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An Integrating of Blended Learning Based on Superstar in Table Tennis General Course for Sports Majors

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Abstract
Background and Aim: Nowadays, with the development of information technology, physical education in universities calls for the integration of modern technology with teaching activities. This study aims to establish a blended learning model based on Superstar, compare its impact on students' learning effectiveness (learning engagement, skill performance, and professional competence) with the traditional face-to-face teaching model, and explore students' experiences with the blended learning model based on Superstar.
Methodology: A mixed method was used in this study. The population consisted of sophomore students majoring in Leisure Sports at the School of Sports Science at Anshan Normal University who are enrolled in the Table Tennis General Education course in Liaoning Province, China. This sample was 42 students (34 male and 8 female) who were drawn from sophomore students majoring in Leisure Sports. The sample students were randomly selected. Performance tests and an open-ended questionnaire were employed to collect data. SPSS and NVivo were used to make the analysis. Independent samples t-tests and thematic analysis were used to test the hypotheses.
Results: The findings indicated there was a significant difference in students' learning effectiveness between the blended learning based on Superstar and traditional face-to-face teaching. The average scores after the blended learning model based on Superstar were higher than those in traditional face-to-face teaching. On the other hand, students expressed positive attitudes towards their learning experience with this teaching model.
Conclusion: Blended learning based on Superstar had a positive effect on table tennis general courses and provided students with a positive learning experience.
Keywords: Blended Learning; Learning Performance; Professional Competence; Student Experience

Introduction

The rapid growth of information technology, especially the use of network-based technologies and communication, has provided educators with more opportunities to explore the most suitable learning environments that cater to students' learning styles (Zhao, 2021). State Council of the People's Republic of China (2017) proposed the active development of "Internet+ Education" and the promotion of deep integration between information technology and educational instruction. It encouraged teachers to use information technology to enhance teaching levels, innovate teaching models, and make effective use of high-quality digital resources through methods such as flipped classrooms and blended learning. This provides a strong impetus for the reform and innovation of teaching methods and serves as a guiding principle for the development of innovative teaching models, digital education, and blended learning.

Blended learning is the integration of online learning and face-to-face learning between teachers and students (Graham et al., 2012). Compared to the face-to-face (FTF) approach, the blended learning method creates an active and productive learning environment while facilitating the teaching process (Afacan, 2016). Students are free to develop their interest in learning activities. They can control their learning pace, select appropriate materials, and manage their own time (Syamsuddin, 2019). Sun et al. (2017) have observed that interaction and contact among students increase and improve in a blended learning environment. Rahman (2019) supports this trend, showing that students in blended learning environments perform better than those in non-blended environments. Blended learning combines online and face-to-face components, providing students with unique experiences by offering flexibility in their learning time, location, and pace. Sembiring (2018) argued that blended learning provides students with greater choices and allows them to select learning modes that suit their needs. Blended learning is being increasingly applied and developed in all educational institutions, especially

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in higher education (Dos, 2014). Blended learning is now commonly referred to as the "new normal" in higher education (Norberg et al., 2011).

Compared to other disciplines, it enriches course content, facilitates real-time communication, and promotes the sharing of information. Currently, most physical education instructors in universities still employ traditional teaching methods (Lin et al., 2019). In the classroom, the teacher provides explanations and demonstrates movements, then asks students to acquire sports skills through imitation and repetitive physical exercises (Hill, 2018). The teaching approach is teacher-centered, and students progress at the same pace (Liu, 2021). Students are unable to receive individualized guidance from teachers outside of class, and the limited class time cannot meet their individual needs (Papastergiou et al.,2021; Hung et al., 2018). Students can only passively acquire the knowledge provided in the classroom, which may reduce their enthusiasm and engagement (Petsilas, 2019; Xie et al., 2020). The teaching of the table tennis introductory course faces similar challenges.

Superstar is a free application that integrates mobile teaching, mobile learning, mobile reading, and mobile social networking (Peng, 2020). It was officially registered with the Ministry of Education on December 24, 2019 (Peng, 2020). Superstar is one of the 22 recommended learning platforms by the Ministry of Education, providing free online teaching platform services for various schools (WeChat Official Account, 2022).

Based on the research above, blended learning could exert a positive influence on learning activities. This study, based on Superstar, established a blended learning model that combined online and offline teaching and explored the effectiveness of the integration of blended learning based on Superstar in Table Tennis teaching. Students participating in this course benefited from the blended learning based on Superstar. The results of this research would supply table tennis learners with a new way to learn and practice. This research provided new solutions to the issues present in table tennis teaching in physical education programs, met the requirements for the development of table tennis teaching reform in sports majors, and offered a fresh perspective for the reform of physical education teaching in universities.

Objectives

This study aimed to explore the effects of integrating Superstar-based blended learning on the learning effectiveness of students in table tennis general courses in sports major programs, as well as their experiences with this teaching model. Thus, the following research questions were proposed:

1. what is students' learning effectiveness after Superstar-based BL activities?
2. How is the experience of students with blended learning based on Superstar?

Based on the above-mentioned research questions, the objectives of this study were as follows:

1. To compare students' effectiveness after Superstar-based BL activities.
2. To understand the experience of students with blended learning based on Superstar.

Literature review

Constructivist theory

Boutell (2011) Constructivism emerged in the 1990s and is based on theories of children's cognitive development. It posits that learning is a process where learners generate meaning and construct understanding based on their existing knowledge and experiences in social and cultural activities. Constructivism is a learning concept that has its historical roots in the works of Dewey, Bruner, Vygotsky, and Piaget. Bednar et.al. (1992) and von Glasersfeld (1995) provide several insights for instructional developers based on constructivist theory. They emphasize that the focus of learning outcomes should be on the process of knowledge construction and learning objectives should be determined by authentic tasks with specific goals. Constructivism is an instructional approach based on the premise that cognitive learning is the result of "psychological construction," wherein students learn by integrating new information with what they already know (Von Glasersfeld, 1995). He (1998) Constructivism argues that knowledge is constructed by learners in a social and cultural context, utilizing necessary learning resources and with the assistance of learning partners and teachers, rather than being transmitted by teachers.

Self-Determination Theory

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Self-Determination Theory (SDT) is a motivation process theory regarding human self-determined behavior, proposed by American psychologists Deci and Ryan in the 1980s. SDT defines the intrinsic and various extrinsic sources of motivation and describes the roles of intrinsic and extrinsic motivation in cognitive and social development (Deci & Ryan, 1985). Individual differences are reflected in the experiences of autonomy, competence, and relatedness, which are crucial in fields such as education, arts, sports, and many others (Ryan et al.,2009). SDT helps to better understand human processes in various domains, including education, work, leisure activities, and parenting and guides its application and interventions to improve human conditions (Vallerand et al., 2008). According to SDT, people can find intrinsic interest in many activities, but individuals may be drawn to certain activities while avoiding others. Thus, SDT suggests that activities that fulfill certain basic psychological needs are experienced as interesting and have intrinsic motivation (Ryan et al., 2009). Self-determination theory considers various aspects of human motivation, including the affective component of learning, and can also be used to explain the benefits of blended learning (Ten et al 2011). In summary, only learners themselves are the key to determining the achievement of learning goals. Blended learning based on Superstar, whether online or offline, puts learners in charge and fully embodies self-directed learning.

Co11aborative Learning

Collaborative Learning (CL) is a teaching theory and strategy that emerged in the early 1970s in the United States and made substantial progress in the 1970s to mid-1980s. Slavin (1995) defines CL as a classroom teaching technique where students engage in a series of learning activities in small groups and receive rewards or recognition based on their group's performance. Johnson (1999) identifies the basic elements of CL as positive interdependence, face-to-face promotive interaction, individual and group accountability, interpersonal and small-group skills, and group processing. It involves engaging learners in active and experiential processes, emphasizing the importance of peer interaction in achieving common goals. It is an approach based on constructivist theories (Bruner, 1990), where learners participate and find solutions by exploring knowledge and viewpoints.CL is a subset of active learning that requires learners to work together to acquire knowledge, solve problems, or create new things. This form of collaboration provides students with opportunities for purposeful dialogue, creating mutual understanding, and engaging in deep critical thinking. Going beyond traditional methods, it places students at the center of the learning experience and provides opportunities for active engagement, promoting meaningful and lasting learning (Barkley et al.,2014). In summary, CL can be either peer-to-peer or group-based. By collaboratively solving problems, students creatively and critically apply theoretical knowledge, express and understand ideas from different perspectives, and synthesize information to build consensus. Collaborating in this way can cultivate discipline-specific skills as well as broader transferable skills.

Learning engagement

Learning engagement is one of the important factors in learning (Biggs, 1999). Learning engagement is a focal point for evaluating learning effectiveness (Zerihun & Van, 2012). Engagement can be divided into multiple domains, including behavioral engagement, emotional engagement, and cognitive engagement (Bernard, 2015; Bowyer & Chambers, 2017). Behavioral engagement involves the physical actions of learners, such as attending classes, participating in classroom activities, and concentrating (Gunuc & Kuzu, 2015; Alrashidi, 2016). Emotional engagement refers to learners' positive and negative emotional reactions to teachers, peers, and the educational environment (Alrashidi, 2016). Cognitive engagement involves students' ability to engage in independent learning and recognize the value of learning (Alrashidi, 2016). Researchers have shown great interest in the impact of blended learning on student learning engagement. Zhang et. al. (2018) investigated the course design of a blended learning model in basketball courses at Chinese universities, utilizing flipped classrooms and mobile technology, and assessed student satisfaction through survey data. The results indicated that this approach improved classroom interaction. Al-Ani (2008) examined the perceptions of students at Sudan University of Science and Technology regarding the use of the Moodle course management system for English as a foreign language learning. The study found that the use of Moodle increased student engagement in learning, exchanging ideas, and acquiring knowledge. Stockwell et. al. (2015) conducted a randomized controlled trial with biochemistry students and found that the

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blended learning group showed significant improvements in biology learning outcomes and attendance. Hence, one hypothesis was set:

$H_0$1: There is no difference between the control group and the treatment group in learning engagement scores.

There is a difference between the control group and the treatment group in learning engagement scores.

Skills performance

Mastering sports and physical skills is a complex and demanding process that requires time and effort. In sports and physical education, developing professional skills not only relies on innate talent and high-level guidance but also requires the cultivation of self-regulation abilities (Ommundsen & Lemyre, 2007; Zimmerman & Kitsantas, 2005). Gu (1990) defines sports skills as the ability to accurately and proficiently perform physical exercises according to specific requirements. Sports skills refer to the ability to perform certain movements according to specific technical requirements, also known as sports skills (Chinese Society of Sports Science and Hong Kong Sports Institute Joint Publishing House, 2000). Magill（2010）proposed that motor skills are the ability to perform actions according to specific technical requirements, considering both the process and the outcome, it is a complex, chained, and proprioceptive conditioned reflex. Ministry of Education of the People's Republic of China (2001), sports skills refer to the ability to effectively perform specific actions in sports, including the coordination of different muscle groups under neural system regulation. Learning performance is directly related to skills and serves as an indicator for assessing skill acquisition (Moccozet et al.,2012). Researchers have conducted relevant studies on the impact of blended learning on skill performance. Garrison and Akyol (2015) studied the learning outcomes of a large number of American graduate students in a blended learning environment. The student's cognitive presence and learning outcomes were significantly improved, leading to enhanced skill performance. AL-Ghareeb (2010) measured the effects of blended learning on the academic performance and first aid skills of 16 students in the sports department of Kuwait University. López-Pérez (2011) collected numerous case studies of blended courses at the University of Granada in Spain and found that blended learning increased students' pass rates and academic performance. Thus, this study concluded a hypothesis:

$H_0$2: There is no difference between the control group and the treatment group in skills performance score.

Ha2: There is a difference between the control group and the treatment group in skills performance score.

Professional competence

In the process of understanding professional competence, most authors have reached a consensus on certain attributes. Competence is seen as a concept that acquires meaning in a specific context (Grønborg, 2013). It is seen as the general, comprehensive, and internalized ability to perform sustainably and effectively (with value) in specific professional fields, roles, organizational environments, and task situations, including problem-solving, innovation, and driving change (Epstein, 2002). Kane (1992) professional competence refers to the ability to apply professional knowledge and skills to solve practical problems that arise in the workplace. Vainshtein et (2021) define professional competence from the perspective of competence and profession, stating that it refers to the specific skills individuals possess to support the completion of specific job tasks. Shen and Tsai (2011) found that blended learning has been widely applied in vocational education, improving students' practical skills and problem-solving abilities. Zhang and Wang (2014) developed a blended learning model based on the flipped classroom approach, which enhanced students' interest, problem-solving abilities, and achieved significant teaching effects. Accordingly, a hypothesis was indicated:

$H_0$3: There is no difference between the control group and the treatment group in professional competence score.

Ha3: There is a difference between the control group and the treatment group in professional competence score.

Learning experience

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Student experience is an important factor in successful e-learning (Gilbert, 2007). Nellie Mae Education Foundation (2016), learning experience refers to the experience students have with courses, teaching activities, teaching interactions, learning environments, and more during the learning process. Hu and Huang (2016) defined learning experience as the perception, response, and behavioral manifestation of learners toward various teaching elements involved in the learning process, such as learning environment, learning activities, and learning support services. Student experience directly influences the acceptance and satisfaction of technology-based blended learning. There have been numerous studies on student experience in technology-based blended learning. Kiviniemi (2014) found that students had a highly positive evaluation of blended learning, with the majority of students (83%) preferring it over traditional face-to-face instruction. Chou and Liu (2005) conducted a 14-week experimental study with students in a Taiwanese high school and found higher satisfaction compared to traditional face-to-face instruction. Medina (2018) found that implementing blended courses enhanced the learning experience and fostered the formation of collaborative learning communities from the student's perspective. Similar findings were reported (Bruff et al. 2013; South et al. 2008).

Conceptual Framework

This study employs a mixed-methods approach, combining quasi-experimental research methodology with open-ended questionnaire research methods, to investigate the blended learning based on the Superstar. Quasi-experimental teaching experiment research methodology will be used primarily to compare the learning effectiveness of the blended learning approach with the traditional face-to-face physical education teaching methods. Open-ended questionnaire to understand students' learning experiences in blended learning based on the Superstar.

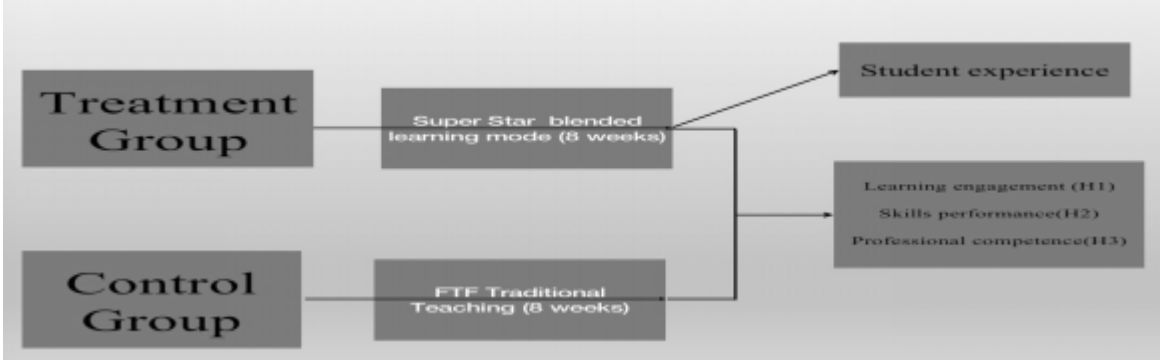

Figure 1 *Conceptual Framework*
Source: Constructed by the Author

Methodology

In this research, a mixed method was used. Performance tests and an open-ended questionnaire were used to collect data.

Population

The population was sophomore students majoring in Leisure Sports at the School of Sports Science at Anshan Normal University in Liaoning Province, China.

According to the talent training program of the Leisure Sports major at Anshan Normal University, the table tennis course is offered in the 3rd semester. The population under study consisted of students in their sophomore year, and there were more male students than female students. They were admitted based on their comprehensive scores, which include both the physical education exam and the general education exam of the national college entrance examination. They had a certain level of physical fitness and a foundation in general education courses. The training objective for them was to master the basic theories and methods of leisure sports, possess the ability to plan and organize leisure sports activities, manage and operate sports clubs, promote and operate sports tourism, as well as provide sports instruction and management, and be competent in related work in the field of leisure sports (Ministry of Education of the People's Republic of China, 2001).

Sample

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The research sample was a total of 42 sophomore students majoring in Leisure Sports at Anshan Normal University College of Sports Science. The students were divided into two subgroups based on their specialized subjects. The sample characteristics are consistent with the population characteristics. Therefore, the sample completely represents the population.

Sampling Techniques

The population of this study consisted of sophomore students majoring in Leisure Sports at Anshan Normal University College of Sports Science who were enrolled in the Table Tennis General Education course. Currently, there are only 42 students in the sophomore year, divided into two teaching classes for the course. Therefore, this study utilized a census sample approach, where one group was randomly selected from the two classes as the experimental group, while the other group served as the control group.

Research Instruments and Tools

In this research, performance tests and open-ended questionnaires were used as the research instruments. Independent samples t-tests were used to make an analysis. Mean, standard deviation, mean difference, significance, t-value, and p-value were calculated and shown. For the feedback of the open-ended questionnaire, thematic analysis by NVivo was used to conclude the students' experience. For pre-test: The students from two classes, who are in their sophomore year, underwent data analysis of their academic performance in their first year. There were no differences found in terms of their learning engagement and professional competence. The specific test indicators focused mainly on the basic techniques of table tennis. Two associate professors or higher-ranking teachers specializing in table tennis were assigned to assess their table tennis skills.

For post-test: To ensure fair and objective test results, and to avoid the influence of examiners on the test results, this test involved objective scoring by the course teachers based on regular records for the learning engagement segment. Skills performance and professional competence were evaluated by two associate professors or higher-ranking teachers specializing in table tennis.

The open-ended questionnaire was conducted with six questions, primarily focusing on the learning experience of students in the experimental group regarding blended learning based on the Superstar.

The specific questions were as follows:

Q1: Did this blended-learning course coordinate your desires for blended learning? In case yes, how? In case no, why do you think this was the case?

Q2: What challenges did you encounter in this blended learning course?

Q3: What feedback did you receive in this blended learning course?

Q4: What positive experiences have you gained from participating in the blended learning course?

Q5: What changes have occurred in the role of teachers in the blended learning course compared to traditional face-to-face teaching?

Q6: How has the role of students changed in the blended learning course compared to the traditional face-to-face mode?

Table 1: ***The Results Ratings on a 6-question Scale by Three Experts: Questions Rated 3 or 4 on a 4-Point Relevance Scale***

Question	Expert 1	Expert 2	Expert 3	Number in Agreement	Item CVI
1	3	4	3	3	1.00
2	4	3	4	3	1.00
3	4	3	3	3	1.00
4	3	4	3	3	1.00
5	4	3	4	3	1.00

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Question	Expert 1	Expert 2	Expert 3	Number in Agreement	Item CVI
6	3	4	3	3	1.00
Proportion Relevant:	1.00	1.00	1.00	Mean I-CVI = (1+1+1+1+1+1)/6 = 1.00	

Source: Illustrated by the Author

Data Collection

The experiment lasted for 10 weeks. Week 1 involved preparation work, such as conducting pre-tests for the experimental and control groups and establishing the Superstar. Weeks 2 to 9 had been dedicated to conducting the teaching experiment, in Week 16, the post-test had been conducted. Open-ended questionnaires had been conducted, and relevant data had been collected and organized. Quantitative analysis of the test results for the experimental and control groups had been performed, and qualitative analysis had been conducted on the open-ended questionnaire results. This led to the formation of the final research findings on the effectiveness of blended learning based on the Superstar and students' experiences with this teaching model.

Data Analysis and Results

In Table 2 and Table 3, this independent samples t-test was calculated to compare the Learning engagement score between the Treatment Group and the Control Group. The t-test was not significant, t (40) =.878, p =.385. The result indicated that there was no difference in Learning engagement scores between the Treatment Group and the Control Group.

Table 2: Descriptive Statistics of Pre-test Learning Engagement

	Group	N	Mean	SD
Learning Engagement	Treatment	21	8.40	0.515
	Control	21	8.24	0.700

Table 3: Pre-test Learning Engagement Independent Samples T-Test

	Mean difference	Sig.
Treatment & Control	0.167	.385

From Table 4 and Table 5, this independent samples t-test was calculated to compare learning engagement score improvement between the Treatment Group and the Control Group. The t-test was significant, t (40) =2.90, p=.006. The result indicated that there was some difference between the Treatment Group and the Control Group.

Table 4: Descriptive Statistics of Post-test Learning Engagement

	Group	N	Mean	SD
Learning Engagement	Treatment	21	8.55	0.472
	Control	21	8.00	0.725

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Table 5: Post-test Learning Engagement Independent Samples T-Test

	Mean difference	Sig.
Treatment & Control	0.548	.006

Table 6 and Table 7 showed that the independent samples t-test was calculated to compare the Skills Performance score between the Treatment Group and the Control Group. The t-test was not significant, t (40) =.05, p=.963. The result indicated that there was no difference in Learning engagement scores between the Treatment Group and the Control Group.

Table 6: Descriptive Statistics of Pre-test Skills Performance

	Group	**N**	**Mean**	**SD**
Skills Performance	Treatment	21	6.50	11.6
	Control	21	6.34	11.1

Table 7: Pre-test Skills Performance Independent Samples T-Test

	Mean difference	Sig.
Treatment & Control	0.162	.963

From Table 8 to Table 9, this independent samples t-test was calculated to compare Skills Performance score improvement between the Treatment Group and the Control Group. The t-test was significant, t (40) =2.16, p=.037. The result indicated that there was some difference between the Treatment Group and the Control Group.

Table 8: Descriptive Statistics of Post-test Skills Performance

	Group	N	Mean	SD
Skills Performance	Treatment	21	50.6	3.41
	Control	21	48.0	4.17

Table 9: Post-test Skills Performance Independent Samples T-Test

	Mean difference	Sig.
Treatment & Control	2.54	.037

In Table 10 to Table 11, this independent samples t-test was calculated to compare the Professional Competence score between the Treatment Group and the Control Group. The t-test was not significant, t (40) =.221, p =.826. Thus, the null hypothesis was retained. The result indicated that there is no difference in Professional Competence score between the Treatment Group and the Control Group.

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Table 10: Descriptive Statistics of Pre-test Professional Competence

	Group	N	Mean	SD
Professional Competence	Treatment	21	25.0	1.38
	Control	21	24.9	1.41

Table 11: Pre-test Professional Competence Independent Samples T-Test

	Mean difference	Sig.
Treatment & Control	0.095	.826

Table 12 and Table 13 show that the independent samples t-test was calculated to compare the Professional Competence score improvement between the Treatment Group and the Control Group. The t-test was significant, t (40) =2.94, p=.005. The result indicated that there is some difference between the Treatment Group and the Control Group.

Table 12: Descriptive Statistics of Post-test Professional Competence

	Group	N	Mean	SD
Professional Competence	Treatment	21	25.0	1.46
	Control	21	23.5	1.82

Table 13: Post-test Professional Competence Independent Samples T-Test

	Mean difference	Sig.
Treatment & Control	0.509	.005

According to the above analysis, we got the results of hypothesis testing as follows in Table 14:

Table 14: Summary of Hypothesis Testing and Results

Hypotheses	Statement	Result after Analysis
$H_0$1	There is no difference between the control group and the treatment group in learning engagement scores.	rejected
$H_0$2	There is no difference between the control group and the treatment group in skills performance scores.	rejected
$H_0$3	There is no difference between the control group and treatment group in skills performance score.	rejected

Results of Students' Experience of Blended Learning Based on Superstar

After an 8-week instructional experiment, in the 9th week, an open-ended questionnaire regarding the "Blended Learning Experience Based on Learning Path" was distributed to students

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through the platform Questionnaire Star. Before the distribution of the questionnaire, the teacher explained the intention behind each question. Participation in answering the questions was voluntary, and a total of 20 students engaged in online responses. Using NVivo software, employing thematic coding to conduct a qualitative analysis of students' responses.

Question 1: Did this blended-learning course coordinate your desires for blended learning? In case yes, how? In case no, why do you think this was the case?

Regarding the responses to this question, the theme coding for the analysis includes five main aspects: Flexibility and Autonomous Learning, Interactivity and Team Collaboration, Technological Applications and Teaching Platforms, In-depth Understanding of Subject Knowledge, and Challenges and Growth. Emotion coding was also utilized for this question. In a comprehensive analysis, students generally expressed approval for blended learning based on the Learning Platform. The majority of students believed it aligned with their expectations, stating that blended learning provides more flexible learning times and locations, catering to individual needs. Online learning platforms and resources enable students to learn at their own pace and explore based on their interests, enhancing individual autonomous learning abilities. Blended learning, through both virtual and physical interaction, facilitates collaboration and communication among students. Diverse learning resources and methods help them gain a deeper understanding of subject knowledge. However, some individual students expressed a dislike for this learning approach because of their lower self-discipline and weaker autonomous learning skills. They prefer traditional face-to-face teaching from teachers.

Question 2: What challenges did you encounter in this blended learning course?

The analysis was theme coding based on learning modes, technology usage, interactive communication, and assessment methods. A summary analysis of student responses reveals that the main challenges faced by students include the potential difficulty in transitioning between traditional classroom and online learning environments in blended learning. This requires time to adapt to different learning methods and teaching approaches. Students need to enhance their autonomous learning skills, including time management, goal setting, and resource allocation. Challenges in team collaboration may arise, including issues related to time zone differences and online communication barriers. Students might perceive limited interaction with teachers in the online learning environment. Additionally, uncertainties and technical issues related to assessment content and methods, as well as relevant network and device issues, may be encountered.

Question 3: What feedback did you receive in this blended learning course?

An inductive analysis was conducted based on four themes: the effectiveness and depth of teacher feedback, interaction and feedback among classmates, expectations for diverse assessment methods, and the impact of feedback on learning motivation and drive. The analysis indicates that students hold a positive attitude towards the feedback mechanism in blended learning, emphasizing the importance of timeliness, detail, and positivity. They have expressed expectations and improvement suggestions regarding specificity, diversity, and interaction among classmates. This reflects students' demand for personalized, effective, and interactive feedback.

Question 4: What positive experiences have you gained from participating in the blended learning course?

Based on the content of student responses, six thematic codes were established: Subject Depth and Breadth Expansion, Practical Application and Career Competitiveness, Flexible Learning Experience and Personalized Paths, Team Collaboration and Social Development, Skill Enhancement and Autonomous Learning, and Personalized Teaching Support and Critical Thinking Improvement. Through analysis and summary, it is evident that students, through blended learning, have achieved a profound understanding of subject knowledge, exploring a broader range of knowledge domains. The emphasis on practical application allows students to transform theoretical knowledge into practical skills. Students can tailor their learning based on personal preferences and time management, aligning more closely with individual needs. Through group projects, they have honed their teamwork skills, fostering collective wisdom and communication proficiency. Teachers provide personalized support, attending to each student's needs and offering targeted teaching suggestions. This approach nurtures students' critical thinking, enabling them to analyze and evaluate subject content more deeply.

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Question 5: What changes have occurred in the role of teachers in the blended learning course compared to traditional face-to-face teaching?

Through the thematic coding of Online Support and Interactivity, Cultivation of Learning Styles and Abilities, Application of Teaching Methods and Resources, Practice Orientation and Practical Operations, and Assessment and Feedback, a comprehensive analysis was conducted to summarize the changes in the role of teachers in blended learning. In conclusion, blended learning enables teachers to provide more real-time interaction and support through online platforms, fostering enhanced interaction with students and strengthening the teaching atmosphere. In blended learning, teachers prioritize cultivating students' autonomous learning abilities, encouraging them to choose learning methods and subject content based on personal interests and preferences. There is a focus on developing students' comprehensive abilities and instilling in them independent thinking and problem-solving skills. Teachers employ a more flexible use of diverse teaching methods, combining online resources and traditional materials to enhance the diversity and interest of classroom activities. There is an increased emphasis on practice-oriented teaching, helping students better apply theoretical knowledge to real-life scenarios through practical operations and targeted development of problem-solving skills. Through online platforms, teachers can provide more timely interaction and feedback mechanisms, promoting communication among students and gaining a more comprehensive understanding of their learning situations.

Question 6: How has the role of students changed in the blended learning course compared to the traditional face-to-face mode?

Based on student responses, four thematic codes were designed: Learning Modes and Time Management, Independent Learning and Problem-Solving Skills, Technological Application and Practical Skill Development, and Expansion of Subject Knowledge. An analysis was conducted to explore the changes in students' roles in blended learning. The analysis indicates that in blended learning, students have more flexible learning schedules, allowing them to freely arrange their study plans and progress. Students engage in deeper reflections on the subject matter, emphasizing a profound understanding of theoretical knowledge and enhancing their problem-solving abilities. Blended learning emphasizes practical tasks, fostering students' practical problem-solving skills and better transforming theoretical knowledge into practical skills. Students can utilize online subject resources more extensively, enriching the avenues through which they acquire subject knowledge.

Based on the NVivo analysis, the summarized learning experiences of sports science students in the blended teaching based on Superstar were as follows:

1. The blended learning model based on Superstar met their expectations. Their expectations for blended learning mode were mainly evaluated in terms of flexibility in learning time and location, richness of teaching resources, and autonomy in learning content.

2. Compared to traditional face-to-face teaching, students felt that the role of teachers and students in blended learning based on Superstar had changed. Teachers transformed from instructors to guides, while students transformed from passive receivers to active learners.

3. Based on the blended learning approach, learning interest and motivation were improved, and the relevant knowledge and techniques of table tennis were better mastered, enhancing self-learning ability, teamwork ability, and innovation ability.

4. Poor technical operation and self-management abilities were challenges encountered in blended learning.

Conclusion

According to the results of independent samples t-tests, the null hypotheses were all rejected. After using the blended learning model based on Superstar, students' learning effectiveness was improved. By comparing the improvement (post-test minus pre-test) between the control group and the treatment group, students' learning engagement, skill performance, and professional competence were improved after using this teaching model.

Based on the feedback from the open-ended questionnaire, students were satisfied with this teaching model, they thought this teaching model supplied them with a more effective way to learn and practice table tennis.

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The findings of this research indicated that the teaching effectiveness of this blended approach was greatly improved compared with traditional physical education teaching methods. Students had a positive attitude towards the teaching experience of blended learning based on Superstar, believing that its teaching mode had increased their interest and motivation in learning, stimulated their awareness of self-directed learning, and improved learning efficiency.

Discussion

This study found that the integration of a blended learning model based on Superstar had an effective influence on students' learning of table tennis. Just as Khachatryan (2020) stated in the research, the blended learning method created a positive and effective learning environment while enhancing the teaching process.

After an 8-week teaching experiment, it was observed that the p-values for students in terms of learning engagement, skill performance, and professional competence were respectively: $p = .006$, $p = .037$, $p = .005$. All of these values are less than 0.05, indicating significant differences in statistical terms. Moreover, the scores in all three aspects based on blended learning through the learning management system were higher than those in traditional face-to-face learning.

The results were consistent with previous research findings indicating that blended learning enhances student learning engagement (de Moura et al., 2021), improves students' professional skills (Garrison & Akyol, 2015), and enhances students' problem-solving abilities and professional competence (Zhang et al., 2018). The p-value for professional competence is 0.005, indicating the maximum level of difference. The assessment of professional competence includes assignments, instructional organization, teamwork, and on-the-spot judging. This section of the assessment emphasizes how students apply theoretical knowledge to professional practice (Mulder, M., 2014).

The research sample for this study was only from two classes of second-year students majoring in Leisure Sports at the School of Sports Science at Anshan Normal University. In future experimental research, the comparison time of the experiment can be extended from different grades to different sports colleges and majors.

Recommendation

The results of this research showed it was an effective way to integrate the Superstar application in teaching table tennis. Blended learning based on Superstar could exert great impacts on teaching activities and would be a new way of integrating technology in physical education. Therefore, teachers and students can take Superstar as a new way of physical education.

It is also feasible to apply blended learning based on Superstar to experimental research on different groups and projects to verify its teaching effectiveness in the future. This research also gives some hints to educational institutions and software developers to use and develop more applications to improve teaching effectiveness.

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