place for online learning before and after class, as well as whether to review instructional videos. Teachers only provide reminders to students who haven't completed their learning and answer questions from students with doubts. Through a semester of online self-directed learning and practice, students develop habits of independent thinking and exploration, enhancing their self-discipline and self-directed learning awareness.

Students not only learn the content uploaded by teachers to the educational platform and WeChat study groups but are also encouraged to actively utilize the abundant learning resources available on the Internet, such as automotive courses offered by major MOOC platforms, instructional content provided by Bilibili, TikTok influencers, and others in the field of automotive education. This approach not only helps students accelerate their mastery of practical skills but also improves their ability to search for instructional texts and videos on the Internet. Therefore, students in the experimental class applying blended learning have shown a significant improvement in their self-directed learning awareness.

3. Overall, compared to traditional classroom teaching, blended learning provides a flexible, personalized, and diversified approach to learning, which has a positive impact on learning outcomes. It increases student engagement, fosters students' self-directed learning abilities, promotes collaboration among students, and cultivates a positive learning attitude. Blended learning, by integrating online and offline learning resources, offers a broader range of learning opportunities and resources, enabling students to choose and delve deeper into topics based on their learning needs and interests. Additionally, blended learning can provide real-time feedback and

personalized guidance through technological tools and interactive platforms, assisting students in better understanding and mastering the learning content.

Moreover, the application of different learning modalities has shown significant differences in learning outcomes. Engagement, independent learning abilities, attitudes, and collaboration all demonstrate the advantages of "online + offline" blended learning. Students have high regard for the effectiveness of blended learning, indicating their active participation and willingness to engage in discussions during the learning process. Pre-class preparation establishes correct action representations while focusing on key and challenging aspects during class accelerates students' mastery of the techniques. Guiding students to discover and solve problems through group collaboration enhances their group cohesion and increases their motivation to learn.

Although blended learning has shown many positive effects in automotive professional courses, this study has some limitations. For example, the research sample was limited and only covered specific schools or programs. Future research can expand the sample size and consider differences across schools and districts to further verify the effectiveness and applicability of blended learning.

5.2 Recommendation

1. Compared with traditional classroom learning, blended learning can significantly improve students' hands-on ability, and effectively stimulate students' learning interest, cooperative learning ability, and independent learning ability. Therefore, it is suggested that blended learning should be widely promoted in the learning of automobile majors in colleges and universities, to promote the reform of informatization and improve the learning effect of automobile major courses.

2. Although there are abundant online learning resources for automotive majors, these resources are scattered on various online platforms, and the quality varies. Therefore, teachers should pay attention to the selection of online learning resources, and make suitable learning resources according to the learning situation and needs of students to make up for the lack of online learning resources. In the offline classroom, teachers should avoid one-way indoctrination teaching, but use a variety of teaching methods and methods to stimulate students' thirst for knowledge and guide students to learn actively. At the same time, teachers should strengthen communication with students, understand students' questions and confusion, and solve problems encountered by students in a targeted manner.

3. Blended teaching puts forward certain requirements for teachers' informatization teaching level. Teachers should actively participate in training related to information-based teaching and earnestly learn the techniques and experience of online teaching. At the same time, teachers should enhance their hands-on ability, conduct teaching exchanges with senior teachers and professional maintenance personnel, and listen to the opinions and suggestions of professionals to optimize and improve their hands-on ability.

4. Schools and governments should support the development of blended teaching through policies and finances. Schools should pay attention to the construction or selection of online teaching platforms. Strong schools can independently develop online teaching platforms, but it is recommended to cooperate with online platforms that have been used on a large scale (such as China University MOOC, Xuetangx, Chaoxing platform, etc.).

Cooperative research and development. In this way, it is easier to obtain specific learning data of students, and it is convenient for teachers to monitor students' online learning. Schools should also vigorously support teachers with rich teaching experience in recording teaching videos, and participating in the application of online and offline first-class courses and online first-class courses, to provide high-quality online and offline mixed courses for the future study of hybrid automobile professional courses. Learning Resources.

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Appendices

Appendix A:

Higher Vocational Blended Learning Questionnaire (Pre-test Paper)

Dear students:

Hello, classmates. This questionnaire is to investigate the views of secondary vocational students on online and offline hybrid teaching. The questionnaire is anonymous, please feel free to fill it out!

Please fill in the questionnaire according to the following rules: 1. Each question can only choose one answer; 2. Mark "√" in the "□" corresponding to the selected answer 3. Basic questions (please choose according to your actual situation, only one choice)

1. What is your computer skills level?
□A very poor
□B poor
□C average
□D good
□E very good
2. What is your experience with using the Internet for study and research?
□A no experience
□B little experience
□C general experience
□D more experience
□E a very rich experience
3. Which learning style do you prefer?
□A completely face-to-face traditional learning
□B Mostly face-to-face traditional learning, some online learning
□C Equal proportions of face-to-face traditional learning and online learning
□D Mostly online learning, a small amount of face-to-face traditional learning
□E Completely Online Learning
4. How do you think the learning effect of your preferred learning method is?
□A The effect is very bad
□B The effect is poor
□C The effect is average
□D The effect is good
□E The effect is very good
5. What do you think of your ability to learn independently?
□A very poor
□B poor
□C average
□D good
□E very good
6. How do you think your attention is in the process of studying?

□A very not concentrated
□B not concentrated
□C average
□D relatively concentrated
□E very concentrated
7. Can you preview before class and review after class?
□A can't do it at all
□B can't do it
□C sometimes can do it sometimes can't do it
□D can do it
□E can do it at all
8. How long do you spend on pre-class preview and after-class review?
□A Within 5 minutes
□B 5-10 minutes
□C 10-15 minutes
□D 15-20 minutes
□E More than 20 minutes

Appendix B:

Higher Vocational Blended Learning Questionnaire (post-test paper)

II. Basic questions (please choose according to your actual situation, only one choice)

No.	Question	disagree	disagree	generally	quite agree	agree
1	I have been actively participating in discussions and asking questions in the classroom through blended learning followed by professional courses.					
2	After blended learning, I can earnestly complete the homework and test questions assigned by the teacher					
3	I became a serious listener in an automotive specialization class after going through blended learning.					
4	I became willing to actively complete the preview and review after going through blended learning.					
5	After blended learning, I was able to make my study plan and goals.					
6	I was able to manage myself and improve my self-discipline through blended learning.					
7	I can collaborate with others on learning tasks through blended learning.					
8	After blended learning, and participating in cooperative learning activities, I am more proactive and cooperative than before					