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The Impact of Blended Teaching in Computer Fundamentals Under the Online Learning Platform on College Students' Learning Outcomes

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Abstract

Background and Aim: With the rapid development of technology, online learning platforms have become important tools in the field of education, having a profound impact on traditional teaching methods. This study aims to construct a blended teaching model for computer fundamentals based on the 5Y online learning platform, exploring its effects on enhancing students' learning outcomes (theoretical knowledge, practical skills, attendance, and interactive participation). Additionally, the study analyzes students' perceptions of blended learning in computer fundamentals under this platform.

Materials and Methods: This study adopts a mixed-method research approach, combining quantitative research through quasi-experiments and qualitative research through face-to-face interviews. A total of 84 first-year students from Zhanjiang University of Science and Technology, Guangdong Province, China, were selected using purposive sampling during the 2023 academic year. The quasi-experiment divided the students into a control group (42 students) and an experimental group (42 students). The experimental group engaged in blended learning using the 5Y online learning platform, while the control group received traditional teaching. Data were collected through performance tests, attendance records, participation scores, and face-to-face interviews, and analyzed using descriptive statistics, independent sample t-tests, and thematic analysis.

Results: The results show that blended learning in computer fundamentals using the 5Y online learning platform significantly outperforms traditional face-to-face teaching in improving students' learning outcomes. The experimental group demonstrated significant advantages in enhancing theoretical knowledge, practical skills, attendance, and interactive participation. Compared to the control group, all improvement dimensions (theoretical knowledge, practical skills, attendance, and interaction) had p-values less than 0.05, indicating statistically significant differences. Furthermore, students expressed positive attitudes toward the learning experience in this blended teaching model.

Conclusion: Blended teaching based on the 5Y online learning platform shows a significant advantage in improving learning outcomes in computer fundamentals courses, providing students with a positive learning experience. These findings provide important insights for future digital teaching strategies and research.

Keywords: 5Y Online Learning Platform; Computer Fundamentals Course; Blended Learning; Learning Outcomes

Introduction

In the era of rapid technological advancement, online learning platforms have become essential tools in the education sector, driving profound transformations in traditional teaching models (Anderson & Dron, 2011). This change has had a significant impact on university teaching, particularly in higher education (Garrison & Kanuka, 2004). In the late 1990s and early 21st century, the widespread application of the Internet provided a platform for online learning (Harasim, 2017). Educational institutions began to use the Internet to offer courses and resources, promoting the development of distance and online learning. The introduction of online learning platforms enabled educational institutions to manage courses, student information, and learning resources more efficiently, improving both teaching efficiency and the student experience (Al-Fraihat et al., 2020). During the outbreak of the pandemic, online learning platforms served as a solution for remote education, ensuring the continuity of students' academic progress (Bozkurt et al., 2020). The pandemic spurred the demand for online education, driving continuous innovation and

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development of online learning platforms and educational technology tools. More researchers began to focus on the effectiveness of online education, particularly its impact on student learning outcomes (Dhawan, 2020). Educational technology continues to innovate and evolve, providing increasingly rich, personalized, and efficient learning experiences for both students and educators (Weller, 2020). With technological advancements, the future development of educational technology will continue to be influenced by new technologies and the evolving demands of education. In addition, increases in student involvement, academic achievement, and flexibility have been demonstrated by Georgia State University and the University of Central Florida's successful blended learning initiatives (Siphai & Siphai, 2024). To benefit from new technologies, it is essential to integrate them and solve pedagogical and technological challenges. To optimize blended learning and satisfy the evolving demands of instructors and students, ongoing research and support mechanisms will be required.

General education aims to cultivate well-rounded competencies in students, equipping them with interdisciplinary knowledge, thinking, and skills (Association of American Colleges and Universities, 2013). In the age of technology, introducing computer literacy education in higher education focuses on developing students' computational thinking and computer science literacy (Wing, 2008). Through computer literacy teaching, students can better understand and address the challenges of today's technology-driven society. Computational thinking is not exclusively for computer science majors but is a general cognitive skill necessary for the digital age, applicable across various fields (Barr et al., 2011). The computer fundamentals course, as the first computer literacy course for freshmen in Chinese universities, provides significant support for computer literacy education (O'Leary & O'Leary, 2020).

The computer fundamentals course equips students with the basic tools and methods to master computer applications. The course introduces the fundamental concepts and skills of computer science and information technology, mainly covering five aspects: basic knowledge, operating systems and network usage, word processing, data processing, and presentation design. Whether it is searching for literature online, sending files remotely, exchanging emails, writing theses, creating data forms, or designing presentations, solid foundational computer knowledge and skills are essential (Lizhen & Fan, 2020). This course is crucial for students to acquire basic IT skills and enhance their academic and career abilities (Wang, 2020).

However, the traditional teaching of the course faces some challenges: 1) The teaching relies primarily on traditional lecture-based methods, where teachers deliver knowledge through lectures and students mainly passively receive it. This single teaching method may lead to low student engagement and limited interaction opportunities. 2) Student absenteeism, leaves of absence, and missed exams are not uncommon on campus. To improve classroom outcomes, it is necessary to track student attendance and implement effective attendance management to eliminate negative impacts on the normal classroom order. Strict attendance control is key to ensuring student participation and improving overall teaching effectiveness. 3) Students' theoretical knowledge may be insufficient, their flexibility in practical operations lacking, and their comprehensive application abilities need improvement. The current focus on theory over practice cannot meet the requirements of the new teaching plan and curriculum structure. 4) The personalized needs of students are not adequately addressed. Due to the single teaching model, students' different levels of understanding, learning interests, and subject requirements may not receive sufficient attention. Students desire an environment that fosters personalized learning, improves learning efficiency, provides positive feedback, and integrates the course with their major to enhance their overall learning experience.

To address these challenges, researchers proposed a blended teaching model that incorporates the 5Y online learning platform. This model not only integrates the flexibility of online learning but also enhances interaction inside and outside the classroom, providing a more personalized and efficient learning experience for students (Means et al., 2013). The 5Y online learning platform, as an emerging online learning tool, offers rich learning resources, interactive functions, quiz tools, and other diverse features such

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as progress tracking, learning analytics, and instant feedback, making it an ideal choice for implementing a blended learning model (Hew & Cheung, 2014).

This study aims to address the following research questions:

1. How to implement blended computer fundamentals teaching using the 5Y online learning platform at Zhanjiang University of Science and Technology?

2. What differences exist in learning outcome improvements (including theoretical knowledge, operational skills, attendance, and interactive participation) between students undergoing blended learning in computer fundamentals on the 5Y platform and those undergoing traditional learning?

3. What is the student's perception of learning computer fundamentals through blended learning using the 5Y learning platform?

The study will establish a blended teaching model based on the 5Y online learning platform, compare this model with traditional face-to-face teaching in terms of improvements in student learning outcomes (including theoretical knowledge, practical skills, attendance rates, and interaction engagement), and evaluate the effectiveness of the blended teaching model. In addition, the study will analyze students' perceptions of blended learning based on the 5Y platform and further improve teaching based on feedback. This research will provide empirical support for optimizing digital teaching strategies, enhancing academic performance, and meeting educational needs, contributing to the improvement of teaching methods, better student learning outcomes, and the continuous development of higher education.

Objectives

1. To construct a blended teaching model for computer fundamentals based on the 5Y online learning platform, aiming to enhance students' learning outcomes in terms of theoretical knowledge, practical skills, attendance, and interactive participation.

2. To explore the differences in learning outcomes (including theoretical knowledge, practical skills, attendance, and interaction) between the blended teaching model based on the 5Y learning platform and traditional face-to-face teaching for first-year students, and evaluate the improvement scores across these dimensions to validate the effectiveness of the blended model.

3. To explore students' perceptions of blended learning in the computer fundamentals course under this platform, including satisfaction with platform features, operational difficulties, experiences, and gains, as well as suggestions for improvement.

Literature review

Theory of Technology Integration

In the field of education, the theory of technology integration emphasizes the incorporation of various technologies, including information technology, into the educational process to promote a more effective and enriched learning experience (Roblyer & Doering, 2013). As a theoretical framework, it guides the organic combination of different technologies, systems, or resources to achieve higher levels of functionality or goals. This process highlights the creation of a synergistic effect through the integration of various technological elements, surpassing the individual performance of each component. Garrison and Kanuka (2004) pointed out that the theory of technology integration emphasizes the effective combination of technology with traditional teaching methods to enhance learning outcomes.

TPACK Framework

The TPACK (Technological Pedagogical Content Knowledge) framework originated from research on the integration of educational technology and was proposed by American educational technology scholars Punya Mishra and Matthew J. Koehler in 2006. The core idea of the framework is that to effectively integrate and apply technology in teaching, educators need to have knowledge of technology, pedagogy, and content, and understand the interrelationships between them. This comprehensive knowledge enables teachers to better select, design, and implement technology-supported teaching strategies (Mishra & Koehler, 2006; Koehler & Mishra, 2008). The introduction of the TPACK framework marked an expansion

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of traditional educational technology integration models, making it more comprehensive and targeted. Over time, the TPACK framework has been widely applied in educational technology research and practice. Researchers continue to deepen and expand the TPACK theoretical framework to adapt to different educational contexts and technological developments.

When educators apply the TPACK framework, they consider how to integrate technology (T), pedagogy (P), and content knowledge (CK) to more effectively design and implement teaching activities. Graham (2011) explored the factors involved in understanding TPACK at a theoretical level, providing educators with a deeper perspective on better understanding and applying the TPACK framework. Niess (2011), through studying the growth of educators' knowledge when using technology, demonstrated how the TPACK framework helps educators gradually develop pedagogical knowledge. These applications illustrate how educators consider and integrate various aspects of the TPACK framework in actual teaching to improve the quality and adaptability of instruction.

Blended Learning

Blended learning is a teaching model that combines traditional face-to-face instruction with online learning (Garrison & Kanuka, 2004). While the concept of blended learning may seem simple, its actual application is quite complex (Garrison and Vaughan, 2008). Blended learning is not merely the simple overlay of information technology and educational instruction; it involves the deep integration of information technology with teaching through organic instructional design, becoming an effective teaching method. In blended learning, teachers combine traditional classroom instruction with online platforms, digital tools, and internet resources to provide a more diverse, flexible, and personalized learning experience (Garrison & Kanuka, 2004). This teaching method aims to leverage the advantages of technology, allowing students to learn more flexibly (Pérez et al., 2011) while promoting interaction and practice within the face-to-face classroom environment (Wang et al., 2009).

Constructivist Theory

Bada and Olusegun (2015) pointed out that constructivism is an important concept in the field of education. Constructivism emphasizes learner-centered learning and advocates for learners to actively engage in thinking, problem-solving, and constructing knowledge structures to acquire information, rather than passively receiving information transmitted by teachers (Fosnot, 1996; Steffe & Gale, 1995). Individuals construct knowledge through interaction, collaboration, and communication with others (Bada & Olusegun, 2015). In educational practice, constructivist theory encourages the use of open learning environments, where students are encouraged to participate in problem-solving, project-based learning, and collaborative activities (Brooks & Brooks, 1999).

Conceptual Framework

The conceptual framework of the study is shown in Figure 1.

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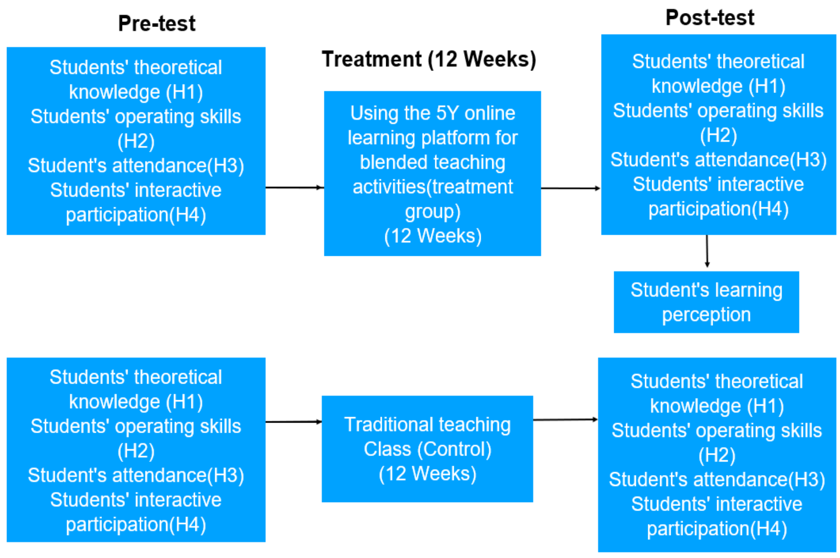

Figure 1 Conceptual Framework of the Study

Based on the conceptual framework, the research hypotheses are formulated as follows:

$H_0$1: There is no difference in theoretical knowledge improvement scores between students receiving blended learning with the 5Y learning platform in computer fundamentals and those receiving traditional learning.

H_a1: There is a difference in theoretical knowledge improvement scores between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.

$H_0$2: There is no difference in operational skills improvement scores between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.

H_a2: There is a difference in operational skills improvement scores between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.

$H_0$3: There is no difference in attendance improvement scores between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.

H_a3: There is a difference in attendance improvement scores between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.

$H_0$4: There is no difference in interactive participation improvement score between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.

H_a4: There is a difference in interactive participation improvement scores between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.

Methodology

Research Design

This study adopts a mixed research method, combining quasi-experimental design and interview research. The quasi-experimental portion aims to explore the differences in learning outcomes (including theoretical knowledge, practical skills, attendance, and interaction) between freshman students under blended learning using the 5Y learning platform and those under traditional face-to-face teaching, assessing

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the improvement scores across various dimensions to validate the effectiveness of the blended learning model. The participants were divided into an experimental group and a control group. The experimental group engaged in blended learning via the 5Y online learning platform, while the control group followed the traditional teaching method. Both groups underwent a 12-week course taught by the same instructor. Pre- and post-tests were conducted for both groups, and independent samples t-tests were used to evaluate the differences in learning outcomes between the two groups. The study content was based on the syllabus for the Chinese University Computer Proficiency Test (Guangdong District) Level I "Computer Applications (MS Office 2016)" and the 2022 revised syllabus of the "Basic Computer Course" at Zhanjiang University of Science and Technology.

The interview research focuses on exploring freshman students' perceptions of blended learning in the basic computer course using the 5Y learning platform at Zhanjiang University of Science and Technology. Thematic analysis was employed to analyze the data.

Research Treatment

The following is the research process adopted during the study, with each procedure serving a specific purpose. The instructional activities will span 12 weeks.

In the experimental group, the 5Y Learning Platform will be utilized as a tool to enhance the efficiency and effectiveness of blended learning. Employing teaching methods under the 5Y Learning Platform will offer students a novel learning experience. This involves the use of advanced educational technology and online resources. The 5Y Learning Platform ensures the provision of course instructional resources, process tracking, strategy application, and result analysis during the teaching process, promoting student participation and interaction. A 12-week student learning plan has been designed, arranging learning tasks and exercises based on the plan to strengthen student interaction, foster learning, and enhance learning outcomes. The detailed 12-week learning plan for the experimental group is outlined in Table 1. In the control group, traditional teaching methods are employed, emphasizing face-to-face instruction. Students will complete their learning through traditional textbooks and classroom interactions.

Students in the experimental group will take a pre-test using the CCT matching question bank provided by the 5Y Learning Platform. The test will include both theoretical and practical components. Performance testing will be conducted through a unified CCT examination organized by the Guangdong Provincial Department of Education, with the test scores used to assess academic performance. Interactive participation scores will be used to evaluate student learning outcomes. The 5Y Learning Platform's features, including discussion posts, test feedback, process tracking, and assignments, will be used to record interactive participation for the experimental group. Interactive participation includes two parts: the first part involves participating in classroom Q&A and thematic discussions, and the second part involves completing in-class exercises and assignments. The first recorded interactive participation score on the platform will serve as the pre-test score for interactive participation. The average of the 5 interactive participation scores will be used as the post-test score for interactive participation. Attendance will be recorded using the attendance feature on the 5Y Learning Platform. The first recorded attendance score on the platform will serve as the pre-test score for attendance. The average of the 10 attendance scores will be used as the post-test score for attendance.

For the control group, theoretical and operational skills scores will be assessed using paper-based tests with the same content for pre-testing and through the CCT examination for post-testing. Interactive participation and attendance scores will be recorded using teaching logs and attendance records. The first recorded interactive participation and attendance scores will be used as pre-test scores for the control group. The average of 5 recorded interactive participation scores will be used as the post-test score for interactive participation, and the average of 10 recorded attendance scores will be used as the post-test score for attendance.

After the performance tests, interviews are conducted with 10 students from the experimental group to understand their learning experiences and feedback, with proper data recording and analysis.

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Table 1 Student Learning Plan

weeks	student	Offline teaching content	The instructional content on the 5Y learning platform
	Conduct a pre-test before the start of the teaching session.		
1		Computer development Computer composition and technical indicators Basic working principle of computer	Computational thinking
2		Data representation and storage Number system conversion	Network security and regulations
3		Operating system concept and basic operation	Use of common software
4	The 84 first-year students of Zhanjiang University of Science and Technology in the year 2023	Word Basic Functions Document Editing Basics Document Format Settings	Document input
5		Long document editing	Insertion and setting of elements in documents
6	In 12 weeks, the control group will use traditional teaching, and the experimental group will use blended teaching within the 5Y learning platform to complete the course learning.	Mail Merge Multi-window and multi-document	Document review revision
7		Worksheet data entry worksheet formatting	Basic Excel
8		The basic function of data analysis and application	Excel Chart Application
9		Presentation editing Insert Element Action for Presentation	PowerPoint Overview
10		Show of presentation	Insert a picture to create an album.
11		Application of Internet	Fundamentals of Computer Network
12		digital media	New technology of computer application
	The final exam will be used as a post-test		
	The experimental group will select 10 students to be interviewed to understand the learning experience of students in blended learning.		

Both the experimental and control groups have adopted "pre-class, in-class, post-class" teaching designs. The following is a detailed description of the teaching in the experimental group:

Pre-Class:

Before the class, the teacher pushes learning tasks to students based on the study plan, taking approximately 20 minutes. The learning tasks complement the classroom teaching content without repetition. Students complete the learning tasks through the 5Y Learning Platform, engaging in self-directed

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learning. The learning videos can be reviewed multiple times, and exercises can be practiced repeatedly. The platform records students' progress in video learning and exercise completion. This stage's design intends to focus on students, promoting proactive and engaged learning. The teacher also prepares relevant classroom questions, exercises, and discussion topics for use during the class.

In-Class:

During the class, the blended teaching under the 5Y Learning Platform divides the teaching time into multiple segments. The teacher begins with a 5-minute attendance check and reviews, helping students recall previously learned content to prepare for new material. This facilitates students' understanding of the connections between prior and current knowledge, allowing them to grasp the course's overall structure. Subsequently, the teacher spends approximately 25 minutes presenting new knowledge and skills and explaining key and challenging points. Students concentrate on learning new information and skills, striving to make breakthroughs at critical and difficult points, fostering learning, and satisfying students' curiosity and freshness. Following that, the teacher interacts with students for about 15 minutes based on pre-class learning, including progress tracking, timed Q&A, theme discussions, and classroom exercises. The teacher manages the pace of the class to create a sense of novelty, urgency, and tension for all students, achieving a sense of achievement for most students and honor for a few. Students actively participate, understand each other's learning progress, reinforce knowledge, and systematize fragmented knowledge. The 25-minute teaching and 15-minute interaction segments are repeated twice, and the final 5 minutes consist of summarizing the class, reviewing the content, and assigning new pre-class learning tasks and post-class assignments. Students review the class content and record new pre-class learning tasks. This helps both teachers and students clarify their thoughts and strengthen memory.

Post-Class:

After the class, students review, identify gaps, and complete assignments. The teacher guides and encourages students to complete assignments diligently. Students actively complete assignments by watching instructional videos on the 5Y Learning Platform, searching for information, and reflecting continually. The goal is to consolidate learned knowledge, enhance problem-analysis and problem-solving abilities, and cultivate students' innovative thinking.

Research Population

The research population consists of 2,000 first-year students from the 2023 cohort at Zhanjiang University of Science and Technology who are required to take the computer fundamentals course. These students were admitted through the national college entrance examination, aged between 18 and 20, and are from China. During their secondary education, they had only brief exposure to computer courses and possessed limited knowledge and skills in computing. Additionally, they have a preliminary understanding of the university learning environment but have not previously used the 5Y online learning platform.

Sample

The sample includes 84 first-year students from the 2023 cohort at Zhanjiang University of Science and Technology who are required to take the computer fundamentals course. These students are divided into an experimental group and a control group, with each group consisting of 42 students. Both groups will receive 12 weeks of instruction from the same teacher, with the experimental group using the 5Y learning platform for blended learning, while the control group will use traditional face-to-face teaching methods.

Sampling Technique

In this quasi-experimental study, purposive sampling was used to select 84 first-year students from the 2023 cohort at Zhanjiang University of Science and Technology. These students admitted through the national college entrance examination, are required to participate in the computer fundamentals course and are aged between 18 and 20. They have not previously used the 5Y online learning platform and have high school entrance exam scores ranging from 460 to 480, showing significant homogeneity. This homogeneity allows for an in-depth examination of the instructional impact of blended teaching with the 5Y online learning platform on this homogeneous student group. Random sampling was used to select 10 students from the experimental group for face-to-face interviews.

Research Instruments

The research instruments for this study include performance tests, attendance performance, participation scoring, and face-to-face interviews.

Performance tests will assess students' theoretical knowledge and practical skills. Students in the experimental group will take a pre-test using the CCT matching question bank provided by the 5Y Learning

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Platform, including both theoretical knowledge and practical skills. The control group will use paper-based tests with the same content as the pre-test. Both groups will participate in the CCT examination organized by the Guangdong Provincial Department of Education after 12 weeks of learning for the post-test. The test scores will be used to evaluate academic performance in theoretical knowledge and practical skills, with the test scores accounting for 50% of the total course grade. The CCT exam, which is a national standardized exam for assessing students' computer application knowledge and skills, will follow the examination syllabus for Level I "Computer Applications (MS Office 2016)" for Guangdong Province. This ensures that the test accurately reflects students' performance levels.

Attendance performance and participation scoring will evaluate students' attendance and interactive participation. Scoring will follow the process learning assessment standards outlined in the computer fundamentals course syllabus at Zhanjiang University of Science and Technology. Participation includes classroom Q&A and thematic discussions, as well as in-class exercises and assignments. For the experimental group, attendance and participation will be recorded through the 5Y Learning Platform, using features such as attendance tracking, discussion posts, test feedback, and assignments. For the control group, attendance and participation will be recorded by the teacher and compiled in teaching logs and attendance records. Participation records will be collected bi-weekly, with the first record serving as the pre-test score and the average of five records as the post-test score. Attendance records will be collected weekly, with the first record serving as the pre-test score and the average of ten records as the post-test score. Attendance will account for 10% of the total course grade, while participation will account for 40%. This standard, developed through in-depth discussions with computer science professors at the university, aligns with internationally recognized standards for university course assessment and is recognized as a valid and reliable assessment criterion.

To understand students' learning perceptions of blended teaching with the 5Y online learning platform and to further optimize instructional technology integration and improve student satisfaction, face-to-face interviews will be conducted with 10 randomly selected students from the experimental group after the final exam. The interviews will be recorded and analyzed using thematic analysis to ensure continuous improvement of the course. The interview questions are as follows:

1. Question 1: What features or design aspects of this online learning platform do you find particularly satisfying?
2. Question 2: What operational difficulties have you encountered while using this online learning platform?
3. Question 3: What experiences and tips can you share when using this online learning platform?
4. Question 4: What are your feelings and gains during this blended learning process in the Computer Fundamentals course?
5. Question 5: What aspects of the blended learning in the Computer Fundamentals course do you think need improvement?

To understand students' perception of the blended learning approach for basic computer science under the 5Y online learning platform, further optimize the integration of teaching technologies, and enhance student satisfaction, interviews will be conducted with 10 students from the experimental group after the final exam. The results of the interviews will be recorded to ensure continuous improvement of the course.

The Content Validity of the interview questions was assessed using the Scale Content Validity Index (S-CVI). Four recruited experts conducted the review of the interview questions. According to Polit and Beck (2006), 3-5 experts reviewing with a rating of 1.00 are suitable for evaluating the content validity of the interview.

The results of the expert review will be presented in Table 2.

Table 2 The results ratings on a 5-Item Scale by Four Experts: Items Rated 3 or 4 on a 4-Point Relevance Scale

Item	Expert 1	Expert 2	Expert 3	Expert 4	Number in Agreement	Item CVI
1	4	3	4	4	4	1.00
2	4	4	4	3	4	1.00

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Item	Expert 1	Expert 2	Expert 3	Expert 4	Number in Agreement	Item CVI
3	4	4	3	4	4	1.00
4	4	4	4	4	4	1.00
5	4	4	4	4	4	1.00
Proportion Relevant:	1.00	1.00	1.00	1.00	Mean I-CVI = (1+1+1+1+1)/5 = 1.00	

In summary, the interview comprising five questions, utilizing a 4-point scale (1=not applicable at all, 2=not applicable, 3=applicable, 4=very applicable), underwent evaluation by four experts. The results indicated that experts predominantly assigned ratings of 3 and 4. In the process of calculating the Content Validity Index, ratings of 1 and 2 were grouped, and ratings of 3 and 4 were grouped. Consequently, the effectiveness calculation for individual items of the interview (I-CVI) was 1.00, aligning with the S-CVI procedure's requirement that ratings of 3 or 4 are acceptable. Furthermore, when there are five or fewer judges, I-CVI should be 1.00 (Polit and Beck, 2006). The average of I-CVIs was computed by summing the Content Validity Index of individual items (I-CVI) and dividing by the number of items: (1.00+1.00+1.00+1.00+1.00)/5 = 1.00.

Based on the expert evaluation results, all items in the interview questions received a score of 1, indicating their suitability. Therefore, following the standards of Polit and Beck (2006), these items are considered valid.

Data Collection

Prepare research instruments, including teaching plans, tests, and interview questions.

Conduct pre-tests for both the experimental and control groups to establish baseline data. The experimental group will take a pre-test using test papers generated from the CCT question bank provided by the 5Y Learning Platform, while the control group will use paper-based test papers with identical content. The tests will cover theoretical knowledge and practical skills, including multiple-choice questions, Windows operation questions, Word operation questions, Excel operation questions, PowerPoint operation questions, and network questions.

Implement teaching activities according to the teaching plan, with separate teaching for the experimental group and the control group. The teaching activities will take place in integrated classrooms, where the teacher will use a teacher's computer and projector for instruction, and students will use their computers for practice and participation. Pre-class and post-class learning activities will be carried out on students' individual computers.

After the teaching activities, conduct post-tests for both the experimental and control groups. Students in both groups will take a post-test using the CCT exam organized by the Guangdong Provincial Department of Education. The scores will include assessments of both theoretical knowledge and practical skills. The test content will be the same as in the pre-test, including the same six question types.

Interactive participation accounts for 40% of the total grade. The interactive participation score for the experimental group will be collected and recorded through the 5Y Learning Platform, while the control group will use instructional record sheets. Interactive participation scores will be recorded every two weeks, with a total of 5 recordings. The first recorded score will serve as the pre-test score, and the average of the 5 recorded scores will be used as the post-test score.

Attendance accounts for 10% of the total grade. The experimental group will record attendance using the 5Y Learning Platform, while the control group will use attendance records and instructional record sheets. Attendance will be recorded weekly, with a total of 10 recordings. The first recorded attendance score will serve as the pre-test score, and the average of the 10 recorded attendance scores will be used as the post-test score.

Conduct face-to-face interviews with 10 students from the experimental group to collect data on students' perceptions of the blended learning approach in the Computer Fundamentals course using the 5Y Learning Platform.

Data Analysis

For quantitative data, the study used JAMOVI statistical software for analysis:

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Descriptive Statistics: Used to summarize and present the collected data. This includes calculating basic statistical data such as frequencies and percentages of demographic information, as well as measures of central tendency (e.g., mean) and measures of variability (e.g., standard deviation, range).

Independent Samples t-Test: Used to compare the improvement differences between the experimental group and the control group in terms of theoretical knowledge, operational skills, attendance, and interactive participation, to determine if there are significant differences. This method is used to assess whether the impact of the blended learning approach under the 5Y Learning Platform on students' learning outcomes is significant.

For qualitative data, interviews were conducted with 10 randomly selected students from the experimental group to collect their perceptions of blended learning. The interview data will be coded, summarized, organized, and analyzed to answer the predefined research questions. Thematic analysis will be used to identify the main themes regarding students' views, experiences, and perspectives on the interview questions.

Descriptive Statistics

Table 3 Demographic Information of Samples

Variable	Category	Frequency	Percentage
Age	19	65	77.4 %
	18	11	13.1 %
	20	8	9.5 %
	Total	84	100.0 %
Gender	Female	61	72.6 %
	Male	23	27.4 %
	Total	84	100.0 %
Year of Study	Year 1	84	100.0 %
	Total	84	100.0 %

Detailed information is shown in Table 3. The sample in this study consists of 84 first-year students from Zhanjiang University of Science and Technology, Class of 2023. Among this sample, 11 students are 18 years old, accounting for 13% of the total; 65 students are 19 years old, accounting for 77%; and 8 students are 20 years old, accounting for 10%. In terms of gender, there are 61 female students, making up 73% of the sample, and 23 male students, representing 27%. The total number of first-year students in the Class of 2023 is 84, accounting for 100% of the sample.

Table 4 Theoretical Knowledge, Practical Skills, Attendance and Interaction Participation Pre-test, Post-test, and Improvement Mean

	N	Mean	SD	Minimum	Maximum
Theoretical knowledge_1	84	9.27	1.96	5	15
Theoretical knowledge_2	84	14.6	2.84	9	22
Theoretical knowledge_Imp	84	5.32	1.55	1	11
Practical skills_1	84	20.52	3.83	12	30
Practical skills_2	84	62.29	9.41	25	76
Practical skills_Imp	84	41.76	7.47	9	53
Attendance_1	84	71.83	6.03	60	85
Attendance_2	84	83.35	5.94	70	92
Attendance_Imp	84	11.51	3.65	3	21
Interaction participation_1	84	71.07	6.43	60	85

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	N	Mean	SD	Minimum	Maximum
Interaction participation-2	84	84.25	5.42	70	95
Interaction participation_Imp	84	13.18	3.42	3	22

Table 4 presents the descriptive statistics for the pre-test, post-test, and improvement scores in theoretical knowledge, practical skills, attendance, and interactive participation.

The data indicate that the post-test score for theoretical knowledge (14.60) is significantly higher than the pre-test score (9.27), and the improvement score (5.32) shows a significant enhancement in theoretical knowledge. The post-test score for practical skills (62.29) is significantly higher than the pre-test score (20.52), and the improvement score (41.76) shows a significant enhancement in practical skills. The post-test score for attendance (83.35) is significantly higher than the pre-test score (71.83), and the improvement score (11.51) indicates a significant increase in attendance rate. The post-test score for interactive participation (84.25) is significantly higher than the pre-test score (71.07), and the improvement score (13.18) shows a significant enhancement in interactive participation levels.

These results indicate that, whether in theoretical knowledge, practical skills, attendance, or interactive participation, post-test scores are higher than pre-test scores, showing significant progress in all areas.

Table 5 presents the statistical data for the pre-test, post-test, and improvement scores in theoretical knowledge, practical skills, attendance, and interactive participation for Experimental Group A and Control Group B, as follows:

Table 5 Theoretical knowledge, Practical skills, Attendance, and Interaction participation Pre-test, Post-test, and Improvement Mean by Class

	Class	N	Mean	SD	Minimum	Maximum
Theoretical knowledge_1	Class A	42	9.29	1.92	6	14
	Class B	42	9.26	2.02	5	15
Theoretical knowledge_2	Class A	42	15.12	3.01	9	22
	Class B	42	14.07	2.59	9	21
Theoretical knowledge_Imp	Class A	42	5.83	1.45	3	11
	Class B	42	4.81	1.49	1	7
Practical skills_1	Class A	42	20.55	2.92	12	29
	Class B	42	20.5	4.59	13	30
Practical skills_2	Class A	42	64.12	6.78	46	75
	Class B	42	60.45	11.25	25	76
Practical skills_Imp	Class A	42	43.57	5.79	23	53
	Class B	42	39.95	8.53	9	50
Attendance_1	Class A	42	71.88	5.22	63	82
	Class B	42	71.79	6.81	60	85
Attendance_2	Class A	42	84.4	5.59	72	92
	Class B	42	82.29	6.16	70	90
Attendance_Imp	Class A	42	12.52	3.7	3	21
	Class B	42	10.5	3.34	3	15
Interaction participation_1	Class A	42	71.1	6.06	61	85
	Class B	42	71.05	6.86	60	84
Interaction participation_2	Class A	42	85.17	5.96	70	95
	Class B	42	83.33	4.72	75	90
Interaction participation_Imp	Class A	42	14.07	3.39	8	22
	Class B	42	12.29	3.24	3	18

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As shown in Table 5:

The post-test mean score for Experimental Group A (15.12) is significantly higher than that of Control Group B (14.07), and the improvement score for Experimental Group A (5.83) also exceeds that of Control Group B (4.81). This indicates more significant progress and enhancement in theoretical knowledge for Experimental Group A.

The post-test score for practical skills in Experimental Group A (64.12) and the improvement score (43.57) are both higher than those of Control Group B, which are 60.45 and 39.95, respectively. This indicates a significant enhancement in practical skills for Experimental Group A, showing that the intervention measures had a better effect on improving practical skills.

The post-test attendance score for Experimental Group A (84.40) and the improvement score (12.52) are both higher than those of Control Group B, which are 82.29 and 10.50, respectively. This indicates a better improvement in attendance for Experimental Group A, showing that the intervention measures were effective in increasing attendance rates.

The post-test scores for interactive participation in Experimental Group A (85.17) and the improvement score (14.07) are both higher than those of Control Group B, which are 83.33 and 12.29, respectively. This indicates significant progress in interactive participation for Experimental Group A, showing that the intervention measures were effective in enhancing student interaction levels.

Overall, Experimental Group A shows higher post-test scores than pre-test scores across all measured dimensions, and compared to Control Group B, Experimental Group A demonstrates significant progress in all areas. This indicates that the intervention measures in Experimental Group A achieved positive results.

Perceptions of Learning with Blended Learning in Computer Basics on the 5Y Network Learning Platform

After 12 weeks of instruction, one week following the final exam, the researcher randomly selected 10 students from the experimental group for face-to-face interviews to understand their perceptions of blended learning in computer basics using the 5Y Network Learning Platform. The goal was to further optimize the integration of teaching technology and enhance student satisfaction. The interviews were conducted in Chinese and were recorded for analysis and course improvement. Subsequently, thematic analysis was applied to analyze the interview content.

The interviews identified four themes: satisfaction with platform features, operational difficulties, sharing and gains, and suggestions for improvement.

Theme 1: Satisfaction with Platform Features

Overall, students are satisfied with the platform’s features. The intuitive interface makes navigation very easy, while the task management function helps students track their progress and complete tasks on time. Online exercises and real-time feedback positively impact skill development. The real-time chat feature quickly resolves issues students encounter, providing additional support during their learning process.

Student Quotes:

Student 1: I particularly like the platform's interface design; it's intuitive and easy to use. With the course navigation and task management, I can quickly find the resources I need. Also, the video explanations and online practice on the platform are great, which makes me feel more efficient in my learning.

Student 3: I think the platform's real-time chat function is excellent. Additionally, the learning resources on the platform are very rich, which helps me learn more comprehensively.

Theme 2: Operational Difficulties

Students encountered some operational difficulties while using the platform. Slow loading speed was a major issue, especially during peak times. Browser compatibility was also considered a barrier, requiring extra time to install specific browsers. Installation problems also troubled students, who faced difficulties when installing certain software.

Student Quotes:

Student 1: The main issue I faced was spending a lot of time downloading and installing specific browsers. Sometimes, during peak times, the platform loads slowly, which affects my learning progress.

Student 5: Overall, the platform's operation is relatively simple. However, I encountered difficulties with needing to install the 5ystudy browser in advance for online exercises.

Theme 3: Sharing and Gains

Regarding sharing and gains, students believe that familiarizing themselves with platform features significantly improves learning efficiency. Regularly checking for updates helps students stay informed

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about course changes and keep up with the course progress. Actively participating in discussions and exercises is also an effective strategy, providing students with more learning experiences and knowledge through interaction.

Student Quotes:

Student 6: I suggest making frequent use of the platform's online practice function, as it allows for continuous improvement of your operational skills through real-time feedback.

Student 3: I found that blended learning improved my learning efficiency. Combining online and offline learning methods allowed me to grasp more knowledge in a shorter time.

Theme 4: Suggestions for Improvement

For improvement suggestions, students proposed the following points: First, increase interactivity by adding more online discussions and real-time Q&A sessions to enhance learning interaction and engagement. Second, provide comprehensive case studies and more practical opportunities to help students apply theoretical knowledge to real situations. Finally, improve mobile functionality to enhance the platform's flexibility and convenience, meeting students' needs on different devices.

Student Quotes:

Student 3: The current learning system is already quite comprehensive and effective, but it would be even better if the mobile functionality could be further improved.

Student 9: I hope the platform can provide relevant cases and exercises based on professional backgrounds. These exercises, combined with practical application scenarios, would integrate technical knowledge with professional requirements. This not only enhances technical skills but also better supports professional development. Such integration would make learning more targeted and practical, providing stronger support for future careers.

The analysis of the face-to-face interviews shows that students hold a positive attitude towards the blended learning of computer fundamentals based on the 5Y online learning platform. The interview data supports the previous quantitative analysis results, indicating that the blended learning model has played a significant role in improving students' learning outcomes.

Hypotheses Testing

Levene's test is used to assess whether the variances of the experimental and control groups are equal, which is a prerequisite for the assumption of homogeneity of variances necessary for performing an independent samples t-test. Before conducting an independent samples t-test, Levene's test is performed to ensure that the variances of the two groups are not significantly different.

Table 6 Homogeneity of Variances Test (Levene's)

	F	**df**	**df2**	**p**
Theoretical knowledge_Imp	0.719	1	82	0.399
Practical skills_Imp	2.754	1	82	0.101
Attendance_Imp	0.672	1	82	0.415
Interaction participation_Imp	0.86	1	82	0.356

As shown in Table 6:

Levene's Test results in Table 16 show that the p-value for the homogeneity of variances test for improvements in theoretical knowledge is 0.399, which is much greater than 0.05. This indicates that the assumption of homogeneity of variances is not rejected, meaning there is no significant difference in variances between the experimental and control groups regarding improvements in theoretical knowledge. Therefore, it is reasonable to assume equal variances in further statistical analysis.

The p-value for the homogeneity of variances test for improvements in practical skills is 0.101, which is also greater than 0.05. This suggests that the assumption of homogeneity of variances is not rejected, and there is no significant difference in variances between the experimental and control groups regarding improvements in practical skills. Thus, assuming equal variances is appropriate.

The p-value for the homogeneity of variances test for improvements in attendance is 0.415, which is greater than 0.05. This indicates that the assumption of homogeneity of variances is not rejected, and there is no significant difference in variances between the experimental and control groups regarding

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improvements in attendance. Hence, it is reasonable to assume equal variances between the two groups for attendance improvement.

The p-value for the homogeneity of variances test for improvements in interaction participation is 0.356, which is greater than 0.05. This suggests that the assumption of homogeneity of variances is not rejected, indicating no significant difference in variances between the experimental and control groups regarding improvements in interaction participation. Therefore, assuming equal variances is justified.

In summary, Levene's Test results show that the p-value for theoretical knowledge improvement is 0.399, practical skills improvement is 0.101, attendance improvement is 0.415, and interaction participation improvement is 0.356. This indicates that there are no significant differences in variances between the experimental and control groups, and the assumption of equal variances is valid.

Results

Based on the results of Levene's test, the independent samples t-test assuming equal variances can be used for subsequent statistical analysis. The results of the independent samples t-test assuming equal variances are presented in Table 7.

Table 7 Independent Samples T-Test

		Statistic	df	p	Mean difference	SE difference
Theoretical knowledge_Imp	Student's t-value	3.2	82	0.002	1.02	0.32
Practical skills_Imp	Student's t-value	2.28	82	0.025	3.62	1.591
Attendance_Imp	Student's t-value	2.63	82	0.01	2.02	0.768
Interaction participation_Imp	Student's t-value	2.47	82	0.016	1.79	0.723

Note. H_a $\mu 1 \neq \mu 2$ Indicates that there is a difference between the means of the two groups.

Table 7 shows that the t-value for improvements in theoretical knowledge is 3.2, with 82 degrees of freedom and a p-value of 0.002. Since the p-value is less than 0.05, this indicates a significant difference between Experimental Group A and Control Group B in terms of theoretical knowledge improvement. Specifically, the mean improvement in theoretical knowledge for Experimental Group A is 1.02 points higher than that of Control Group B, with a standard error of 0.32, indicating a significant advantage for Experimental Group A in theoretical knowledge improvement.

For improvements in practical skills, the t-value is 2.28, with 82 degrees of freedom and a p-value of 0.025. Since the p-value is less than 0.05, this indicates a significant difference between Experimental Group A and Control Group B in terms of practical skills improvement. The mean improvement in practical skills for Experimental Group A is 3.62 points higher than that of Control Group B, with a standard error of 1.591, showing a significant effect of Experimental Group A in enhancing practical skills.

The t-value for improvements in attendance is 2.63, with 82 degrees of freedom and a p-value of 0.01. Since the p-value is less than 0.05, this indicates a significant difference between Experimental Group A and Control Group B in terms of attendance improvement. The mean improvement in attendance for Experimental Group A is 2.02 points higher than that of Control Group B, with a standard error of 0.768, demonstrating a significant advantage of Experimental Group A in improving student attendance.

For improvements in interaction participation, the t-value is 2.47, with 82 degrees of freedom and a p-value of 0.016. Since the p-value is less than 0.05, this indicates a significant difference between Experimental Group A and Control Group B in terms of interaction participation improvement. The mean improvement in interaction participation for Experimental Group A is 1.79 points higher than that of Control Group B, with a standard error of 0.723, showing significant progress for Experimental Group A in enhancing student interaction participation.

The independent samples t-tests assuming equal variances reveal that the p-values for all improvement dimensions (theoretical knowledge, practical skills, attendance, interaction participation) are

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less than 0.05, indicating significant advantages of Experimental Group A over Control Group B in these areas. These results suggest that the interventions in Experimental Group A have achieved significant effects in enhancing each measurement dimension.

Table 8 summarizes the results of the hypothesis testing in this study. In all hypotheses, significant differences were observed between the Experimental Group (receiving blended learning with the 5Y learning platform) and the Control Group (receiving traditional learning) across various improvement indicators.

Table 8 Summary of Hypothesis testing and results

Hypotheses	Statement	Result after Analysis
$H_0 1$	There is no difference in theoretical knowledge improvement scores between students receiving blended learning with the 5Y learning platform in computer fundamentals and those receiving traditional learning.	Rejected
$H_0 2$	There is no difference in operational skills improvement scores between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.	Rejected
$H_0 3$	There is no difference in attendance improvement scores between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.	Rejected
$H_0 4$	There is no difference in interactive participation improvement score between students receiving blended learning with the 5Y Learning Platform in computer fundamentals and those receiving traditional learning.	Rejected

Based on the analysis above, the experimental group, which used the blended teaching model based on the 5Y online learning platform, showed significant improvement in learning outcomes compared to the control group with traditional teaching. These improvements include theoretical knowledge, practical skills, attendance rates, and interaction engagement. Feedback from the semi-structured interviews is presented in the figure 2.

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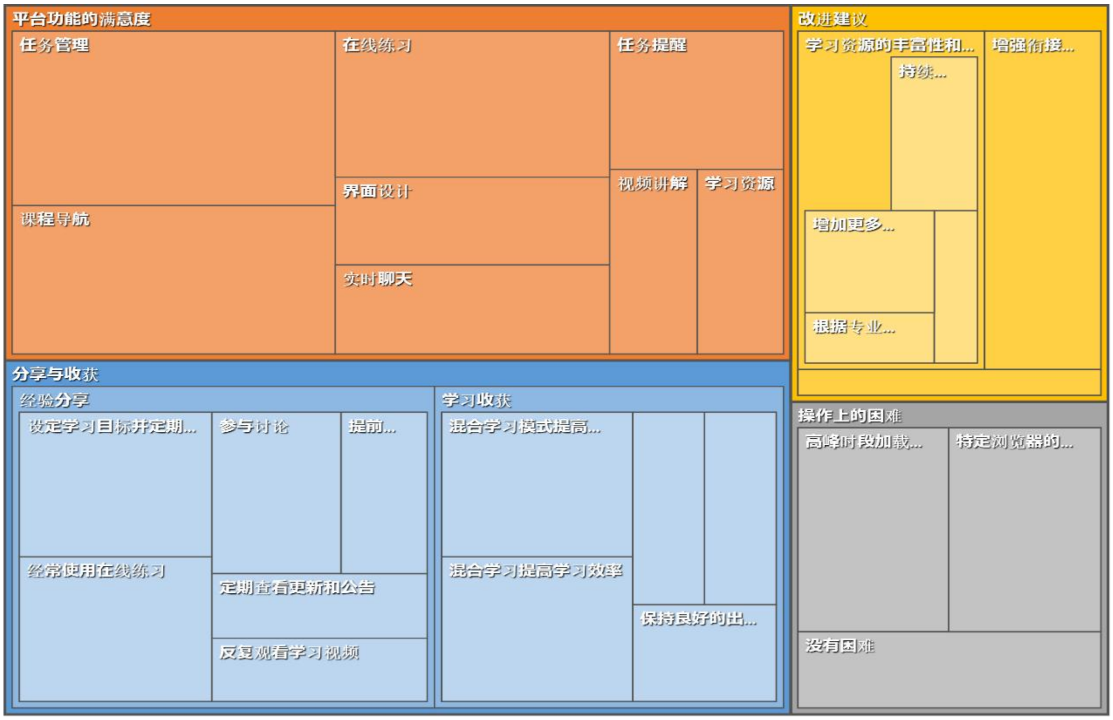

Figure 2 Thematic Analysis Results from NVivo
Source: Created by the Author

Based on the NVivo analysis, Figure 2 illustrates four themes of varying proportions and colors. These themes are: satisfaction with platform features, operational difficulties, sharing and gains, and suggestions for improvement. Their relationships are as follows: "Satisfaction with platform features" reflects learners' experiences with the platform's functionality; "operational difficulties" highlight specific issues encountered during platform use; "sharing and gains" refers to the knowledge and experience learners have gained from the blended learning process using the 5Y online learning platform; and "suggestions for improvement" represents learners' recommendations for enhancing the blended teaching approach. These themes account for a significant proportion of all nodes. The larger the area of a theme, the more frequently it appears in the feedback, indicating that participants mentioned these aspects more often in their responses.

Discussion

The results indicate that the blended teaching approach based on the 5Y online learning platform significantly outperforms traditional face-to-face teaching in enhancing student learning outcomes. The experimental group showed significant advantages in theoretical knowledge ($t(82) = 3.2, p < 0.01$), practical skills ($t(82) = 2.28, p < 0.05$), attendance ($t(82) = 2.63, p < 0.05$), and interaction ($t(82) = 2.47, p < 0.05$). All learning outcome indicators had p-values less than 0.05, indicating statistically significant differences between the experimental and control groups in these dimensions. Additionally, students expressed positive attitudes towards the blended learning model supported by the 5Y platform, believing that this model effectively enhanced their learning experience. Students found that blended learning using the 5Y platform was highly effective for studying computer fundamentals. They highly valued the platform's functional design, recognizing that these features contributed to improved learning outcomes. Addressing operational challenges will further enhance their learning experience. The students' shared experiences, learning gains, and suggestions for improvement provide valuable insights not only for optimizing the platform but also for refining the blended teaching model itself, enhancing its support for student learning, and improving overall teaching effectiveness.

Research data indicates that the blended learning model on the 5Y platform significantly improved students' theoretical knowledge in the Computer Fundamentals course. Compared to traditional learning methods, students using the 5Y platform performed better in theoretical knowledge tests, with statistical significance ($p < 0.05$). This result suggests that the blended learning model not only provides richer and

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more flexible learning resources but also effectively promotes knowledge acquisition through various platform features. Hattie and Yates (2013) emphasized the impact of effective learning strategies on academic performance, which is consistent with this study's findings and further validates the effectiveness of the blended learning model.

In terms of practical skills, the blended learning model on the 5Y platform also demonstrated significant advantages. Compared to traditional methods, students showed notable improvements in practical tasks and skills tests ($p < 0.05$). This result aligns with Kolb's (2014) experiential learning theory, indicating that the platform effectively enhances students' practical abilities by providing more opportunities for practice and real-time feedback.

Regarding attendance, the 5Y platform also showed significant improvement ($p < 0.05$). The platform's flexible resources and interactive opportunities effectively increased students' attendance rates, and the efficient attendance data system motivated students through a sense of competition. This finding is supported by Crede et al. (2010), which highlights the impact of attendance on academic performance.

In terms of interaction and engagement, the blended learning model on the 5Y platform significantly outperformed traditional methods ($p < 0.05$). This is consistent with Freeman et al. (2014), indicating that interactive learning has a positive impact on students' academic performance.

The interview results show that most students are highly satisfied with the features and design of the online learning platform. They believe these features significantly enhance learning efficiency and experience. The high satisfaction with platform features (such as user-friendly interface design and effective task management) aligns with the findings of Artino and Jones (2012), who discovered that positive emotional experiences in online learning environments are closely related to effective learning strategies and behaviors. Students' appreciation for real-time chat and feedback functions also corresponds with Weaver and Qi (2005), who noted that supportive learning environments can enhance students' sense of engagement and satisfaction.

Despite the positive feedback on the platform's features, students encountered some operational difficulties during use, including slow loading times during peak periods and compatibility requirements for specific browsers. These issues are consistent with challenges identified in online learning research. Artino and Jones (2012) discussed how technical issues impact students' emotional experiences and learning behaviors, supporting the negative effects of operational difficulties on the learning experience.

Students generally believe that the blended learning model significantly improves their learning outcomes. The learning strategies shared by students, such as familiarizing themselves with platform features and actively participating in discussions, reflect the findings of Eccles et al. (1998), which emphasize the importance of self-regulation and engagement in learning. These strategies align with research showing that positive engagement and strategic learning behaviors contribute to improved academic motivation and outcomes. The reported improvements in learning efficiency and understanding of course content are consistent with the findings of Pekrun et al. (2011), highlighting the role of achievement emotions in enhancing learning experiences and academic performance.

Conclusion

The blended teaching model based on the 5Y online learning platform significantly improved students' learning outcomes in the computer fundamentals course (including theoretical knowledge, practical skills, attendance, and interaction participation, as shown in the conceptual framework in Figure 1). The experimental group outperformed the control group in these aspects, with all indicators showing p-values below 0.05, indicating significant statistical differences. Additionally, students had a positive attitude towards the blended teaching model supported by the 5Y platform, believing that it effectively enhanced their learning experience. They particularly praised the platform's functional design, recognizing that these features contributed to improved learning outcomes. Students' feedback and suggestions provided valuable insights for further optimizing the platform and teaching model. This study provides empirical evidence for future digital teaching strategies, advances teaching effectiveness, and offers valuable references for further optimizing digital teaching models.

Recommendation

Expanding Research Scope

Future research should broaden the sample scope to include students from different universities and regions to validate the generalizability and effectiveness of the findings.

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Diversifying Research Design

Employ longitudinal studies to observe the long-term impact of blended learning models across different stages.

Optimizing Platform Features

Further enhance the functionality of the 5Y platform by incorporating more interactive and personalized learning tools to improve the student learning experience.

Expanding Research Subjects

Include teachers in the research to gather their perspectives on the blended learning model and provide recommendations for improvement.

Comparative Platform Study

Compare the 5Y platform with other online learning platforms to evaluate the relative effectiveness of different platforms in teaching and promote continuous improvement.

Through these measures, more representative and practical research results can be obtained, and improvements in relevant teaching tools and methods can be driven.

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