



**THE EFFECTS OF BLENDED TEACHING METHODS BASED  
ON ONLINE RESOURCES ON STUDENTS' LEARNING  
OUTCOMES - A CASE STUDY ON THE COMPUTER-AIDED  
DESIGN COURSE OF NANJING COMMERCIAL COLLEGE**

**NI GUOQING**

**6517195032**

**AN INDEPENDENT STUDY SUBMITTED IN PARTIAL FULFILLMENT OF  
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**NI GUOQING**

This Independent Study has been Approved as a Partial Fulfillment of the Requirement  
of International Master of Business Administration

Advisor: .....  
(Dr. Jidapa Chollathanrattanapong)

Date: 14 / March / 2024

.....  
(Associate Professor Dr. Jomphong Mongkhonvanit)  
Dean, Graduate School of Business Administration

Date: 26 / 4 / 2024  
Siam University, Bangkok, Thailand

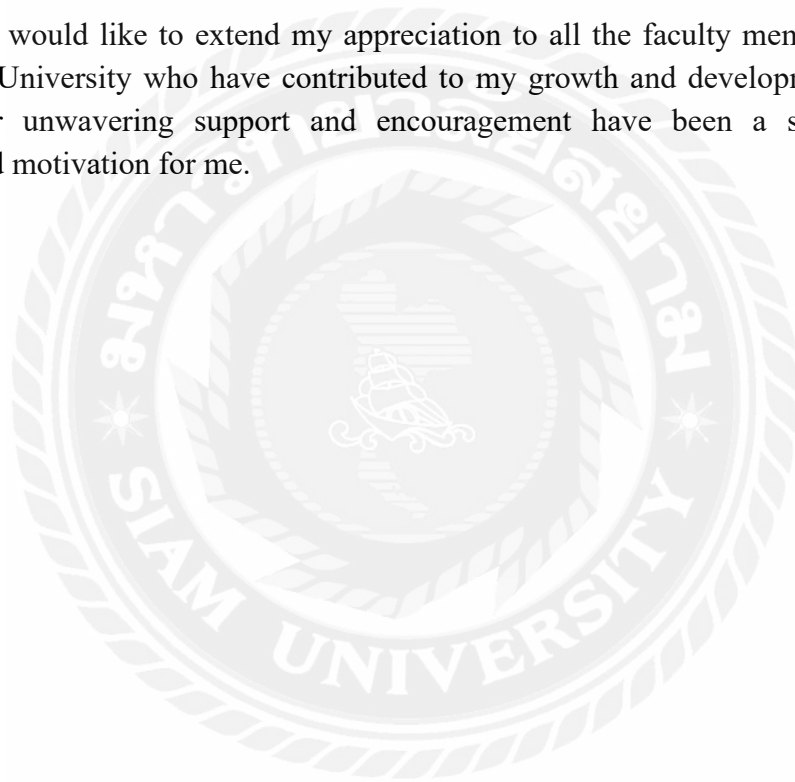


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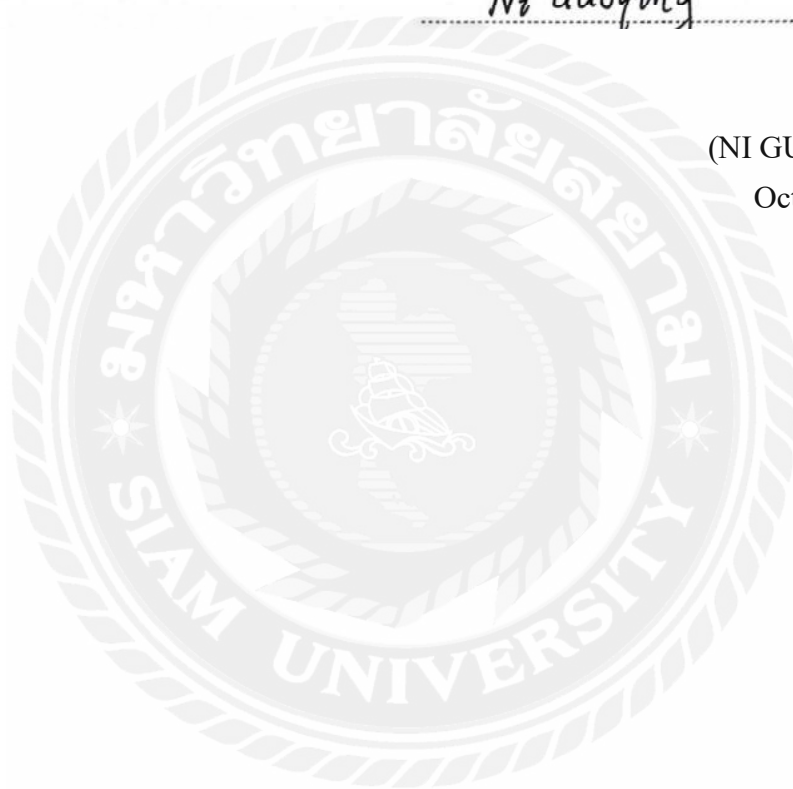
## Declaration

I, NI GOUQING, as a result of this, certify that the work embodied in this, independent study entitled **"Study on the effects of blended teaching method based on online resources on students' learning outcomes –Take the Computer Aided Design Course of Nanjing Commercial School as an example"** is a result of original research and has not been submitted for a higher degree to any other university or institution.

*Ni Guoqing*

(NI GUOQING)

Oct 28, 2023



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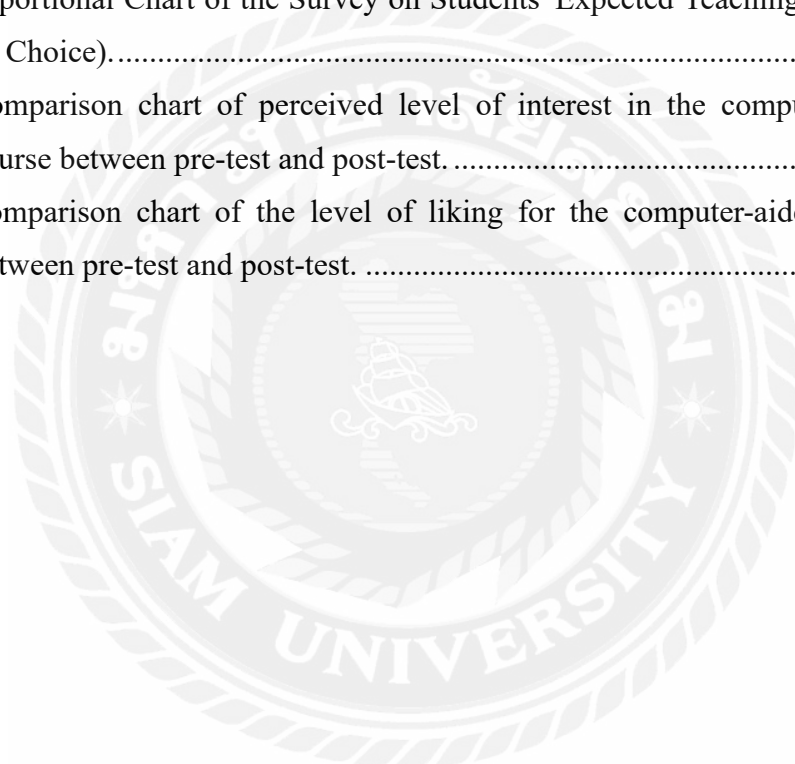
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# Chapter 1 Introduction

## 1.1 Research Background

The availability of abundant online resources and the rapid development of online education have led to continuous improvements in course systems and increasingly personalized classroom models. Effectively integrating online educational resources with traditional education has become a necessity for the development of the era. Blended learning, combining online and offline learning, has emerged as a new teaching and learning approach (Du & Li, 2016). Since 2012, research on Massive Open Online Courses MOOC and Small Private Online Courses SPOC has swept across the globe. Numerous online education platforms such as Netease Open Course, YY Education, and Taobao Education have quickly emerged. The research team at Tsinghua University's Institute of Education Research has interpreted the 11-year series of reports on online education in the United States and pointed out that online development in higher education is an irreversible trend (Zhu, Han, Yang, & Cheng, 2014). As the traditional teaching model is being disrupted, online teaching has become a beneficial supplement to classroom teaching (Lu, 2014).

Currently, many universities still adhere to traditional teaching and evaluation methods. However, this approach severely restricts the cultivation of students' innovative awareness and abilities, hinders the objective evaluation of students' learning abilities and performance, and fails to inspire students' enthusiasm and interest in learning (Qian, Wei, Tian, & Yuan, 2012). Compared to traditional teaching, online teaching has its unique characteristics, such as the separation of teaching and learning activities in time and space, and students' learning activities primarily taking the form of independent learning (Liu & Liu, 2020). The blended learning mode, which combines face-to-face teaching and online classrooms, has multiple advantages, including abundant multimedia resources, diverse communication channels, and autonomous learning methods (Zhang & Ma, 2019).

In universities, computer-aided design courses are fundamental courses for computer design majors, mainly teaching the usage methods and techniques of AutoCAD. Students acquire design abilities through these courses, laying a foundation for their future design work. Computer-aided design courses are highly practical and require continuous practice opportunities for students. Therefore, relying solely on classroom teaching is insufficient to achieve teaching objectives and requirements (Lu, 2013). According to the references, adopting a blended learning mode that combines online and classroom teaching is more beneficial for the teaching of such courses (Ke, 2008). However, in the teaching of computer-aided design courses, problems exist such as low student interest, low classroom participation, weak hands-on practical abilities, and students' limited software application abilities, leading to the phenomenon of "half the effort, half the results" in teaching (Dai, 2007).

In an era of abundant online resources, it is a necessary choice for educational development to use new educational concepts to guide teaching reform and continuously reflect on and reconstruct university teaching models (Gu, 2017). The demand from companies for the application of computer design knowledge by university students is also increasing (Xue & Guo, 2020). As the cradle of talent cultivation, universities need to reflect on teaching content, teaching methods, and other aspects, introduce advanced blended learning concepts, and reform teaching models to meet the demands of the era (Gu, 2017).

This study is based on blended learning theory, constructivism theory, and multiple intelligence theory. It integrates blended learning into the teaching of computer-aided design courses, constructs a blended teaching model based on online and offline courses, and conducts experimental research with a control group to draw conclusions. The aim is to provide reference for the teaching reform of computer-aided design courses in universities.

## 1.2 Research Questions

Classroom activities typically follow a teaching model of "teach first, then learn," with a pattern of lecture, demonstration, and practice, especially in skill-based courses. Usually, the teacher instructs one step, and students practice one step (Qian, 2012). Students tend to mimic without deep critical thinking. In this process, individual creativity is often stifled, and student engagement is limited. Teachers often focus on completing assignments or evaluating the results, emphasizing praise for excellent work while neglecting feedback for poor performance (Zheng, 2008). More importantly, the evaluation of the teaching process itself is often overlooked, which can lead to demotivation and hinder student enthusiasm.

Nanjing Commercial College, being a vocational school, faces challenges with students' low self-directed learning abilities, weak intrinsic motivation, limited attention spans, and narrow interests. These students often exhibit low enthusiasm and a disengaged attitude towards learning (Li, 2006). Real classroom activities should reflect students' enthusiasm, initiative, autonomy, and inquiry abilities, aiming to nurture their problem-solving abilities. Nanjing Commercial College's computer-aided design course has traditionally followed a conventional teaching approach, resulting in a noticeable decline in teaching effectiveness. Given this background and the theoretical basis of blended teaching methods, the main focus of the research was on the following three questions:

1. Do blended teaching methods have a positive impact on students' learning interest or not?
2. Do blended teaching methods have a positive impact on students' classroom participation or not?
3. Do blended teaching methods have a positive impact on students' practical abilities or not?

### **1.3 Objectives of the Study**

To thoroughly investigate the issues in teaching computer-aided design courses and find a teaching model that benefits both teachers and students, this paper analyzes and researches the blended teaching model of computer-aided design courses at Nanjing Commercial College, which is based on online resources. The main research objectives are as follows:

- 1) To verify that blended teaching methods have a positive impact on students' learning interest.
- 2) To verify that blended teaching methods have a positive impact on students' classroom participation.
- 3) To verify that blended teaching methods have a positive impact on students' practical abilities.

### **1.4 Scope of the Study**

This study selected first-year students from Nanjing Commercial College as participants for the experiment, conducted in the first half of 2023, which spans one semester. Two classes were chosen, comprising a total of 165 students. Class 1 served as the experimental group with 83 students, while Class 2 functioned as the control group with 82 students. The same computer-aided design teaching staff instructed both the experimental and control groups. Among the participants, there were 79 male students, accounting for 47.9% of the total, and 86 female students, accounting for 52.1% of the total. Among them, 54% were 19 years old, 25% were 20 years old, and 11% were 21 years old or older.

The primary teaching method employed in the experimental group was blended teaching. This study aimed to explore the conflicts and issues arising from the integration of teaching methods and courses for college students based on online resources. It investigated specific strategies for reforming the blended teaching method compared to traditional classroom instruction, with the goal of helping vocational colleges improve students' interest in computer-aided design and enhance teaching effectiveness for instructors.

### **1.5 Significance of the Study**

First, it helps to stimulate learners' autonomy and enhances their interest in learning. Through the study of a university-level computer fundamentals course teaching model based on online resources, it has to some extent changed the traditional teaching methods, making the teaching of university computer fundamentals courses more diverse, engaging, and effective. The emergence of online resources has broken the barriers of traditional education, making the sharing of high-quality educational resources possible (Pan, 2020). Compared to traditional teaching courses, online resources meet the demands of society with characteristics such as being online and open, attracting the attention of most learners. In contrast to the

limitations of traditional computer-aided design courses that can be monotonous and dull, the use of online resource platforms for teaching brings significant differences in teaching methods, evaluation, and resources. Online resources emphasize the student-centered teaching philosophy, transforming teachers from lecturers to facilitators and motivators, reflecting a value concept centered around "learning," stimulating learners' autonomy, and enhancing their interest in learning (Chen, 2019).

This study attempts to explore the application of online resources in the classroom by selecting high-quality computer-aided design learning resources from online resource platforms, promoting the blended teaching model suitable for the development of vocational colleges in China, and providing insights for future blended teaching and student learning in China.

Second, it helps promote student autonomy and places students as the primary participants, thereby increasing their engagement. Teachers should not be the central figure in teaching activities but should shift the focus to the students. This enables learners to consciously and actively integrate new and old knowledge, constructing their own new knowledge (Wen & Jia, 2012). By leveraging online resource platforms, teachers can assign learning tasks that are suitable for students' current situation, create corresponding teaching scenarios, and provide individual guidance when students encounter difficulties. This provides a foundation for students to complete knowledge construction.

Third, blended learning will greatly enhance the quality of student education and their practical application abilities, making their learning more aligned with societal needs. The educational reform of the "Computer-Aided Design" course, based on the blended learning model, breaks away from the traditional teaching methods and approaches, allowing for the extension and expansion of student classroom activities. It not only extends students' learning before and during class but also extends it to after class and even beyond the campus (Luo, 2010). Learning can take place anytime and anywhere, as long as there is time and a need, reflecting the transformation of new learning methods and habits in the era of online resources. Blended learning will significantly improve the quality of student education, making their learning more aligned with societal needs. Therefore, after graduation, students will have better adaptability to society, which will be advantageous for improving their professional competence (Li, 2016).

## Chapter 2 Literature Review

In today's rapidly developing era of globalization and information technology, online resources have experienced rapid growth. This new form of online learning not only provides more possibilities for teaching but also changes the learning methods of students. In the field of basic education, online resources are not only reliant on online platforms but are also closely related to blended learning. Therefore, this paper summarizes and outlines the relevant concepts and proposes the theoretical foundation for computer-aided design blended learning practices based on online resources.

### 2.1 Network Resource

In simple terms, online resources refer to resources available on the internet that users can gather based on their own needs. Online resource teaching is a form of online education where courses are freely published on internet platforms in the form of short video segments. This allows learners from all over the world to access and learn the courses they are interested in for free, with assignments and assessments similar to traditional courses. If learners can complete the course assignments and pass the final exam on time, they can also receive a corresponding course certificate (Pan, 2020). Utilizing online resources is a new teaching method and model in the internet age, characterized by real-time interaction between teachers and learners and a "flipped classroom" approach.

The emergence of online resources has shattered the "walled" approach of traditional education and made the sharing of high-quality educational resources possible. Compared to traditional teaching courses, online resources meet the demands of society with characteristics such as being online and open, attracting the attention of the majority of learners. Firstly, unlike the limited number of students in traditional teaching, a high-quality course on an online learning platform can attract tens of thousands of learners. This scale of learning is unachievable in traditional classroom teaching. Secondly, teaching with the support of online resources is a completely new teaching method. For learners, there are no limitations of time and location. Learners have control over the learning content and pace, and real-time interaction between learners and teachers can be achieved on online platforms. Lastly, online resources have no qualification restrictions for learners. They are open to all learners worldwide, and the registration and learning processes are completely free. After completing regular assignments and the final online examination, each learner can obtain a certificate of completion for the selected course. This greatly promotes the sharing of high-quality educational resources (Chen, 2019). With its unique advantages, online resources have quickly gained prominence in the global education industry, providing learners with more possibilities for learning.

## **2.2 Blended Teaching Methods**

Blended teaching methods combine the advantages of both online and offline education. They leverage information technology and online media, relying on platforms like MOOC and Superstar Learning to facilitate both online and in-person learning. The close integration of online and offline instruction guides learners to progress from simple to complex and from easy to difficult levels (Zhao, 2018). Online course resources are a prerequisite for implementing blended teaching methods. These methods innovate by delivering previously classroom-taught knowledge through micro-videos, providing students with ample study time, allowing them to enter the classroom with a strong knowledge foundation, thereby ensuring the quality of classroom teaching. Teachers should assist students in digesting foundational knowledge acquired through online learning, clarifying their understanding, and addressing any gaps in their learning. In-class activities should be carefully planned to help students master and apply the knowledge they've acquired both online and offline, thereby achieving improved educational outcomes.

Blended learning is a teaching approach that combines online network-based learning with offline classroom teaching (Zhao, 2018). Teachers reorganize and adjust the time inside and outside the classroom, moving teaching activities that traditionally occur in the classroom to outside, and incorporating out-of-class teaching activities into the classroom, making learners the center of the teaching activities and the owners of the classroom (Zhou, 2016). Blended learning transforms traditional teaching methods by giving students more freedom in their learning, allowing them to choose the most suitable learning methods for themselves. Prior to the class, students can use online instructional videos provided by the teacher and abundant online information resources to plan their learning activities based on their own circumstances, freeing learning from the limitations of time and space in the classroom. In the classroom, teachers focus on the internalization process of more important knowledge, promoting the generation of knowledge through communication and interaction between teachers and students, as well as among students themselves (Wang, 2019). Blended learning overturns the shortcomings of limited teacher-student interaction in traditional teaching and effectively changes the mode of communication between teachers and students. The transmission of teaching tasks relies on the information technology platform before and after class, while the internalization of students' knowledge requires continuous communication between teachers and students in the classroom, thus achieving blended learning.

### **2.2.1 Blended Teaching with Online and Offline Components**

With the advent of the "Internet+" era, we have entered a new digital information age. Online courses, primarily led by MOOC and platforms like Superstar, serve as the material foundation for blended teaching methods, providing students with rich learning resources and enabling them to actively seek answers and solve problems (Zhao, 2018). Online classroom teaching resources for computer-aided design courses mainly include WeChat class groups, public accounts, as well as the teaching library,

extended resource library, and practice library on the Superstar Learning platform. Simultaneously, the openness, inclusiveness, and diversity of online classroom teaching allow students to gain a deeper understanding of theoretical knowledge related to their field of study and the analysis of technical skills. Online learning can encompass activities such as online study, collaboration, discussions, communication, testing, and Q&A. In addition, teachers can provide students with a wider range of learning resources, expanding the depth and breadth of their education (Zhou, 2016). When students encounter any questions during the learning process, they can discuss them with peers online or communicate individually with teachers at any time, which is a significant departure from traditional teaching, where questions can only be asked when the teacher is present. Furthermore, through statistical data provided by the teaching platform, students receive specific feedback on their learning progress. This feedback enables the teaching faculty to assess the overall effectiveness of student learning and serves as a reference for future teaching method reforms and innovations.

In the blended teaching approach for computer-aided design courses, the role of teachers in offline classroom teaching has undergone a significant transformation. Teachers are no longer just classroom leaders but rather designers and organizers. Since students have already watched relevant videos and accessed materials before class, they have a certain level of understanding of the knowledge to be covered in the class. Therefore, in the practical process of teaching computer-aided design courses, teachers don't need to spoon-feed all the teaching content to the students. Instead, they should leave room for students to think critically and extend online learning activities into the classroom (Zhou, 2016). During offline teaching, collective exercises are important to ensure that teachers can standardize students' drawing techniques. While students practice, teachers guide them, correct common mistakes, and record videos of students designing drawings. After class, these videos are categorized and sent to the online teaching platform, allowing students to visually learn drawing skills and improve their learning abilities.

### **2.2.2 Blended Learning Styles**

Based on constructivist theory, students' learning is characterized by active construction and social interaction. This includes collaboration and communication among individuals, as well as the use of necessary information. In computer-aided design courses within a blended teaching framework, teachers can employ various teaching formats to impart design knowledge to students. In addition to organizing group discussions, design practices, and explanations during class, teachers can use resources such as videos and presentations on the course platform to convey knowledge and assess knowledge mastery.

Furthermore, engaging in conversations with students and answering questions on social platforms can also be a teaching approach used by instructors to enhance student participation (Whang, 2019). This approach fosters a more interactive and collaborative learning environment, aligning with the principles of constructivist theory.

### **2.2.3 Blending Teaching Resources**

In the context of blended teaching methods, the teaching resources are diversified and encompass various elements. These resources include teaching videos, course materials, and textbooks created based on research requirements. They greatly enrich the content of computer-aided design courses (Zhou, 2016). Before the class, teachers upload teaching content and course resources to the learning platform, allowing students to access these materials according to their individual needs, which enhances students' interest in learning.

#### **1. Teaching Videos:**

Teachers produce short instructional videos for computer-aided design, usually limited to about 10 minutes, making it convenient for students to study and watch during their free time (Whang, 2019). These videos assist students in understanding technical actions. Furthermore, these videos can reduce the in-class time needed for hands-on practice, as teachers can use the videos repeatedly in subsequent classes. This reduces the workload for teachers and allows them to focus more on individual student differences and the overall class's teaching level.

#### **2. Teaching Slides and Textual Materials:**

Teachers should upload relevant teaching materials to the learning platform for student access. These materials typically consist of essential technical action guidelines, key teaching points, and practice methods (Zhou, 2016). By studying these resources, students can develop a comprehensive framework of technical actions in their minds. This not only helps them understand how to practice these technical actions but also the principles and methods involved, which enhances students' self-directed learning, innovative thinking, and practical abilities (Zhou, 2016).

#### **3. Superstar Learning Platform Resources:**

The Superstar Learning platform offers numerous resources related to computer-aided design courses. Teachers can upload and share course-related resources with students (Whang, 2019). Students can choose resources that match their needs and interests, thereby enhancing the effectiveness of the teaching and allowing students to gain more knowledge and skills related to the course, promoting both comprehensive and individual development.

After creating these course resources, they are sent to an online course platform such as "Smart Tree" to form an online course resource. Teachers then create an online course called "Computer-Aided Design" on the Superstar Learning platform, establishing the online teaching framework for practical courses. This is organized into five educational content modules, and the corresponding course resources are sent. Students and teachers download and install the Superstar Learning App to synchronize with the resources (Zhou, 2016). The evaluation process is critical, as it allows for the assessment of user information on the Superstar platform, online test completion rates, and other aspects of student learning, including peer assessments, end-of-term exams, and student learning outcomes (Whang, 2019). The evaluation phase is a major component of blended learning, involving both formative and



summative assessments. Formative assessment is integrated throughout the various stages of blended teaching design. Necessary experimental data is collected through surveys and interviews, and adjustments and improvements to the design are made based on this data. Summative assessment occurs after the start of teaching experiments and focuses on comprehensive research and evaluation of student standardized tests, technical assessments, and overall performance. This information is used to modify teaching design and establish best practices for blended teaching methods (Whang, 2019).

### **2.3 Traditional Learning**

Traditional lecture-style teaching refers to a teaching method in which the teacher imparts knowledge to students through instructional language (Wang & Wu, 2017). On the one hand, lecture-style teaching is beneficial for improving classroom teaching efficiency, allowing for the effective role of the teacher and the facilitation of basic instruction. On the other hand, lecture-style teaching also exhibits the characteristics of the "three centers" theory, with the teacher, textbook, and classroom as the central focus, making it a typical teaching method adapted to exam-oriented education. Traditional teaching and online teaching are two major teaching methods existing in the education industry in our country. Traditional teaching is teacher-centered, with the teacher organizing and monitoring teaching activities, which is conducive to the systematic transmission of scientific knowledge (Chen & Wang, 2018). In the traditional classroom teaching format, there is direct interaction and feedback between the teacher and students. The teacher can understand the students' understanding of the course content through their expressions and communication, and adjust the content accordingly based on the teaching effect (Yang, 2015). Moreover, during experimental activities, direct and real-time guidance can be provided to students, addressing any issues encountered during the experiment. Considering the abundant resources and direct interaction in the traditional classroom teaching format, it is irreplaceable in the teaching process (Ma & Zhang, 2019).

Traditional classroom teaching requires fixed class schedules for students, while compared to online teaching formats such as MOOC, students have the freedom to choose their own learning time, which offers more flexibility (Chen & Wang, 2018). Similarly, students can repeatedly watch the videos according to their own needs. In contrast, traditional classroom teaching, due to the time constraints of the course, cannot repeat explanations based on each student's understanding, which is a disadvantage compared to online teaching platforms. In general, computer-aided design courses emphasize practical skills, and the assessment usually consists of 20% for regular grades, 20% for theoretical grades, and 60% for practical grades, with theoretical grades mostly determined by written exams. Regarding regular grades, they are often determined by attendance, assignments, and classroom performance (Yang, 2015). However, due to the time constraints of the course, attendance can only be occasionally taken to confirm, and it cannot guarantee that attendance will be taken

every class. For assignment grading, teachers often need to manually record and calculate the scores for each assignment. At the end of the semester, regular grades are calculated based on attendance, assignment scores, and classroom performance. On the other hand, online teaching platforms allow for online attendance and submission of assignments, automatically recording attendance and assignment scores. Finally, regular grades are calculated based on the proportions set by the teacher, providing a more fair and accurate evaluation standard for regular grades on online platforms (Ma & Zhang, 2019).

## **2.4 Computer-Aided Design Course**

The Computer-Aided Design (CAD) course is a multidisciplinary applied technology that tightly integrates theory, practice, and the development of computer technology. With the widespread adoption and promotion of digital design and manufacturing technology, CAD courses have become a crucial tool for enhancing manufacturing productivity and product quality, a key technology for improving competitiveness. CAD courses are a core subject in vocational colleges. They are based on courses like mechanical drawing, basic mechanical design, computer programming, and encompass computer-aided design and computer-aided manufacturing (Zhang, & Wang, 2006).

Anthony conducted research on teaching reforms that introduce problem-solving in CAD courses. He focused on students' abilities to apply CAD to practical problems and explored how to enhance students' design and problem-solving skills through course design and teaching strategies. Scott Greenhalgh's (2016) research emphasized the reform of CAD courses by introducing hands-on projects and team collaboration. He explored how classroom learning could be integrated with real engineering projects to develop students' practical engineering skills and teamwork. Paul Withrell (2022) studied the transformation of CAD course teaching through the use of virtual simulations. He investigated how virtual simulation tools can provide students with a more realistic and immersive design and production experience and evaluated the impact of this teaching method on student learning outcomes.

Through research and practice, CAD courses have undergone teaching reforms that explore various teaching methods and models aimed at improving student learning outcomes and career readiness. This research provides valuable experience and references for the teaching practices of CAD courses.

Based on the literature analysis above, this paper study the "Computer-Aided Design Course," using a blended learning approach in course design, evaluate and improve the CAD course through surveys, student performance assessments, and course enhancements. In terms of teaching effectiveness, the focus will be on nurturing students' innovative and practical abilities in the classroom by inspiring their learning interests and motivation.

## **2.5 Students' learning interest**

Interest in learning is a cognitive inclination and emotional state in which individuals strive to understand the world, crave knowledge, and continually seek truth (Ren, 2018). It is also known as cognitive interest. People with a genuine interest in learning will engage in their studies actively, attentively, and with enthusiasm, thereby enhancing the effectiveness of their learning. Therefore, learning interest serves as one of the most practical and dynamic internal motivators driving student learning (Chen, 2015). Learning interest can be categorized into direct and indirect interests. The former is directly aroused by the content or activities of learning. Factors such as the appeal of the study material, innovative learning formats, lively teaching by instructors, and the satisfaction derived from academic achievements can all stimulate students' direct interest in learning (Ren, 2018). Indirect interest is generated by the recognition of learning outcomes and is characterized by a strong sense of self-awareness (Chen, 2015). It plays a vital role in sustaining learning perseverance and determination (Ren, 2018). Both types of learning interest are essential for effective learning. Without direct interest, studying can become a monotonous burden, and without indirect interest, it becomes difficult to maintain a lasting commitment to learning (Ren, 2018). The organic combination of these two types of learning interest is a crucial factor in enhancing learning motivation and improving learning outcomes.

## **2.6 Students' classroom participation**

Different researchers have defined the concept of "students' classroom participation level" based on their own research perspectives (Chen, 2015). The concept of "student involvement" was first introduced by an American scholar, who considered it as the degree of mental investment in cultural knowledge learning in the classroom. Scholar Finn (1993) made significant research breakthroughs after years of continuous efforts. He believed that students' classroom participation could be divided into four stages: passive participation, initial participation, active participation, and positive development. Classroom participation is essentially a behavior, indicating students' contributions to the class and their relevance to the lesson. Student participation refers to students' ability to engage fully in the classroom, interact with teachers based on a real environment, and is a process of fostering meaningful learning and creativity (Wang, Li & Chao, 2019). Classroom participation is a combination of students' attendance and their level of attentiveness during class. Student participation levels reflect changes in their learning states, indicating variations in their engagement during the class. Student participation is seen as a means for students to achieve their learning goals and fulfill their desires. Based on previous research, Kong Qiping (2003) classified classroom participation into three dimensions: behavior, cognition, and emotion. Classroom participation should be active rather than passive, requiring students to actively cooperate with teachers to achieve teaching objectives during instructional activities (Chen, 2015).

Combining scholars' research on classroom participation and considering the research purposes and questions in this context, the classification of students' classroom participation into cognitive participation, behavioral participation, and emotional participation will be adopted (Wang, Li & Chao, 2019).

## **2.7 Students' practical abilities**

Scholars define the concept of practical abilities as follows: practical abilities, also known as practical abilities, are the physiological and psychological characteristics necessary to ensure that individuals can apply existing knowledge and skills to solve real-world problems (Zhang, 2015). Practical abilities encompass the sum of individual physiological and psychological traits that directly play a stable regulatory and controlling role in the process and manner of problem-solving. It constitutes a complex and unified body-mind energy system (Zhang, 2015). This system consists of four basic elements: practical motivation, general practical skills, specialized practical abilities, and situational practical skills. In the paper "On Students' Practical abilities and Their Development," the concept of practice is further understood from three dimensions: existentialism, ontology, and activity theory. Practical abilities are defined as the performance state of the practical subject in the process of practical activities and the results formed at the end of practical activities (Zhang, 2015). In the paper "On the Connotation and Structure of Practical abilities," it is proposed that practical abilities are not only manual dexterity but a comprehensive ability that integrates manual dexterity, vocational activity abilities, self-expression abilities, and interpersonal communication abilities. In the research on "Developing Practical abilities in Higher Agricultural Schools," practical abilities are described as the ability of the subject to purposefully and consciously transform the object (Xu, 2018). Specifically, it refers to the behavioral or psychological activity patterns of individuals successfully completing certain tasks in social activities.

In the computer-aided design (CAD) industry studied in this research, students' practical abilities refer to their actual operational and application proficiency in CAD software (Xu, 2018). Specifically, this includes the following aspects: software operation abilities, 3D modeling abilities, drawing production capabilities, problem-solving abilities, and teamwork abilities. In summary, practical abilities of students in computer-aided design not only encompass technical operational aspects but also require spatial imagination, problem-solving abilities, and teamwork abilities to adapt to complex and changing design demands.

## **2.8 Cultivation Theory**

### **2.8.1 Tacit knowledge theory**

Constructivism has received significant attention from researchers in recent years and has experienced substantial development. This theoretical perspective argues that students, as learners, cannot simply rely on teachers' knowledge transmission in the classroom for learning. Instead, learning involves the construction and reorganization

of new knowledge by students themselves based on external conditions and their existing learning foundations (Wen & Jia, 2012). In this process, students are no longer passive recipients of knowledge but actively engage in the processing and selection of new knowledge. It involves the interaction and construction between old and new knowledge, with learners taking on the role of active constructors in the process of knowledge acquisition. This constructive behavior can only be accomplished by the learners themselves and cannot be replaced by others. The constructivist perspective challenges the absolute authority of teachers in traditional teaching and emphasizes that teachers are facilitators and guides of the teaching process, while students are the central focus of the entire teaching activity. The constructivist theory emphasizes that when learners acquire new knowledge, they should build connections by integrating new and existing knowledge based on their existing knowledge frameworks, thus forming the process of constructing new knowledge (He, 1997).

In addition, Piaget and Vygotsky, within the constructivist framework, emphasize that learners' learning relies on contextual construction. Teachers should create meaningful contexts in their instructional design for learners to share, enabling learners to consciously and actively integrate old and new knowledge and construct their own new knowledge (Wen & Jia, 2012). Even though learners may have different construction methods and diverse prior knowledge, teachers should not negate learners' own construction process. Instead, they should listen to students' thoughts and provide appropriate guidance and assistance (He, 1997). In summary, teachers assume the role of guides in the teaching process, while students are the active agents of learning activities.

In summary, the impact of constructivist theory on this study primarily lies in the active construction of new knowledge by learners in the context of computer-aided design learning, with the learning objectives aimed at practical application (He, 1997). Therefore, teachers should not be the main actors in teaching activities but should shift the focus to students. Teachers can utilize online resource platforms to assign learning tasks that are suitable for students' current situations, create corresponding teaching contexts, and provide individual guidance when students encounter difficulties, thereby providing a foundation for students to engage in knowledge construction. This provides an important theoretical foundation for blended learning on online resource platforms.

### **2.8.2 Multiple intelligences theory**

American psychologist Howard Gardner from Harvard University believes that intelligence tests cannot accurately and completely measure a person's intelligence, mainly due to the diversity of human intelligence. Gardner defines "intelligence" as "the ability to solve practical problems and produce or create products valued by a particular culture in various cultural contexts" [Davis]. Gardner believes that each person's intelligence exists in different forms, and each individual possesses different types of intelligence. The combination of different intelligences results in differences among individuals. Based on this, Gardner proposed the theory of multiple

intelligences (An, 2016). He believes that every learner possesses nine types of intelligence, representing different potentials of each learner. Each learner has their own strengths and learning styles in terms of intelligence. The different combinations of intelligence demonstrate the differences in intellectual abilities among learners. This requires teachers to pay attention to the individual differences of each learner during the teaching process, provide personalized instruction based on their abilities, and develop the multiple intelligence potential of each learner, allowing them to discover their own strengths.

Furthermore, the manifestation of these nine intelligences relies on appropriate contexts. Different individuals with diverse learning environments and educational backgrounds demonstrate different types of intelligence. Teachers should adopt diverse teaching evaluations to identify each learner's strengths and provide them with the greatest opportunities for development.

### **2.8.3 Blended learning theory**

Blended learning theory is not a newly emerged theory in recent years; it has been present in traditional education for many years. In 2000, Professor Li Kedong proposed the concept of blended learning, emphasizing the optimal utilization of various instructional media to achieve the best teaching results. Professor He Kekang suggested integrating traditional teaching models with online teaching models, leveraging the advantages of each to achieve educational objectives, which represents the sublimation and return of educational concepts. With the development of information technology and the internet, blended learning theory has gained widespread attention once again (He, 2004). One of the key figures in this theory is Professor Curtis J. Bonk from Indiana University, who believes that blended learning combines face-to-face teaching and computer-assisted instruction in traditional teaching models. He emphasizes the importance of addressing the integration of face-to-face teaching and computer-assisted instruction in blended learning (Oliver, Kaur, Hedberg, et al., 2005).

Based on the theory of blended learning, computer-aided design education should focus on integrating online resources with traditional teaching resources, combining the strengths of traditional instructional media with computer networks, multimedia devices, and mobile devices to complement each other. In addition, teachers can adopt a blended teaching approach that combines student-centered online learning with traditional lecture-style classrooms, enhancing student engagement and improving teaching effectiveness through forms such as peer and self-assessment.

## **2.9 Theoretical Framework**

The current research is summarized and analyzed using the literature review method to explore the research background, review the existing studies, and discuss the relevant concepts and theoretical foundations. The study utilizes the theories of blended learning, constructivism, and multiple intelligences as theoretical frameworks. The research employs survey questionnaires and experimental control methods to

investigate the current status of computer-aided design course instruction. It identifies the existing problems and conducts attribution analysis. Based on the empirical evidence, the study explores the necessity and feasibility of applying blended learning to the course and develops a blended learning model that aligns with the characteristics of the course.

The study proposes the design of a blended learning approach that combines online and offline elements to enhance student engagement and improve teaching effectiveness.

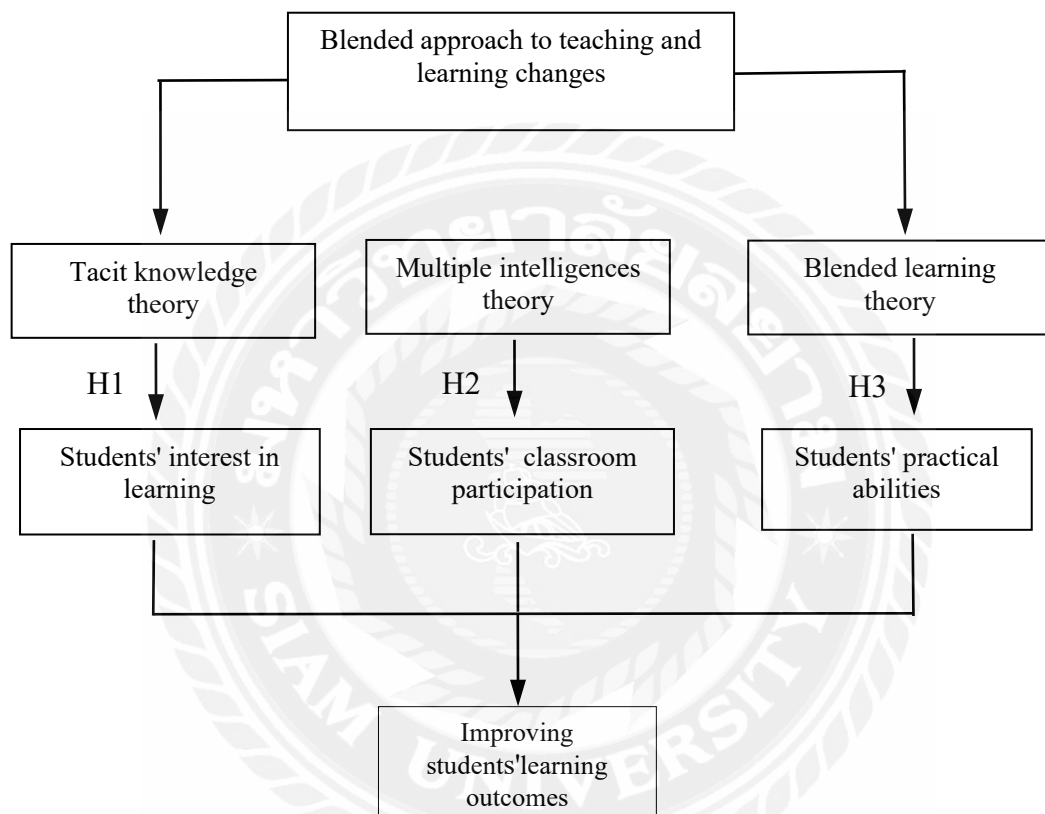


Figure 2.1 Diagram of the theoretical framework of the Study

## **Chapter 3 Research Methodology**

This paper adopts a quantitative research method and mainly utilizes questionnaire surveys and teaching experiments. The data was analyzed using SPSS, and research conclusions were drawn. A total of two classes were selected, with a total of 165 students. Class 1 was the experimental group with 83 students, while Class 2 was the traditional teaching group with 82 students.

### **3.1 Introduction**

#### **3.1.1 Background of the Questionnaire Survey**

Currently, blended learning methods have attracted the attention of many scholars. Investigating and analyzing the status quo of traditional teaching among students is the foundation for teachers to implement blended learning (Zhu, Duan, & Li, 2021). The effectiveness of students' course learning is influenced both by their self-management and self-discipline, as well as external factors such as the learning environment and the teaching methods employed by the teacher (Liu & Feng, 2023). Therefore, in the context of blended learning, it is important for teachers to understand the current status of computer-aided design course learning, the teaching practices of teachers, and the students' level of awareness regarding online resources (Zhu, Duan, & Li, 2021). Questionnaire survey is a research method in which researchers present a series of questions to respondents based on the research objectives of the study and ask them to provide answers or make choices from the given options (Tao, 2011). The questionnaire survey method has the advantage of collecting sample data on a large scale (Deng & Feng, 2000). Therefore questionnaire method was used as one of the main research methods in this study.

The main purpose of this survey is to identify the difficulties faced by students in course learning at Nanjing Commercial College, as well as the status of blended learning and students' level of understanding of online resources. This information will help facilitate the implementation of the experiment more effectively. The survey will be conducted in the form of a questionnaire, with the focus on blended learning and students' understanding of online resources. The results of the questionnaire will be statistically analyzed to explore the current challenges faced by students in computer-aided design course learning and the teaching practices of teachers. This will serve as the foundation for subsequent teaching experiments.

#### **3.1.2 Questionnaire implementation**

Due to the nature of this survey, which focuses on the current status of computer-aided design course learning and teachers' blended learning practices, an online questionnaire will be utilized. The survey will be distributed through the Wenjuanxing platform. The questionnaire link will be sent through QQ groups and WeChat, allowing students to conveniently access and complete the questionnaire at any time



and from anywhere using their computers or mobile devices. Before students fill out the questionnaire, they will be informed that the survey is anonymous, and they are only required to provide responses based on their own experiences, ensuring the authenticity of the survey.

### 3.2 Hypotheses

H1: Blended teaching has a positive impact on students' learning interest.

H2: Blended teaching has a positive impact on students' classroom participation.

H3: Blended teaching has a positive impact on students' practical abilities.

### 3.3 Sample size and sampling

The survey was conducted among 165 students from two classes of the first year at Nanjing Commercial College. Among them, there were 79 male students, accounting for 47.9% of the total, and 86 female students, accounting for 52.1% of the total. A total of 165 valid questionnaires were collected, resulting in a response rate of 100%. refer to Table 3.1.

The questionnaire used in this study was characterized by drawing upon the survey questionnaire from Master Tang's thesis titled "Investigation of the Application Effectiveness of Internet Resources in Teaching" (Tang, 2020) and making modifications to certain questions based on relevant literature from other scholars. The basic demographic variables included in the questionnaire mainly focused on students' interest in teaching methods and types of internet resources. The reliability and validity of the preliminary test results were analyzed to ensure the scientific and effective nature of the questionnaire. Thus, the questionnaire used in this study was finalized.

Table 3.1 Statistics on questionnaire data

digital	Number of cases	%
validity	165	100
rule out	0	0
total	165	100

### 3.4 Questionnaire design

The questionnaire consists of 9 objective questions, designed mainly around three dimensions: students' learning interests, students' classroom participation, and students' practical abilities. These questions are designed based on the talent training program for computer-aided design courses at Nanjing Commercial College, focusing on these three dimensions. The questionnaire uses a Likert 5-level scoring system, where values 1 to 5 are assigned sequentially to the options of the questions, forming a five-level scale. The content evaluation is divided into five levels: 1. Highly suitable (1 point), 2. Suitable (2 points), 3. general(3 points), 4. Not suitable (4 points), 5. Not

suitable at all (5 points). Through the analysis of students' individual learning outcomes, this study aims to explore the impact of the blended teaching method on students' learning achievements from the perspective of students. Shown in Table 3.2.

Table 3.2 Measuring item design

Variable	Measurement item	NO.
Students' interest in learning	1. The online resources selected by the teacher have provided certain assistance to my computer-aided design learning.	Q1
	2. The teacher's blended teaching approach has sparked my interest in computer-aided design learning.	Q2
	3. Compared to traditional teaching methods, I prefer the blended teaching approach.	Q3
students' classroom participation	1. Before class, I will independently watch videos on online platforms as per the teacher's instructions.	Q4
	2. During class, I can wholeheartedly focus on the lecture and interact with the teacher.	Q5
	3. After class, I will repeatedly watch the instructional videos to address the topics I do not understand.	Q6
students' practical abilities	1. The blended teaching method is very engaging and can ignite my enthusiasm for learning computer-aided design. It enhances my practical abilities.	Q7
	2. I am overall satisfied with the use of online resources in computer-aided design teaching. It has enhanced my level of design skills.	Q8
	3. I can independently complete project-based product designs.	Q9

### 3.5 Data analysis

#### 3.5.1 Sample analysis

This study selected first-year students from Nanjing Commercial College to participate in the experiment, which took place during the first half of the year 2023, spanning one semester. Two classes were chosen, totaling 165 students. Class 1 was the experimental group with 83 students, while Class 2 was the control group with 82 students. The same computer-aided design teaching instructor was assigned to both the experimental and control groups. The primary teaching method in the experimental group was blended learning. The main variables examined were the impact of blended learning and traditional teaching methods on students' application abilities. The preliminary test results were analyzed to ensure the validity of the data,

ultimately forming the experimental data used in this study. Refer to Table 3.3 for further details. Among the students, there were 79 males, accounting for 47.9% of the total, and 86 females, accounting for 52.1% of the total. In terms of age distribution, 54% were 19 years old, 25% were 20 years old, and 11% were 21 years old or older.

Table 3.3 Basic questionnaire for experiments with look-alike data

Sample data	sports event	Percentage (%)
Gender	boys	47.9
	girls	52.1
age	19	54
	20	25
	21	11

In the initial stage of the experiment, the final exam scores of the computer-aided design course were used as a reference for the students in the experimental class at the end of the previous semester at Nanjing Commercial College. The statistical analysis was conducted on the scores of the students in the experimental class. The average score for the computer-aided design course in the experimental class before implementing blended learning was 79.323, while the average score in the control class was 80.452. The average score in the experimental class was slightly lower than that in the control class, but there was no significant difference between the means.

Under the assumption that the student's score data followed a normal distribution, the scores of the two groups, the experimental class and the control class, were subjected to SPSS testing, as shown in Table 3.4. The results of the experiment ( $T=-0.595$ ,  $P=0.554>0.05$ ) indicate that there is no significant difference in the scores between the students in the experimental class and the control class. The basic levels of the students in the experimental and control classes are similar, demonstrating the effectiveness of the grouping in this experiment.

Table 3.4 Independent Samples t-test.

Pre-test scores of computer-aided design.						
	average value	standard deviation	Standard error average	standard deviation	T-value	significance
Experimental group	79.323	8.146	1.4631	1.8981	-0.595	0.554
Control group	80.452	6.732	1.2091			

### 3.5.2 Reliability analysis

Reliability analysis refers to the consistency between a measure and the variable it is intended to measure. It indicates the extent to which evaluation scores can be

trusted. The higher the reliability, the less affected the scores of different items within the same scale are by errors. This consistency ensures that the scores obtained on the scale remain consistent under different responses from respondents and accurately reflect the true state. The better the consistency, the higher the level of trustworthiness, and vice versa. In this study, Cronbach's Alpha was used as the reliability measure for the survey questionnaire. The survey data indicated excellent reliability. The questionnaire consisted of a total of 9 items. The Cronbach's Alpha for students' learning interests was 0.856, for students' classroom participation was 0.880, for students' practical abilities was 0.8735. All values were greater than 0.8, indicating high stability and consistency of the scale. This suggests that the reliability of the questionnaire in this survey study was very good. Shown in Table 3.5.

Table 3.5 Reliability analysis

Variate	Cronbach's Alpha	N of Items
Students' interest in learning	0.856	3
students' classroom participation level	0.880	3
students' practical abilities	0.873	3

### 3.5.3 Validity analysis

Validity is the examination of the effectiveness of various variables in a questionnaire survey. The commonly used method for testing the validity of a survey questionnaire is factor analysis. Factor analysis is used to determine the validity of the questionnaire. Before conducting principal component factor analysis, the questionnaire needs to undergo the Kaiser-Meyer-Olkin (KMO) test and Bartlett's sphericity test. Factor analysis can only be performed when the KMO value is greater than 0.7. The survey data showed an overall KMO value of 0.907, with a significance level of 0.000, which is less than 0.05, indicating statistical significance. This suggests that factor analysis can be conducted. The results of factor analysis for each variable indicated that the cumulative explanatory power for students' learning interests, students' classroom participation, and students' practical abilities was 0.868, which is greater than 0.5. This indicates good independence for each dimension, demonstrating the overall good validity of the questionnaire. refer to Table 3.6.

Table 3.6 KMO and Bartlett's test

A sampling of sufficient degrees of Kaiser-Meyer-Olkin	Metrics	0.868
Bartlett, the sphericity test	Approximate cardinality	1504.748
	<i>df</i>	231
	Sig.	0.000

## Chapter 4 Findings

In this study, the underlying conditions and each variable of the 165 valid samples were statistically analyzed using SPSS software. The independent variables mainly include students' interest in learning computer-aided design courses, the current situation of traditional teaching methods, and the aspect of network resources.

### 4.1 Analysis of independent variables before blended instruction (pre-test)

#### 4.1.1 Analysis of students' interest in learning and students' interest in teachers' teaching styles

Students' learning interest is a key factor in determining their learning outcomes. It is an expression of their motivation in their overall learning activities. When students are interested in their teacher's computer-aided design course and actively engage in learning, their learning efficiency and outcomes can be significantly improved. The survey results conducted by the author, as shown in Figure 4.1, provide insights into this aspect.

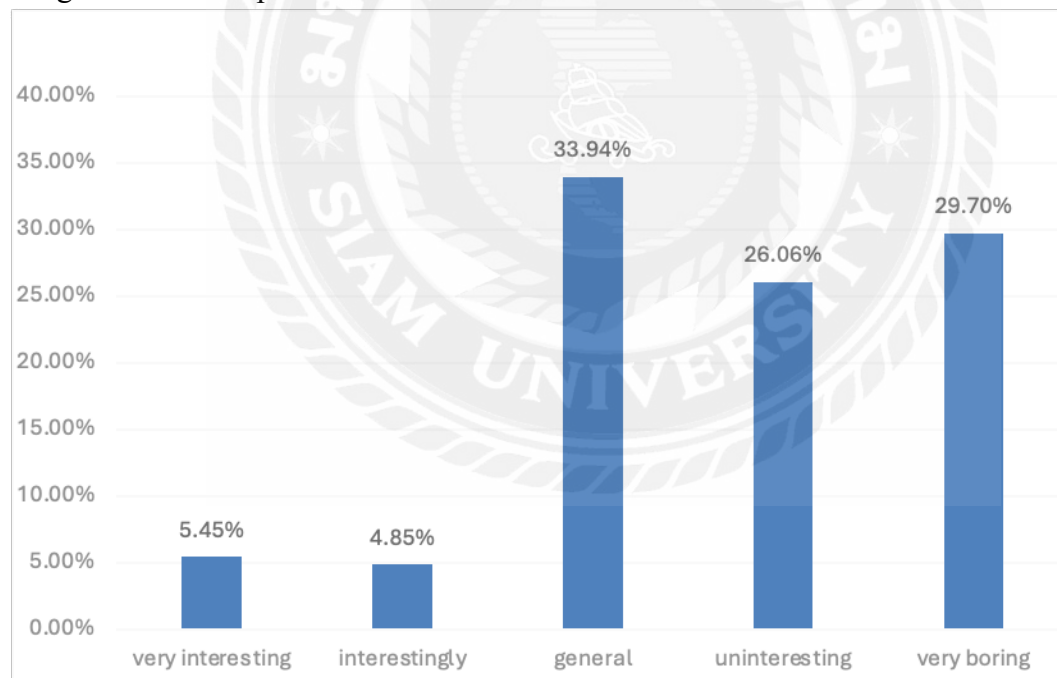


Figure 4.1 Proportional Chart of Students' Perception of the Enjoyment of Computer-Aided Design Learning.

According to the survey on students' perception of the enjoyment of computer-aided design learning, the results show that 29.7% of students find the current learning methods for computer-aided design to be extremely uninteresting, 26.06% find them uninteresting, 33.94% find them average, and only 10.3% of students find the current computer-aided design course to be interesting or very interesting. Based on these

survey results, it can be observed that more than half of the surveyed students find the course either uninteresting or average. The level of students' interest in the teacher's teaching methods is a crucial factor in determining the effectiveness of their learning outcomes.

In order to truly understand whether students have an aversion to the computer-aided design course itself or just dislike the current teaching method, the author also conducted a survey on students' level of liking for the computer-aided design course. The survey results are presented in Figure 4.2.

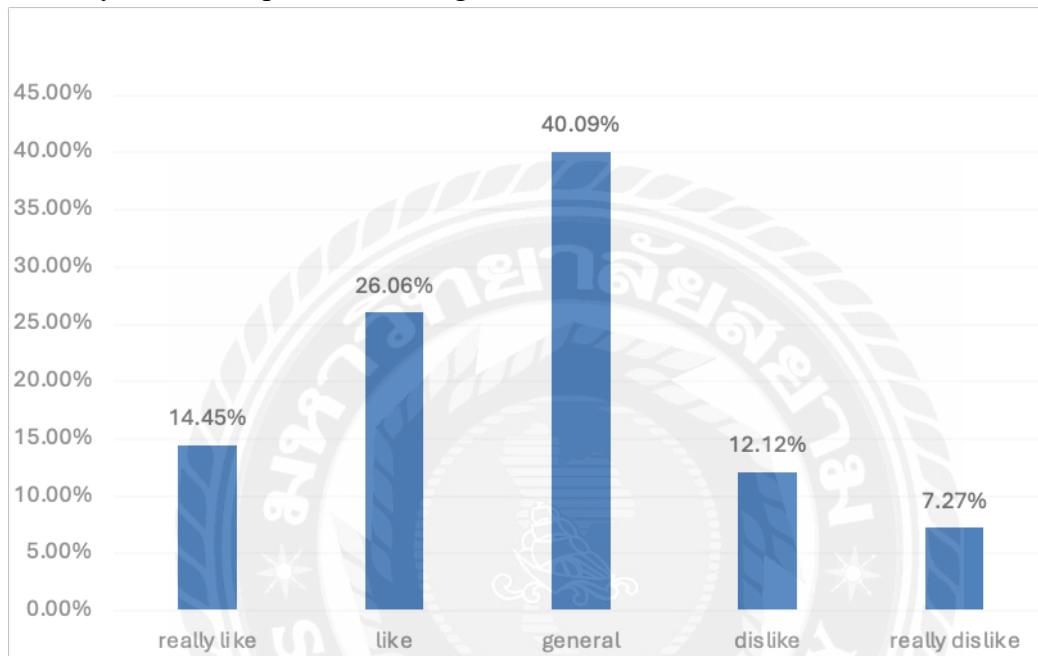


Figure 4.2 Proportional Chart of Students' Level of Liking for the Computer-Aided Design Course.

According to the survey results, it can be observed that 14.45% of students express a strong liking for the computer-aided design course, 26.06% of students like the course, 40.09% of students have a neutral level of liking for the computer-aided design course, and only a minority of 19.39% of students dislike the course and find it either annoying or extremely annoying. The above survey results indicate that the majority of students actually like the computer-aided design course but are dissatisfied with the current teaching method used by the instructor, perceiving it as uninteresting. Only a small portion of students neither like the course nor enjoy the current teaching method. Therefore, it can be concluded that it is crucial for teachers to change the traditional teaching approach, enhance students' interest and classroom engagement, and help students develop a genuine liking for the computer-aided design course in order to improve their motivation and achieve positive learning outcomes. This has become an urgent factor to address in computer-aided design education.

#### 4.1.2 Survey of the Current Status of Teaching Computer-Aided Design Courses

Understanding the current status of computer-aided design course instruction was one of the key aspects of this study. The author conducted a questionnaire survey among students to gain insights into the teaching situation of the computer-aided design course at Nanjing Commercial College. The survey results were collected, analyzed, and revealed certain issues present in both the teacher's instruction and the students' learning process.

Table 4.1 Survey Form on the Current Status of Computer-Aided Design Teaching

question	options	percentage
Currently computer-aided design instructors are using a blended approach to teaching and learning	corresponds exactly	4.24%
	conforming	15.76%
	general	16.97%
	not conforming	24.24%
	Not at all	38.79%
You believe that the teaching resources provided by computer-aided design instructors are relatively scarce at present.	corresponds exactly	27.12%
	conforming	32.42%
	general	18.97%
	not conforming	11.18%
	Not at all	10.3%
In computer-aided design classrooms, instructors often use multimedia for teaching.	corresponds exactly	23.64%
	conforming	32.73%
	general	26.06%
	not conforming	9.09%
	Not at all	8.08%

According to the table above, regarding the question of whether teachers use blended learning in their daily teaching, 4.24% of students believe that it is highly consistent with the current situation of computer-aided design teaching, as teachers have used blended learning in their instruction. However, 24.24% of students and 38.79% of students believe that the use of blended learning by teachers in computer-aided design teaching does not or hardly align with the current teaching situation.

From this, it can be seen that currently, in the process of computer-aided design teaching, teachers rarely or almost never use blended learning. Instead, they predominantly rely on traditional classroom teaching methods, where the teacher lectures in class while students listen passively. This teaching approach leads to low student engagement and excessive teacher-centered instruction, significantly compromising the quality of teaching.

Based on the analysis of the survey results regarding the question of whether the teaching resources provided by computer-aided design instructors are relatively scarce, it can be observed that 27.12% of students strongly agree and 32.42% of students agree that it is consistent with the current state of computer-aided design teaching.

Through the analysis of the questionnaire survey results, it is evident that 78.51% of students believe that the teaching resources provided by computer-aided design instructors are either scarce or average. Only 21.48% of students consider the teaching resources provided by computer-aided design instructors to be abundant or highly abundant. The scarcity of teaching resources provided by instructors remains one of the challenges in computer-aided design teaching, and providing rich teaching resources is crucial for ensuring effective student learning and teacher instruction.

With the rapid development of information technology nowadays, teachers are required to utilize the existing multimedia resources in schools for classroom teaching. In order to better understand the current usage of multimedia by teachers in computer-aided design teaching, a questionnaire survey was conducted. According to the table, it can be seen that 23.64% of students believe that it is highly consistent with the current state of computer-aided design teaching for teachers to frequently use multimedia in the classroom. 32.73% of students believe that the current usage of multimedia by teachers in computer-aided design classrooms is in line with the teaching situation. 26.06% of students believe that the frequency of teachers using multimedia in computer-aided design classrooms is average. Only 17.17% of students think that the use of multimedia by teachers in computer-aided design classrooms does not or hardly align with the current teaching situation. Through the analysis of the results, it can be concluded that currently, teachers in computer-aided design teaching frequently use multimedia devices as a teaching tool. The information technology literacy of teachers is an essential quality for their teaching activities. Although teachers use multimedia frequently, their overall information technology literacy is relatively low.

#### **4.1.3 Analysis of network resource requirements**

Blended learning combines online learning and classroom teaching, and understanding the teaching methods that students expect from teachers during the instructional process is crucial. Additionally, in this study, students are selected as the experimental subjects, and whether the types of online resources selected by teachers before class can stimulate students' interest in learning is also one of the issues that this survey research needs to address.

Moreover, the duration of online resource videos that students expect and other related factors are also important aspects of this survey questionnaire. Therefore, the author conducted the survey and research on the aforementioned questions, and the results are presented as follows.

Understanding students' approval of the types of online resources selected by teachers, such as animations and videos, before class, and whether these types of online resources can stimulate students' interest in computer-aided design learning, is also one of the key focuses of this survey research. The statistical results of the questionnaire are shown in Figure 4.3.



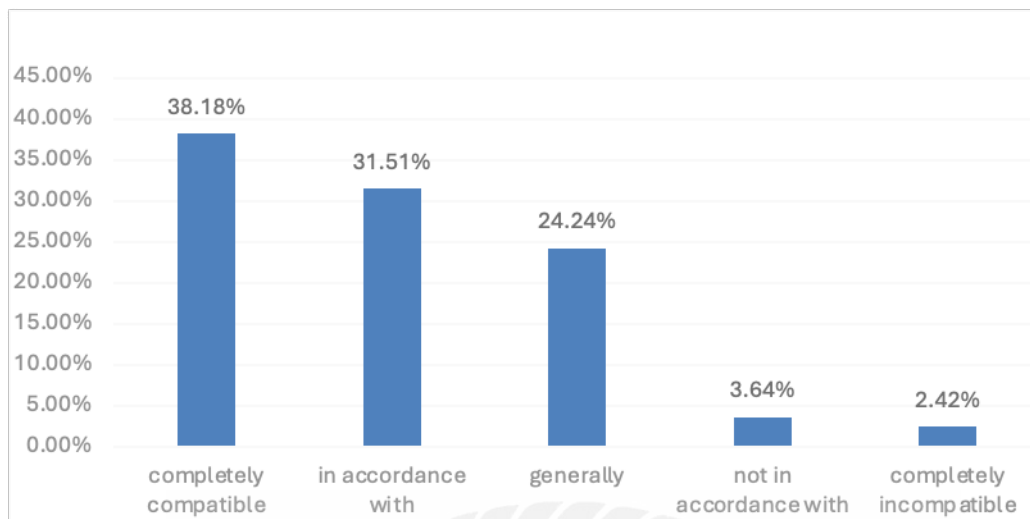


Figure 4.3 Proportional Chart of the Survey on the Effectiveness of Animation Teaching Videos in Stimulating Learning Interest.

According to the above chart, 38.18% of students strongly agree that the use of animation teaching and videos can effectively stimulate their interest in learning computer-aided design. 31.52% of students agree that these forms of teaching can meet their expectations and enhance their interest in learning computer-aided design. Only 6.06% of students think that the use of animation teaching and videos does not or hardly stimulate their interest in learning computer-aided design.

Through analysis, it can be concluded that more than half of the students believe that the use of animation teaching and videos by teachers can effectively stimulate their interest in learning computer-aided design.

Understanding students' expectations for teaching methods before class, during class, and after class is also a crucial step in computer-aided design teaching. This question allows for multiple choices, and students are free to select the teaching methods they expect. The survey results are shown in Figure 4.4.

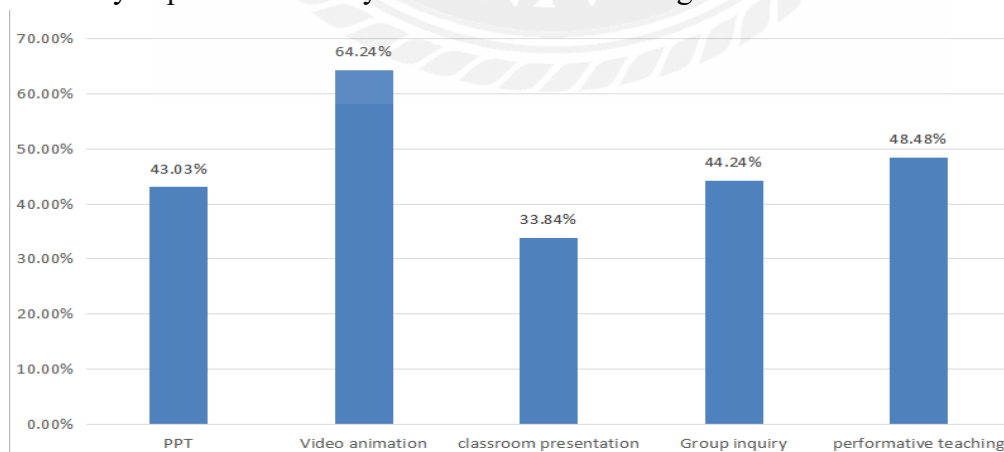


Figure 4.4 Proportional Chart of the Survey on Students' Expected Teaching Methods (Multiple Choice).

According to the above chart, 43.03% of students prefer teachers to use PowerPoint (PPT) for teaching, 64.24% of students prefer the use of videos,

animations, and similar forms, 33.94% of students prefer classroom presentations such as blackboards, 44.24% of students prefer group inquiry-based teaching, and 48.48% of students prefer teachers to use demonstration-based teaching methods. Through comparative analysis of the results, it can be observed that students' preferred teaching method is still video and animation teaching, followed by demonstration-based teaching and group inquiry. Therefore, teachers should flexibly combine various teaching methods based on specific situations during the instructional process.

## 4.2 ANOVA (Analysis of Variance) for the two groups after implementing blended learning.

### 4.2.1 Analysis of students' learning interest and students' interest in teachers' teaching methods.

The teacher's classroom teaching and students' independent learning outside of class are interrelated and mutually supportive. The instructional videos provided on the online platform serve as extensions of the teacher's classroom teaching knowledge for students' post-class exploration. Likewise, the teacher's classroom teaching provides directional guidance for students' independent learning of online resources. In this section, the effectiveness of the teaching experiment was investigated through a questionnaire survey, and the results were discussed and analyzed.

Firstly, a questionnaire survey was conducted regarding student satisfaction with the teaching resources provided by the teacher, the level of autonomy in learning, and whether it enhances students' interest in computer-aided design learning. The survey results are presented in Table 4.2.

Table 4.2 Post-test results survey statistical table for student questionnaires

No.	Title statement	corresponds exactly	conforming	Not conforming	Not at all
1	The online resources selected by the teacher have been helpful to my computer-aided design learning	23.18%	50.86%	6.84%	3.71%
2	The teacher's blended learning approach has stimulated my interest in computer-aided design learning	53.67%	27.83%	5.69%	2.40%
3	I prefer the blended learning model compared to the traditional teaching model.	23.67%	32.74%	16.80%	7.37%

According to the first item in the table, 23.18% and 50.86% of students believe that the teacher-selected online resources have been helpful to their computer-aided

design learning, indicating that the majority of students are satisfied with the resources and find them beneficial for their computer-aided design learning.

Regarding the second item, which pertains to the teacher's instructional approach stimulating students' interest in computer-aided design learning, 53.67% of students chose "strongly agree" and 27.83% chose "agree," indicating that the majority of students feel that the current teaching method employed by the teacher can indeed stimulate their interest in learning computer-aided design.

For the third item, which explores students' preference for online resource learning compared to traditional teaching methods, 23.67% and 32.74% of students expressed a strong liking or liking for the blended learning model. This suggests that, compared to traditional teaching methods, the majority of students prefer this teaching approach.

#### 4.2.2 Analysis of students' classroom participation

Table 4.3 Post-test results survey statistical table for Students' Classroom Participation

No.	Title statement	corresponds exactly	conforming	Not conforming	Not at all
4	Before class, I will independently watch videos on online platforms as per the teacher's instructions.	24.31%	34.41%	5.41%	15.15%
5	During class, I can wholeheartedly focus on the lecture and interact with the teacher.	6.30%	16.08%	27.15%	32.48%
6	After class, I will repeatedly watch the instructional videos to address the topics I do not understand.	6.97%	10.91%	13.33%	19.70%

Items 4, 5, and 6 are surveys regarding student self-directed learning. The results indicate that the majority of students will independently watch online resource videos as per the teacher's instructions before class. However, only a small percentage of students do not follow the teacher's instructions to watch MOOC videos. For item 5, regarding reviewing videos repeatedly for topics they don't understand, 27.15% and 32.48% of students selected "not applicable" or "strongly disagree," indicating that only a few students actively review videos after class. In item 6, about completing online assignments promptly after watching the videos, 19.70% and 49.09% of students chose "not applicable" or "strongly disagree," while only 6.97% and 10.91% selected "strongly agree" or "agree." These results suggest that students' self-directed learning abilities are relatively weak and may require further encouragement and guidance from the teacher.

### 4.2.3 Analysis of students' practical abilities

Table 4.4 Post-test results survey statistical table for Analysis of Students' Practical Abilities

No.	Title statement	corresponds exactly	conforming	Not conforming	Not at all
7	The blended teaching method is very engaging and can ignite my enthusiasm for learning computer-aided design. It enhances my practical abilities.	27.05%	38.72%	26.23%	2.31%
8	I am overall satisfied with the use of online resources in computer-aided design teaching. It has enhanced my level of design skills.	24.58%	28.54%	18.13%	16.67%
9	I can independently complete project-based product designs.	3.13%	6.25%	28.12%	39.58%

In item 7, 27.05% and 38.72% of students believe that the teaching style of the instructor in the videos is very engaging and can stimulate their enthusiasm for learning computer-aided design. This indicates that the majority of students find the teaching style of the instructor in the videos interesting and it ignites their interest in computer-aided design learning. When selecting MOOC videos, teachers should focus on choosing teaching videos that are engaging and captivating.

In item 8, 24.58% and 28.54% of students express their satisfaction with the use of online resource platforms for computer-aided design teaching. This indicates that the majority of students feel satisfied with the teacher's utilization of online resource platforms for computer-aided design teaching.

In item 9, 39.58% and 22.92% of students indicate that they are not yet accustomed to the student-centered teaching approach in the classroom. The majority of students expressed difficulty in adapting to the student-centered teaching format.

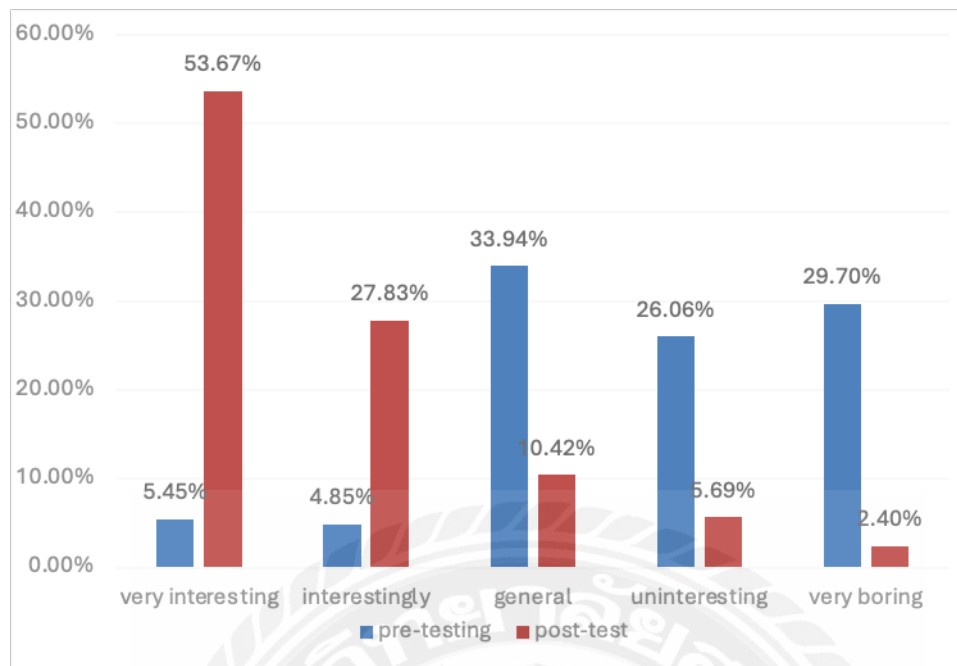


Figure 4.5 Comparison chart of perceived level of interest in the computer-aided design course between pre-test and post-test.

The paper compares the pre-test and post-test results regarding students' perception of whether the computer-aided design course is interesting and whether it can stimulate their learning interest. By comparing the questionnaire results of item 4.3 in the pre-test and item 4.5 in the post-test, it is evident that students' interest in computer-aided design learning has significantly increased in the post-test.

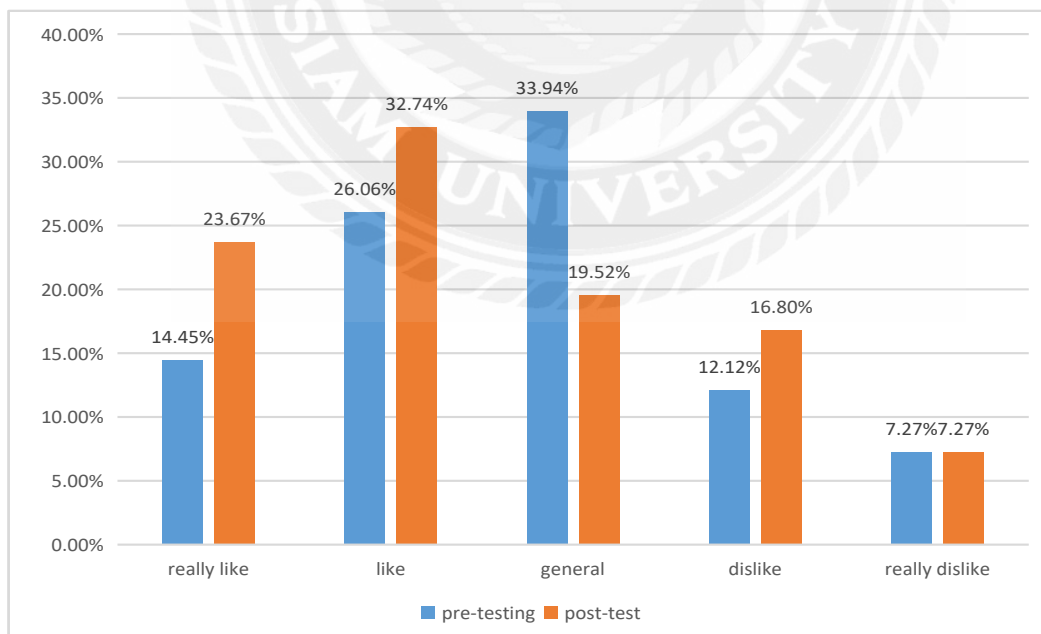


Figure 4.6 Comparison chart of the level of liking for the computer-aided design course between pre-test and post-test.

Furthermore, the paper also compares the level of liking for the computer-aided design course before and after the tests by comparing the results of item 4.4 in the pre-

test and item 4.6 in the post-test. As shown in the graph, in the post-test, most students exhibit a notable increase in their liking for the computer-aided design course compared to the pre-test.

### 4.3 Correlation Analysis

Correlation analysis aims to illustrate the relationships between variables. Pearson correlation analysis is used to examine the linear relationships between variables, with the Pearson correlation coefficient ranging from -1 to 1. The relationship between the factors influencing student nurturing in Nanjing Commercial College is illustrated through Pearson's correlation coefficient analysis. Based on Table 4, it can be concluded that the Pearson correlation coefficients for students' learning interests, classroom participation, and practical abilities are all greater than 0.5 but less than 0.9, with a significance level of  $P < 0.01$ . This indicates positive correlations between these variables.

Table 4.5 Correlation between variables (Pearson correlation matrix)

Variables	Students' interest in learning	students' classroom participation level	students' practical abilities
Students' interest in learning	1		
students' classroom participation level	.591**	1	
Students' practical abilities	.572**	.692**	1

NOTE: \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$

### 4.4 Multiple Regression Analysis

Multiple regression analysis was conducted on the data to determine the relationship between the dependent variables (students' learning interests, classroom participation, and practical abilities) and the independent variable of blended teaching reform. The regression equation was significant, with  $F=142.172$  and  $P < 0.001$ . The Durbin-Watson test value was 1.944, within the range of 1.8 to 2.2, indicating data independence and meeting the requirements for linear regression. In the collinearity diagnosis results, the VIF (Variance Inflation Factor) values for craftsmanship spirit cognition, teaching staff strength, industry-education integration, and curriculum system were 1.118, 1.091, 1.195, and 1.073, respectively. Since all VIF values were close to 1, indicating no issues with multicollinearity, the data met the requirements. Students' learning interests ( $\beta = 0.145$ ,  $P < 0.05$ ), classroom participation ( $\beta = 0.218$ ,  $P < 0.05$ ), and practical abilities ( $\beta = 0.112$ ,  $P < 0.05$ ) significantly and

positively influenced the cultivation of blended teaching methods. These variables jointly explained 57.5% of the variance in classroom participation, meeting the expectations.

Table 4.6 Multiple Regression Analysis

Item	Unstd. B	Std. Beta	t	Sig.	VIF	F	Durbin-Watson
C	3.209	-	7.506	0.000			
Students' interest in learning	0.145	0.175	4.176	0.000	1.118	142.172	1.944
students' classroom participation level	0.218	0.262	5.327	0.000	1.091	***	
Students' practical abilities	0.112	0.130	2.753	0.006	1.195		
R Square					0.579		
Adjusted R Square					0.575		

According to the multiple regression analysis, the relationships between variables can be expressed as follows:

Blended Teaching Cultivation = 3.209 + 0.145 times Students' Learning Interests + 0.218 times Students' Classroom Participation + 0.112 times Students' Practical Abilities.

Considering the questionnaire results and the comparative data from the teaching experiment, the following conclusions can be drawn:

1. Blended teaching has a positive impact on students' learning interest, supporting hypothesis H1.
2. Blended teaching has a positive impact on students' classroom participation, supporting hypothesis H2.
3. Blended teaching has a positive impact on students' development of practical abilities, supporting hypothesis H3.

## Chapter 5 Conclusion and Recommendation

### 5.1 Conclusion

This study aims to propose a solution to the challenges faced by vocational colleges, such as weak teaching staff and low level of instructional digitalization, by focusing on the current issues in computer-aided design teaching. It selects 165 students from two classes at Nanjing Commercial College as the research subjects. The study designs and empirically investigates a blended learning model based on online resources, with videos provided by the online resource platform as the main instructional materials.

Based on the research hypothesis that using a blended learning model in computer-aided design teaching can significantly improve students' interest in learning and their performance in computer-aided design, the study conducts instructional design and empirical research on blended learning in computer-aided design based on online resources. Through data analysis, including student questionnaires, student performance analysis, and teacher interviews, the following research findings are obtained:

#### **5.1.1 Blended teaching methods have a positive impact on students' learning interest.**

Teachers can release software operation demonstration short videos and various other online learning resources on the online learning platform in the form of segmented tasks and challenges. This method encourages students to engage in independent online learning by tackling these tasks and challenges. By providing rich online resources, teachers can transform students from passive recipients of traditional teaching knowledge into active explorers of teaching knowledge, thus stimulating their interest in learning and improving their abilities in computer-aided design.

#### **5.1.2 Blended teaching methods have a positive impact on students' classroom participation.**

At Nanjing Commercial College, a "3+1" blended learning model is employed in the Computer-Aided Design course. This model includes pre-class exploration, in-class guidance, post-class extension, and learning promotion through competitions. Using this teaching model has enhanced student participation.

(1) Pre-class exploration, learning before teaching, and strengthening foundations.

Teachers will upload short instructional videos on software operations and various other online learning resources in segmented tasks on the online learning platform before the class. This allows students to independently engage in online learning through completing the tasks. During the self-directed learning process, students can watch the videos according to their own needs and review any knowledge points they don't understand repeatedly. Additionally, teachers need to set



up test tasks based on the online teaching content to assess students' mastery of the online learning. After students complete the tests, a summary and discussion session should be conducted, where students summarize the tasks they have learned and raise questions and doubts for discussion. Teachers and students can communicate and exchange ideas through online learning platforms, WeChat, QQ groups, and other means of communication.

(2) In-class guidance, teaching based on learning, internalizing knowledge, and segmented teaching to enhance teaching effectiveness.

This stage focuses on skill training and task guidance, with students at the center. After students watch the instructional videos and complete online training tasks, any doubts or questions they have regarding software operations can be addressed by the teacher during class time. Once students are familiar with the basic operations of the software, the teacher will assign a series of foundational tasks in the classroom. Students are required to use their critical thinking skills and independently integrate software commands to connect individual commands together and accomplish the training tasks assigned by the teacher.

(3) Post-class extension, solidifying online learning, timely feedback, teaching to guide learning, and mutual development between teachers and students.

After the class, the teacher will organize the key points and difficulties of the knowledge points covered in the lesson. They will create short videos highlighting crucial points and methods to enhance skills for those challenging knowledge points. These videos will be uploaded to the online learning platform, allowing students to review them repeatedly after class. The teacher should also summarize the online and offline students' learning situations for this lesson and make appropriate adjustments to the subsequent online and offline teaching content based on the specific summary.

(4) Promoting learning through competitions, creating an interactive mechanism of competition, learning, teaching, and improvement.

As a highly practical and applied course, the assessment content should align teaching objectives with industry market demands. It should promote the integration of talent development and industrial growth. Based on the "3+1" blended teaching model, the course design should include a national or provincial design competition project as part of the assessment. This project aims to enhance the teaching quality through formative assessment, summative assessment, and overall comprehensive evaluation.

### **5.1.3 Blended learning methods have a positive impact on students' practical abilities.**

To improve students' hands-on practical abilities and teaching service quality in computer-aided design courses, a blended teaching reform design plan based on online resources can be implemented. The practical projects in the computer-aided design course can be divided into specific projects using project-based teaching methods, further segmented into specific tasks. This approach helps students grasp

concrete practical knowledge and complete specific practical content. Realistic projects should be selected for blended teaching based on the standards and requirements of computer-aided design practical courses.

The practical teaching objectives can be designed using the ABCD method, which stands for Audience, Behavior, Condition, and Degree. Designing teaching objectives using the ABCD method ensures that the objectives are specific, clear, and practical, facilitating teaching guidance and evaluation. The learning content of practical courses can be divided into knowledge and abilities, enabling the integration of theoretical and practical knowledge for students. Online learning resources for practical courses should be developed, incorporating the standards of computer-aided design practical courses and providing students with various forms of learning resources. These resources can include electronic lectures, documents, video resources, animations, etc. Prior to the class, students can learn the knowledge through mind maps, case studies, activities, and other methods.

The specific learning activities in the computer-aided design practical teaching process can be arranged as follows: pre-class preparation and pre-class testing; key explanations, teacher Q&A, group discussions, in-class testing, and project demonstrations during the class; post-class reflection, assignments, and further exploration after the class. The assessment methods for practical courses can include both online and offline learning achievements. Online learning achievements can be comprised of 20% for practical assignments, 15% for online tests, 15% for online learning behavior, and 10% for online discussions. Offline learning achievements can be comprised of 20% for in-class practical performance and 20% for comprehensive practical training. The final practical course grade is the sum of 60% for online assessment and 40% for offline assessment. Online learning can be monitored and managed dynamically using the "Teaching Management" module in the online platform, with online learning behavior including login frequency, online learning duration, resource browsing, and other activities.

By implementing this blended teaching reform design plan, students' hands-on practical abilities can be enhanced, and the quality of teaching services can be improved in computer-aided design courses.

## **5.2 Recommendation**

This study designed a blended teaching model based on task design and carried out the design and implementation of teaching. The effectiveness of the model was validated through quasi-experimental research methods. After a semester of teaching practice, the experimental group showed higher teaching effectiveness to some extent compared to the control group, and student satisfaction was slightly higher than that of the control group. This result suggests that this task-based blended teaching model is suitable for the implementation of computer-aided design teaching at Nanjing Commercial College. It can stimulate students' learning initiative, enhance their

application abilities, and promote their engagement in learning. It is effective to a certain extent.

Based on the analysis of the learning outcomes and teaching behaviors mentioned above, this study proposes suggestions for the blended teaching design in the following aspects.

### **5.2.1 Strengthening teachers' ability to organize blended teaching activities and enhancing students' interest in learning.**

Well-organized teaching activities can to some extent stimulate students' interest in learning, reduce learning anxiety, and encourage students to participate in the course with higher enthusiasm. Firstly, teachers should pay attention to using relevant theories of teaching methods to guide the design of blended teaching activities during the design process. At the same time, teachers should utilize the advantages of online platforms and the different temporal and spatial scopes of offline teaching to arrange teaching activities, striving to maximize the effectiveness of blended learning environments. Secondly, teachers should be aware of the role transformation in the blended learning environment, shifting away from the traditional teacher-centered role of "instructor" or "expert" to that of a teaching organizer, designer, and facilitator who provides appropriate learning support during key stages of student exploration and collaborative work. Finally, teachers should ensure timely feedback and assessment in the blended learning environment. As indicated by students' feedback and suggestions in this study, timely feedback from teachers serves not only as an evaluation of students' learning level but also as a motivation for students to continue participating in the course.

### **5.2.2 Integrating of online and offline blended teaching methods with traditional teaching methods to promote deep learning and increase students' classroom participation.**

Blended learning environments differ from traditional face-to-face classroom teaching, as students become the owners of their learning in the classroom. From a constructivist perspective, effective learning occurs when complex and real-life situations are created, and triggering events provide a good way for teachers to encourage students to apply their existing knowledge and experiences to problem-solving. Online teaching emphasizes the creation of learning environments and the introduction of topics. Students' understanding and engagement with the topics before class can promote further exploration offline. On the other hand, the resolution of deep learning problems offline relies on students integrating their existing knowledge and engaging in interactive communication with peers to seek solutions.

Different types of courses determine the different contextual settings, exploration methods, and problem-solving approaches in blended learning. In practical courses, for example, the blended translation tasks designed by teachers do not demand a single "best" answer in the original text from students. Instead, they encourage students to explore "better" answers through collaboration, providing an excellent opportunity for students to cooperate and integrate perspectives.

Therefore, by effectively combining online and offline blended teaching methods with traditional teaching methods, deep learning can be promoted, and student engagement can be increased.

### **5.2.3 Building an online platform to enhance the blended teaching reform design based on online resources and continuously improving students' practical abilities and teaching service quality.**

To make full use of online resources, it is necessary to build an online platform. The resources should be organized and processed to form multiple modules such as online teaching, online resources, and communication. Each module should ensure its functionality. As computer science disciplines in universities often require practical abilities, teachers should start from cultivating students' practical operation abilities. By utilizing the online platform, students are expected to solidify their theoretical foundations and enrich their practical experience through actual operations. Teachers can comprehensively understand students' weaknesses and identify teaching problems through the feedback provided by the platform, thus improving teaching accordingly.

From a macro perspective, remote teaching on the online platform can be divided into two main categories. The first category is real-time teaching, which can be conducted in a one-on-one or one-to-many mode. Through the screen, teachers can communicate with students, creating zero-distance communication between them. The second category is non-real-time blended teaching based on online resources, which has a wider scope and higher participation. In this mode, teachers publish relevant courseware or tutoring materials online, and when students have related needs, they can search for them online. This helps promote systematic learning for learners, similar to the knowledge framework in classroom teaching. This teaching system has a broader application scope and is widely explored in modern computer teaching in universities.

In this study, the implementation process of teaching was critically reflected upon. The advantages of task-based blended teaching were summarized, providing case references and teaching implementation suggestions for future teaching practices. It also offers recommendations for the theoretical design and practical development of blended teaching in specific disciplines.

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## Appendix

### Questionnaire on the Basic Situation of Computer-Aided Design Teaching

Dear students, hello, thank you for filling out this questionnaire! This questionnaire is anonymous and does not have correct results, you can choose directly according to your own situation. At the same time, the results of this questionnaire are only for my own research, the questionnaire information will be kept strictly confidential, so please feel free to fill out the questionnaire. I would like to express my heartfelt thanks to the students for their support.

#### 一、Your basic information

1. Gender

- A. Male
- B. Female

2. Age

- A. 20 years old
- B. 21 years old
- C. 22 years and above

#### 二、Survey on the teaching of computer-aided design

3. You think your foundation in computer-aided design

- A. very bad
- B. Bad
- C. average
- D. good
- E. Excellent

4. Your attitude towards the current computer-aided design learning is

- A. Very interesting
- B. Interesting
- C. General
- D. uninteresting
- E. Very uninteresting

5. You think the current computer-aided design course

- A. very interesting
- B. Interesting
- C. average
- D. uninteresting
- E. very uninteresting

6. Where do you think you are currently struggling in your computer-aided design studies

- A. Words
- B. Speaking



- C. Listening
  - D. Grammar
  - E. All of the above
7. Computer-aided design instructors are currently using a blended approach in their teaching process
- A. corresponds exactly
  - B. conforming
  - C. generally
  - D. not conforming
  - E. Not at all
8. you think that the current teaching resources provided by computer-aided design teachers are relatively scarce
- A. corresponds exactly
  - B. conforming
  - C. generally
  - D. not conforming
  - E. Not at all
9. In computer-aided design classrooms, teachers often use multimedia to teach.
- A. corresponds exactly
  - B. conforming
  - C. generally
  - D. not conforming
  - E. Not at all
10. You think animations and videos are more likely to stimulate your interest in learning computer-aided design
- A. corresponds exactly
  - B. conforming
  - C. generally
  - D. not conforming
  - E. Not at all
11. in what ways do you expect teachers to teach computer-aided design? (Multiple choice question)
- A. PPT
  - B. Video, animation
  - C. Classroom presentation
  - D. Group inquiry
  - E. Performative teaching
12. have you learned about online resources?
- A. I know and have studied
  - B. Know and have not studied
  - C. Learned online but don't know whether it is or not
  - D. Don't know
  - E. Not interested in knowing

13. According to the actual situation, how long do you think it is appropriate to play the video of online resources in the computer-aided design class?

- A. Within 5 minutes
- B. 5-10 minutes (including 10 minutes)
- C. 10-15 minutes (including 15 minutes)
- D. 15-20 minutes (including 20 minutes)
- E. More than 20 minutes

### 三、 Investigation of Influencing Factors in the blended learning approach in Chinese Vocational Schools

#### Survey of Influencing Factors at the Vocational School Level

Item		Level of Compliance				
		Highly Compatible	Moderately Compatible	general	Moderately Incompatible	Highly Incompatible
<b>The Current Status of Computer-Aided Design Teaching</b>						
1	Currently computer-aided design instructors are using a blended approach to teaching and learning.					
2	You believe that the teaching resources provided by computer-aided design instructors are relatively scarce at present.					
3	In computer-aided design classrooms, instructors often use multimedia for teaching.					
<b>Students' interest in learning</b>						
4	The online resources selected by the teacher have provided certain assistance to my computer-aided design learning.					
5	The teacher's blended teaching approach has sparked my interest in computer-aided design learning.					
6	Compared to traditional teaching methods, I prefer the blended teaching approach.					

<b>students' classroom participation level</b>						
7	Before class, I will independently watch videos on online platforms as per the teacher's instructions.					
8	During class, I can wholeheartedly focus on the lecture and interact with the teacher.					
9	After class, I will repeatedly watch the instructional videos to address the topics I do not understand.					
<b>students' practical abilities</b>						
10	The blended teaching method is very engaging and can ignite my enthusiasm for learning computer-aided design. It enhances my practical abilities.					
11	I am overall satisfied with the use of online resources in computer-aided design teaching. It has enhanced my level of design skills.					
12	I can independently complete project-based product designs.					

The questionnaire is now concluded.  
Thank you once again for your assistance and support!