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Research on the Application of the New Blended Teaching Model Based on Virtual Simulation Technology in Foreign Language Teaching

Lou Lingling
School of English language, Zhejiang Yuexiu University, Shaoxing, China
Email: 237341893@qq.com

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Abstract

The reform of "Internet+" in higher education has been driven by the rapid development of information technology in recent years. While the blended teaching model has brought about greater openness in educational concepts and more humane teaching methods, its effectiveness in addressing students' weak self-directed learning, lack of initiative, and insufficient practical abilities remains limited. In light of these challenges, this study thoroughly investigates the current status and primary problems of foreign language professional courses. The objective is to integrate virtual simulation technology with the traditional blended teaching model, creating a new blended teaching model for implementation in teaching practice. Two parallel classes from the 2020 English major at the researcher's institution were selected as research subjects, with an experimental group and a control group established. The experimental group utilized the new blended teaching model based on virtual simulation technology, while the control group followed the conventional blended teaching model. After implementing the teaching methods, the effects were evaluated through two aspects: the scores of the final theoretical exams and the results of a survey. The experimental results reveal that the experimental group achieved higher scores in the theoretical exams compared to the control group, with a statistically significant difference ($P<0.05$). Additionally, the students in the experimental group demonstrated notable improvements in their self-directed learning abilities, learning attitude, and practical application skills after being exposed to the new blended teaching model. These findings indicate that the online-offline blended teaching model, which incorporates virtual simulation experiments, effectively combines the advantages of blended teaching and virtual simulation technology. Furthermore, it successfully enhances students' academic performance. Thus, it is evident that this new teaching model caters to the individual learning needs of students and exemplifies the integration of theory and practice.

Keywords: Virtual Simulation, New Blended Teaching, Controlled Experiment, Application Effect

1. Introduction

1.1. Research Background

In recent years, the rapid development of information technology in China has prompted in-depth integration with various industries, propelling unprecedented economic growth and societal advancement. In this context, the education sector has also embraced new developments, actively exploring the fusion of information technology with education to advance the "Internet + Education" reform. The blended teaching model, combining online and offline methods, has been extensively applied in higher education. It has proven to improve students' theoretical knowledge learning outcomes to some extent. Nevertheless, it falls short in fostering students' self-directed learning, initiative in learning, and practical application skills. The cultivation of

these abilities is crucial as they directly relate to students' capability for continuous learning, application of knowledge, and meeting the actual demands for talent from the nation, society, and employers.

However, classroom teaching alone is insufficient to nurture self-directed learning, positive learning attitudes, and practical abilities. Thus, elevating students' self-directed learning and initiative, and resolving the issue of applying theoretical knowledge in practice, remain significant challenges for foreign language educators and learners.

On June 11, 2019, the "National Virtual Simulation Experimental Teaching Project Construction and Shared Application Work Conference" took place in Beijing. This conference underscored the importance of exploring innovative educational environments and deeply integrating virtual reality technology into teaching practices. Virtual simulation experiments, facilitated by computer simulation and network technologies, enable the creation of immersive, dynamic, and interactive scenarios. These experiments normalize practical training opportunities and enhance students' ability to apply theoretical knowledge, thereby contributing to the development of their comprehensive abilities.

Building upon this understanding, this study aims to establish a novel online-offline blended teaching model that incorporates both blended teaching platforms and virtual simulation training platforms. The model will be implemented in the context of the "Intercultural Communication" course, with the purpose of investigating its feasibility and examining its application effects.

1.2. Significance of the Study

Theoretically, guided by Constructivism and other theories, this research analyzes the existing problems of blended teaching, constructs a new blended teaching model based on virtual simulation technology, further enriching the theoretical research achievements of blended teaching and providing inspiration for theoretical research in blended teaching.

Practically, constructing a new blended teaching model that integrates online, offline, and virtual simulation experiment technologies and applying it to classroom teaching practice has the following practical values for the reform and development of higher education:

1) The innovative blended teaching model, leveraging virtual simulation technology, places significant emphasis on the integration of theory and practice. It steadfastly advocates for an equitable balance between theoretical knowledge and practical skills, while merging knowledge evaluation and skill assessment in line with the principles and attributes of higher education. By combining practical teaching with virtual reality, it facilitates the creation of interactive and immersive environments that simplify intricate concepts, visualize abstract notions, and imbue static theories with dynamism. Consequently, students readily embrace and willingly engage with theoretical knowledge. Throughout the teaching process, theory and practice harmoniously intersect through the organization of content, execution of instructional methods, and design of learning environments. This approach either directs practical execution through theoretical foundations or explores theoretical principles through hands-on experiences, leading to concurrent advancements in practical competence, professional aptitude, and theoretical proficiency.

2) The novel blended teaching model, underpinned by virtual simulation technology, underscores the pivotal role of students as active learners. This educational paradigm places utmost importance on students, positioning teachers as guides rather than sole disseminators of knowledge. It fully embraces students' autonomy, acknowledges individual differences, and highly values individual expression and emotional experiences. By fostering an environment that stimulates students' intrinsic motivation and encourages self-directed inquiry, the model fosters the development of knowledge construction capabilities that possess practical significance. This is achieved through cooperative learning, effective communication, and immersive experiences that empower students to unlock their untapped potential.

3) The novel blended teaching model, which integrates virtual simulation technology, aims to enhance overall capabilities. It places equal importance on the development of professional skills, methodological proficiency, and social competencies. This model underscores the cultivation of professional literacy, fostering qualities such as a sense of quality, innovation, teamwork, and more. Additionally, it aims to nurture individuals with sound characters, positive moral emotions, and noble ideals along with meaningful value objectives.

4) The emerging blended teaching model, grounded in virtual simulation technology, places significant emphasis on a comprehensive and three-dimensional evaluation system. In the assessment process, it appropriately allocates various modules, including attendance, tests, virtual tasks, and reports in online/offline virtual practices. This modular, task-oriented, and intelligent assessment and evaluation system is characterized by its real-time nature, scientific approach, and equitable nature, thereby stimulating students' interest and enthusiasm in learning. In comparison to traditional evaluations, this system is more comprehensive, fairer, and scientifically oriented.

1.3. Research Questions

Chinese higher education has transitioned from elite education to mass education over the past decade. Against this backdrop, the talent cultivation model of "application-oriented undergraduate" has emerged. Application-oriented universities need to transform traditional educational concepts, focusing on nurturing students' practical application skills for regional economic development.

However, the specifics of fostering self-directed learning and practical application skills, enhancing learning outcomes, and maximizing the use of modern information technology to facilitate educational reform, remain pressing issues. Therefore, constructing a teaching model that meets future educational requirements is of great significance. Hence, this study takes the core English course "Intercultural Communication" as an example to explore how curriculum reform can improve the quality of talent cultivation, specifically addressing the following questions:

1) How can a new blended teaching model, based on virtual simulation technology, be designed by integrating virtual simulation platforms with blended teaching platforms?

2) Can the new blended teaching model based on virtual simulation technology enhance students' learning outcomes and practical application abilities?

3) Can the new blended teaching model based on virtual simulation technology stimulate students' intrinsic motivation, enhance self-directed learning abilities, and increase their interest in learning?

2. Literature Review

2.1. Current Research on Blended Teaching

Research on blended teaching began in the early 20th century and has received increasing attention in recent years with the rise of mobile teaching and online teaching.

To evaluate the predominant perspectives within the literature on blended teaching, this study referred to the Web of Science (WOS) database core collection (including SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH) as the primary source for international scholarly articles, conducting a search with the criteria "Topic: (blended learning or blended teaching)" up until December 31, 2022. The top 20 journals that published the most articles on this subject were identified, yielding a total of 791 records as the international academic data sample for this study. For Chinese academic literature, the China National Knowledge Infrastructure (CNKI) database was employed with search terms including "'blended teaching', 'blended learning', 'blended teaching model', and 'blended teaching practice'," mirroring the date range of the international literature. CSSCI journal articles were specifically selected for their representativeness, from which 554 documents were retrieved as the sample of domestic academic data.

Utilizing VOSviewer software, a co-word analysis was conducted on the keyword themes of literature published by domestic and foreign scholars on the topics of blended teaching and blended learning. The results revealed that the domestic literature's co-word network primarily exhibited four clusters. Specifically, the first cluster reflected the most closely related concepts to blended teaching, including keywords such as influencing factors, instructional design, teacher professional development, educational informatization, deep learning, and blended learning (Wang et al., 2015; Su & Huang, 2015; Tian & Wang, 2023). The second cluster highlighted the close association between blended teaching and teaching methods such as MOOC, SPOC, and flipped classroom (Wang, 2018; He, 2014; Rong, 2023). The third cluster embodied the environment conducive to successful implementation of blended teaching (Xie et al., 2018; Zheng & Li, 2016; Dong, 2023). The fourth cluster revealed the close connection between blended teaching and the learning methods that emerge in novel educational environments for students (Ma et al., 2018; Cai et al., 2017; Liu, 2023).

The co-word network of foreign literature also primarily showcased four clusters. The first cluster presented the environment and media for implementing blended teaching (Graham, 2004; Dixson, 2010; Mielikainen, 2022). The second cluster displayed the teaching strategies and models of blended teaching (Allen et al., 2007; Fox, 2014; Barber, 2012; Hasan et al., 2022). The third cluster revealed other closely related concepts to blended teaching (Natalie et al., 2010; Christopher & Marcia, 2017; Wang, 2021). The fourth cluster demonstrated factors influencing the performance of blended teaching and methods for evaluating this performance (Hoffmann, 2013; Hara & Bonk, 2016; Pertuz et al., 2022).

2.2. Review of Domestic and Foreign Research

Data analysis of literature relevant to blended research within and outside China indicates that both domestic and foreign scholars maintain a high level of attention toward blended teaching, with a trend of increasing focus over the years.

Analyzing domestic and foreign research situations and keyword maps provides clearer insight into the maturing theoretical research on blended teaching. Definitions of blended teaching concepts have been gradually optimized, and multiple perspectives have studied and analyzed the steps and components of blended teaching. However, current research on blended teaching leans more toward theoretical studies, with fewer empirical studies on teaching effectiveness; additionally, the construction of blended teaching models largely remains confined to methods like MOOC, SPOC, and the flipped classroom, with scant research delving into the integration of virtual simulation laboratory teaching with online and offline blended teaching models.

The "Implementation Opinions on the Construction of First-class Undergraduate Courses" issued by the Ministry of Education emphasize the need to rejuvenate classroom settings and innovate pedagogical strategies to augment teaching efficiency. This entails a deep integration of modern information technology into educational practices, bolstering interactions among teachers and students as well as peer-to-peer engagement. Presently, the majority of blended teaching approaches are centered around online courses, such as MOOCs. The advent of virtual simulation technology further supplements traditional education—especially where there are gaps in practical conditions or challenges in executing hands-on operations—thus enhancing students' comprehensive practical skills and innate motivation for learning. Merging MOOCs with virtual simulation technology to foster an "online + offline" blended teaching paradigm addresses various limitations inherent in conventional educational frameworks. This integration not only amplifies student autonomy and holistic practical skills but also marks a significant trajectory for imminent educational advancements.

3. Theoretical Foundations

3.1. Constructivist Theory

According to constructivist theory, learning is a process in which students actively construct meaning by connecting new information and experiences to their existing knowledge and understanding. This construction of meaning occurs within a specific context and is facilitated by teachers and appropriate learning materials (He, 2002).

Constructivist learning theory emphasizes that the learning process should be guided by teachers, with learners taking an active role in exploring new concepts and relating them to their prior knowledge and experiences. Teachers are responsible for creating learning environments that support students' meaning construction, providing opportunities for students to acquire knowledge and skills within relevant contexts.

Constructivism highlights the importance of "context," "collaboration," and "meaning construction" in education. Therefore, when implementing blended teaching with virtual simulation technology, several considerations should be taken into account. Firstly, online instruction should make use of the benefits of virtual simulation platforms to create engaging situations that facilitate knowledge acquisition; offline instruction should include real-life cases that are closely related to students' experiences, thereby creating an authentic learning environment. Secondly, teaching is a bidirectional interactive process, where teachers should move away from a traditional teacher-centered approach and instead organize effective student interactions and foster collaborative communication. This approach enhances students' problem identification and problem-solving abilities, as well as improves their collaboration skills.Thirdly, in the teaching process, students should be encouraged to engage in group cooperative learning or independent learning. They should actively identify problems, conduct investigations to find answers, and construct knowledge through the process of inquiry.

3.2. Situated Learning Theory

Situated Learning Theory emphasizes the importance of practical contexts in the learning process. It advocates for a learning environment that facilitates active knowledge construction for students. The theory asserts that students can only grasp meaningful ideas and principles when they are engaged in authentic activities within real-world contexts. Moreover, students are encouraged to actively explore and practice in order to construct knowledge independently. Therefore, the essence of situated instruction lies in providing students with a conducive learning environment that supports their self-directed knowledge construction and motivates them to actively seek and acquire knowledge within authentic contexts.

Constructivism emphasizes the importance of "authentic contexts" and "active exploration." Therefore, when implementing new blended teaching experiments based on virtual simulation technology, several points should be considered:

1) Create conducive learning situations: Teachers should utilize virtual simulation platforms to provide highly authentic training environments that bridge the gap between theory and practice. This aids students in applying theoretical knowledge through virtual simulation technology. Additionally, teachers should encourage students to actively participate in internships and training opportunities to deepen their understanding of the learned knowledge.

2) Promote independent learning and exploration: Teachers should encourage students to use virtual simulation platforms and blended teaching platforms for independent learning and exploration, fully exercising student initiative, enhancing engagement, and creativity in learning.

4. A New Blended Teaching Model Based on Virtual Simulation Technology

4.1. Analysis of Student Learning Situations

This course primarily targets third-year English major students at our institution. Through years of educational research and student surveys, several main characteristics have been identified:

1) Students prioritize grades over value formation, lacking the ability to reflect and form independent opinions. As English majors, they are exposed to Western culture but may struggle to question and critically analyze concepts, leading to conformity and rigid thinking.

2) Students rely on rote memorization and lack practical application skills. As students from a local private undergraduate institution, they may have a weaker academic foundation. The emphasis on memorization hinders the extension and practical application of theoretical knowledge.

3) Students are accustomed to teacher-centered instruction and lack independent learning abilities. Influenced by exam-oriented education, they are used to passive learning, resulting in limited skills for effective self-study and independent learning.

4) Students have rich experience in online learning and can adapt well to distance education. Having gone through prolonged online learning during the pandemic, students are now comfortable with online education. Furthermore, being exposed to the digital world and electronic products from a young age, they possess strong information literacy and internet application skills.

Thus, the key issues in course teaching are mainly knowledge-centered learning with insufficient value formation, theory-centered learning with insufficient practical application, and passive learning with insufficient active knowledge-seeking, which are focal points that this reform aims to address. Based on these characteristics, a new blended teaching model based on virtual simulation technology should be designed to address these challenges and provide opportunities for students to actively construct knowledge, engage in practical application, and develop independent learning skills.

4.2. Feasibility Analysis of New Blended Teaching Model Using Virtual Simulation Technology in Foreign Language Curriculum Teaching

The feasibility of implementing a new blended teaching model based on virtual simulation technology in foreign language instruction can be assessed in several aspects:

1) Optimization of Teaching Resources

This model allows for the utilization of various teaching resources by integrating online and offline materials. It takes advantage of existing online course platforms and incorporates emerging virtual simulation resources, resulting in improved teaching outcomes through strategic resource allocation.

2) Effective Enhancement of Teaching Quality

By creating a deep learning environment that combines online platforms with virtual simulation technology, students' understanding and application of theoretical knowledge can be strengthened. Personalized learning arrangements and progress adjustments further enhance teaching quality and efficiency.

3) Continuous Improvement of Learning Experience

The blended model, which combines online education with virtual simulation technology, offers a high-quality learning experience. Students can acquire knowledge in a rich online resource environment and deepen their comprehension and application through immersive virtual simulations. The interactive nature of the platform allows teachers to monitor students' learning progress in real-time, facilitating instructional improvements and continually enhancing the overall learning experience.

4) Fulfillment of Learning Needs

The blended teaching model caters to individual and collective learning needs by providing a customizable package of mandatory and elective learning resources and training projects. This ensures that students' knowledge requirements are met in terms of both breadth and depth.

5) Cultivation of Practical Skills

The blended model seamlessly integrates theoretical instruction with practical application, effectively enhancing students' practical skills. The combination of offline classrooms and online virtual simulation experiments supports students in initially exploring practical scenarios for theoretical knowledge, while the offline practical phases guide students into hands-on practice, boosting their practical application abilities.

4.3. Design of Blended Teaching Model

Based on the feasibility analysis above, it is evident that integrating virtual simulation technology into foreign language instruction is highly feasible. To effectively address current challenges in foreign language teaching, such as insufficient value formation, lack of practical skills, and inadequate self-directed learning abilities, a new blended teaching model based on virtual simulation technology is proposed. This model will incorporate online and offline learning resources, provide opportunities for practical application, and promote self-directed learning, as is shown in Figure 1.

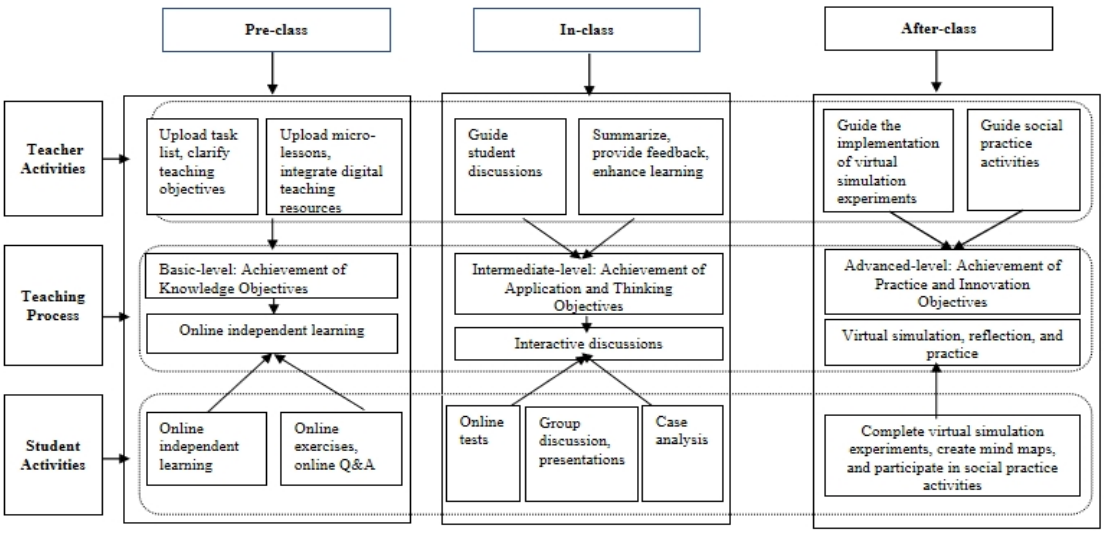

Figure 1 The New Blended Teaching Model Based on Virtual Simulation Technology

The highlight of this teaching model is the integration of virtual simulation experiments and regular practical training into the conventional blended learning approach. This approach is crafted to bolster and hone students' application competencies, which is congruent with the national directives for the development of application-oriented talents. The pedagogical strategy is partitioned into a tripartite sequence—pre-class, in-class, and post-class—to realize educational goals at three levels: basic, intermediate, and advanced.

At the basic level, online resources are modularized to achieve knowledge objectives. Teachers break down content according to ability requirements, set teaching goals for each knowledge point, and integrate a wealth of digital resources on online teaching platforms to cover all teaching resources. Students utilize open online resources for self-directed learning and transfer of knowledge.

At the intermediate level, a flipped classroom format, grounded in project-based learning, is implemented to attain objectives related to application and critical thinking. Through case discussions, role-playing, and group tasks, interactive learning between teachers and students is fostered, allowing the application and practice of knowledge acquired online, and achieving higher cognitive goals.

At the advanced level, virtual simulation tasks, reflective homework assignments, and regular practice exercises are used to accomplish practical and innovative objectives. Initially, virtual simulation educational resources render theoretical concepts into palpable experiences, thus reinforcing students' capacity for practical implementation. Subsequently, students utilize mind maps for consolidation and critical reflection, which promotes innovation and the honing of skills. Ultimately, learners partake in a broad spectrum of practical activities, both online and in-person, including engagement in societal practices at minimum once or twice, thereby enriching their comprehension of the subject matter through hands-on experience.

Through this three-level teaching approach, knowledge, application, and practical objectives are successively achieved, ultimately realizing the integrated development of theoretical knowledge (pre-class online self-study), application ability (interactive discussion during class), and practical and innovative capabilities (post-class virtual simulation, reflection, and practical exercises).

5. Blended Teaching Experiment Design Utilizing Simulation Technology

5.1. Experiment Objectives

Guided by the principles of constructivist learning theory and situated learning theory, this study aims to develop and implement a novel blended teaching model that incorporates virtual simulation technology in the context of the "Intercultural Communication" course. The experimental group will receive instruction using this innovative blended model, which combines both virtual and real-world components, while the control group will be taught using traditional blended teaching methods. Data will be collected through tests and questionnaires to compare and determine if significant differences exist between the students in the control group and those in the experimental group in terms of course learning outcomes, practical application abilities, and self-directed learning capabilities. Based on these considerations, the following experimental hypotheses have been formulated:

1) The new blended teaching model based on virtual simulation technology can effectively enhance students' academic performance.

2) This teaching model can foster the development of students' self-directed learning abilities.

3) It has the potential to increase students' motivation and enthusiasm towards learning.

4) It can facilitate the improvement of students' capacity to apply theoretical knowledge in practical contexts.

5.2. Experiment Subjects

To minimize the interference of irrelevant variables, the subjects selected for the experiment were two parallel classes taught by the same teacher, English Class 2001 and English Class 2006. After comparing the core course scores of the two classes from the previous semester, no significant differences were found in average grades or number of students. Therefore, the author randomly chose the English Class 2001 as the experimental group and the English Class 2006 as the control group to carry out the experiment. The experimental group was taught using the new blended teaching model based on virtual simulation technology, while the control group was taught using traditional blended methods.

5.3. Research Tools

5.3.1. Tests

In order to comprehensively evaluate students' understanding of intercultural communication, the final test included objective questions and short essays that assessed their ability to apply theoretical knowledge to real-world problems.

5.3.2. Questionnaires

Questionnaires were employed to examine changes in students' self-directed learning abilities, learning enthusiasm, and practical application of theoretical knowledge before and after engaging in the new blended teaching approach utilizing virtual simulation technology. The questionnaire consisted of four dimensions: basic information, self-directed learning abilities, learning attitude, and practical application abilities. It comprised 15 questions and utilized a Likert five-point scale. Preliminary testing demonstrated favorable reliability and validity, with a Kaiser-Meyer-Olkin (KMO) value of 0.76, a significant Bartlett's Test of Sphericity value (428.95), and a Cronbach's alpha coefficient of 0.81. The distribution of question types is presented in Table 1.

Table 1. Distribution of Question Types in the "Investigation Questionnaire on the Effects of New Blended Teaching Utilizing Virtual Simulation Technology"

Question Type	Question Number
Basic Information	1,2
Self-directed Learning Abilities	3,6,8,9,12,14
Learning Attitude	4,7,13
Practical Application Abilities	5, 10,11,15

Before and after conducting the new blended teaching practice using virtual simulation technology, the teachers conducted pre-tests and post-tests on the experimental group students, and compared the data obtained from the questionnaire survey. The

aim was to analyze whether there were significant differences in the learning attitudes and abilities of the experimental group students before and after the teaching practice.

6. Analysis of the Effectiveness of Blended Learning Practice Utilizing Simulation Technology

Following a 17-week period of experimental instruction, an evaluation was conducted to assess the efficacy of the newly implemented blended learning model. Both the experimental group and the control group underwent identical tests at the conclusion of the semester. Additionally, to effectively measure the development and changes in the experimental group's self-directed learning abilities, learning attitudes, and practical application skills, a survey was administered both before and after the experiment. The findings are presented below.

6.1. Comparative Analysis of Test Scores

While maintaining consistency with other variables, the experimental group (English Class 2001) received instruction in "Intercultural Communication" using the new blended learning model based on virtual simulation technology; the control group (English Class 2006) followed a conventional blended learning approach. A comparative analysis of the final scores from both classes was conducted, producing quantitative results as presented in Table 2.

Table 2. Output Results of a Two-sample T-test Assuming Equal Variance

Item	English Class 2001	English Class 2006
Average	86.72727273	81.42424242
Variance	41.26704545	73.31439394
Observation	33	33
Pooled variance	57.2907197	
Assumption of average difference	0	
Degree of freedom (df)	64	
t Stat	2.845928219	
P(T<=t) single tail	0.002971389	
t single tail critical	1.669013025	
P(T<=t) double tail	0.005942779	
t double tail critical	1.997729654	

As shown in Table 2, the average test score for the experimental group (English Class 2001) was 86.73, while the control group (English Class 2006) had an average final test score of 81.42. The experimental group's final test scores were significantly higher than those of the control group ($p=0.003$, $p<0.05$). It is worth noting that there were no significant differences in the core course grades from the previous semester between the two classes, suggesting that the experimental and control groups had comparable academic foundations before the experiment. Therefore, the improved performance of the experimental group in "Intercultural Communication" indicates the effectiveness of the new blended learning model based on virtual simulation technology in enhancing students' academic performance.

6.2. Comparative Analysis of Questionnaires Survey

The experimental group was administered a survey titled "The Effects of New Blended Learning Based on Virtual Simulation Technology" before and after the experiment to collect data. Paired-sample t-tests were utilized to compare the pre-test and post-test data, allowing analysis of the development of the experimental group students' self-directed learning abilities, learning attitudes, and practical application skills.

The survey employed a Likert five-point scale, with response options ranging from 1 to 5, representing different degrees of agreement with each statement. A score of 1 indicated complete disagreement, while a score of 5 indicated complete agreement. Higher scores indicated stronger agreement with the statement. The specific findings are outlined below.

Table 3. Survey Results on the Effectiveness of the New Blended Teaching Model in Enhancing Students' Self-directed Learning Abilities

Question	Score (pre-test)	Score (post-test)
3. I always set a study plan for myself in advance and can effectively execute it.	2.52	3.09
6. I am able to grasp the key points and difficulties well during self-study.	2.61	3.03

8. I believe that I have strong self-directed learning abilities.	3.21	3.88
9. I believe that self-directed learning can help me better understand theoretical knowledge.	2.73	3.58
12. I believe that self-directed learning can improve my efficiency in classroom listening.	3.52	4.09
14. I always discuss with teachers and classmates how to improve learning effectiveness.	2.36	3.21

Table 4. Results of Paired t-test Analysis for Self-directed Learning Related Questions Before and After the Test

Name			Pair (mean ± SD)		Difference	*t*□	*p*□
			Pair 1	Pair 2			
Pre-test scores	*Paired*	Post-test scores	2.82±0.45	3.48±0.44	-0.66	-9.391	0.000**

As evident from the findings presented in Table 3 and Table 4, there was a remarkable improvement in the average scores for questions pertaining to self-directed learning in the experimental group. The scores increased from 2.82 in the pre-test to 3.48 in the post-test. Notably, the pre-test scores were significantly lower than the post-test scores, indicating a substantial difference at a 0.01 significance level (t=-9.391, p=0.000). This suggests that the experimental group students' awareness and ability to engage in self-directed learning witnessed a significant enhancement after the 17-week intervention of the new blended learning approach incorporating virtual simulation technology.

Table 5. Survey Results on the Effectiveness of the New Blended Teaching Model in Improving Students' Learning Attitude

Question	Score (pre-test)	Score (post-test)
4. I want to learn this course.	2.91	4.12
7. I believe this course is useful.	3.21	3.91
13. I am confident that I can learn the course well.	2.70	3.82

Table 6. Results of Paired t-test Analysis for Learning Attitude Related Questions Before and After the Test

Name			Pair (mean ± SD)		Difference	*t*□	*p*□
			Pair 1	Pair 2			
Pre-test scores	*Paired*	Post-test scores	2.94±0.26	3.95±0.15	-1.01	-6.426	0.023*

Similarly, the analysis of Table 5 and Table 6 unveiled a significant improvement in the average scores for questions regarding learning attitudes. The scores rose from 2.94 in the pre-test to 3.95 in the post-test. Here, the pre-test scores were significantly lower than the post-test scores, presenting a notable discrepancy at a 0.05 significance level (t=-6.426, p=0.023). These results indicate a noteworthy improvement in the experimental group students' interest in and confidence towards the course subsequent to the instructional intervention.

Table 7. Survey Results on the Effectiveness of the New Blended Teaching Model in Enhancing Students' Practical Application Ability

Question	Score (pre-test)	Score (post-test)
5. I believe that I have strong intercultural communication abilities.	2.30	3.21
10. I am able to apply theoretical knowledge well in practical activities.	2.58	3.61

11. Virtual simulation exercises help to concretize theoretical knowledge.	3.45	3.79
15. I believe that participating in extracurricular activities can achieve satisfactory results.	2.39	2.91

Table 8 Results of Paired t-test Analysis for Practical Application Ability Related Questions Before and After the Test

Name			Pair (mean ± SD)		Difference	*t*	*p*
			Pair 1	Pair 2			
Pre-test scores	Paired	Post-test scores	2.68±0.53	3.38±0.40	-0.70	-4.320	0.023*

As depicted in Table 7 and Table 8, there was a considerable enhancement in the average scores for questions concerning practical application ability. The scores increased from an initial pre-test average of 2.68 to a subsequent post-test average of 3.38. This difference was statistically significant (t=-6.426, p=0.023), pointing to a substantial improvement in the experimental group students' practical skills.

In conclusion, the implementation of the new blended learning model, integrating virtual simulation technology, resulted in significant advancements in the experimental group students' self-directed learning abilities, learning attitudes, and practical skills. Consequently, there was a notable increase in students' intrinsic motivation towards course learning, shifting from a mandatory approach to a voluntary and enthusiastic attitude.

7. Conclusion

Grounded in constructivist learning theories and situated learning theory, this study has successfully developed and implemented a new blended teaching model based on virtual simulation technology within classroom settings. The comparative experimental results have demonstrated a significant enhancement in students' academic performance through the integration of virtual simulation technology, as compared to students who received traditional blended teaching methods. Moreover, the survey results have indicated that students in the experimental group exhibited marked improvements in their self-directed learning abilities, learning attitudes, and practical application skills following the implementation of the new blended teaching model.

Thus, this study argues that the integration of virtual simulation technology in traditional classroom teaching provides students with a more immersive and engaging learning experience. This approach not only stimulates students' interest and enthusiasm for learning but also enhances their learning outcomes.

Future research endeavors could focus on further optimizing the new blended teaching model based on virtual simulation technology. For instance, adapting the functionalities and content of the virtual simulation software could better cater to the diverse learning needs of students. Additionally, exploring the application of this model across different disciplines could validate its universal applicability and efficacy.

To summarize, the new blended teaching model based on virtual simulation technology offers promising prospects for instructional practices. With ongoing refinement, improvement, and implementation, this model has the potential to play a significant role in higher education, fostering innovation, and elevating the overall quality of education.

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