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# Effects of Using Virtual Reality Technology on Forehand and Backhand in Table Tennis

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**Abstract**

**Background and Aim:** The purpose of this study is to evaluate the effects of using virtual reality technology on forehand and backhand in table tennis, and to investigate whether it can enhance the skill level and sports learning interests of college students. The research will explore the practical value of virtual reality applications in physical education and evaluate their potential to enhance the effectiveness of table tennis training.

**Materials and Methods:** This study selected male students from the Guang Dong Engineering Polytechnic's physical education classes of 2023, who are non-sports majors and aged between 18 and 20 years old. Utilizing a table tennis skills assessment, 40 participants were systematically assigned to two groups, an experimental group and a control group, with 20 individuals in each group. The mean and standard deviation of the participant's responses were calculated from the collected survey data. Both the pre-experimental and post-experimental tests, conducted after an 8-week training period, were statistically analyzed using the t-test.

**Result:** The experimental results showed that: 1. Virtual reality technology could not effectively improve the physical fitness of the control group and the experimental group; 2. There was no significant difference in the sports learning interest of the control group whether pre-test or post-test, the experiment under the traditional teaching methods; 3. The experimental group's sports learning interest was significantly improved under the intervention of virtual reality technology; 4. There was a significant difference in sports learning interest between the control group and the experimental group in the post-experimental result analysis. 5. The paired sample t-test of each group was carried out for the skill test after the experiment between the control group and the experimental group. The results showed that the skill level of both groups was significantly improved after the experiment, but the skill level of the experimental group was higher than that of the control group under the influence of virtual reality technology.

**Conclusion:** The scientific application of virtual technology in physical education classrooms should not only give full play to the actual functions of physical education but also ensure the rationalization of the exercise time in physical education classrooms, which is a new problem that needs to be considered in physical education courses in the future. At the same time, the school's emphasis on the informatization of physical education is an urgent part of the current virtual reality technology in the use of university physical education classrooms, which has a long way to go and requires the investment of time and cost and the accumulation of practical proof.

**Keywords**: Virtual reality; Table tennis; Forehand and backhand; Physical education courses

## Introduction

The National Congress of the Communist Party of the People's Republic of China has repeatedly emphasized that "sports can carry the dream of national prosperity and national revitalization." Accelerating the development of a sports power and fostering a positive Chinese sports spirit represent new missions that endow sports with functions in the new era. Fan and Zhang (2022) have noted that young people's value formation is influenced by multiculturalism, and the impact of political education is limited. They propose that integrating ideological and political practice strategies into the physical education curriculum can enhance students' ideological and moral education. Li and Li (2021) have suggested that research and practice are necessary to fully understand and leverage the role of physical education to achieve the goal of promoting moral education in the People's Republic of China.

On the other hand, in practical operations, physical education classes continue to exhibit characteristics of intense technical teaching and relatively singular methods and means. To maximize students' interest in physical education classes, teachers should respect the students' primary position in the teaching process and meet their personalized exercise needs, thereby promoting and stimulating their love for sports from within (San, 2014: 149). Currently, the offline teaching methods of physical education teachers often adhere to convention and lack innovation, making it difficult for students to maintain a sustained passion for sports, and a low learning atmosphere is not conducive to improving the quality of classroom teaching (Sun, 2021: 42). Integrating entertainment and information technology into physical education teaching is one of the effective ways to diversify teaching methods. In physical education teaching, the one-way inculcation of theoretical knowledge and simple



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demonstration of basic movements should be reduced, and information technology should be used to allow students to intuitively feel the technical movements they need to learn in physical education classes through vivid and interesting images (Roussou, 2004: 5). This teaching model has the potential to change students' learning behaviors, encouraging them to shift from passive recipients of knowledge to active explorers.

Informational teaching in college physical education classrooms can be significantly enhanced through the use of Virtual Reality (VR) technology, which adds an entertaining dimension to the learning experience. This technological equipment transcends the limitations of time and space, offering a more realistic personal experience characterized by immersion, interactivity, and imaginativeness (Su, 2021: 17-20). According to researcher Sun (2020), "The advantages of VR technology in virtual teaching are evident in its ability to display the spatial structure of physics and architecture, allowing teachers and students to freely observe and learn from various details and structures from multiple perspectives and directions." Zou (2019) put his options that VR technology, through scenario-based virtual teaching, can improve the English learning system and elevate students' oral English proficiency, thereby providing a feasible application of VR technology across other disciplines. Internationally, VR technology has been integrated into educational applications such as simulation teaching and medical experiments (Wang, 2019: 55). The application of VR technology products is no longer confined to the gaming industry; the demand for information technology across various sectors is on the rise. As a fundamental social service industry, the education sector anticipates the widespread adoption and application of VR technology. The integration of VR technology with physical education classrooms has the potential to break away from traditional, singular teaching methods, enabling students to immerse themselves in virtual environments, explore, and perceive created scenarios. This approach enlivens the teaching process, making it more vivid and engaging, which in turn enhances students' interest in learning and fosters more effective communication between teachers and students.

With the rapid advancement of "Internet Plus Education" information technology, universities around the world are actively adopting multimedia and intelligent teaching methods to optimize the educational environment and integrate teaching resources. This initiative aims to accelerate the deep integration of information technology with innovative teaching methods. In China, comprehensively deepening educational reform is an important goal for promoting educational progress in the new era. It is not only an effective means of achieving educational goals but also a key pathway to cultivating high-quality professional talents needed for the new era.

Against the backdrop of educational development in the new era, the Chinese government is actively advocating a shift from the traditional rote-learning teaching model to a more innovative paradigm. This transformation is not only a response to policy calls but also an inevitable requirement of educational development itself. Educational reform should take talent cultivation and the transformation of the education system as new starting points, with special emphasis on the coordinated development of macro and micro aspects of teaching reform.

At the macro level, educational reform should focus on innovation in educational philosophy and teaching systems. At the micro level, reform should concentrate on the innovation and improvement of the teaching curriculum system, content, methods, and means. Encouraging diversified and personalized teaching forms in practical teaching, and correctly guiding the development of students' interests and independent learning abilities, lays a scientific and practical foundation for the realization of modern education. This contributes to the renewal of educational concepts and the reform of the educational model system, further promoting the development of modern education.

The central objective of contemporary educational reform and innovation is to transition from the conventional teacher-centered pedagogical model, which often leans towards a unidirectional knowledge transmission approach. The focus of the reform shifts towards nurturing students' abilities in independent thinking and proactive exploration. Stimulating learners' interests stands as the primary mission of educational reform, with the ultimate aim of enhancing their learning literacy and instilling a philosophy of lifelong learning. In light of this, virtual reality technology, as an emerging



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instructional tool, aligns closely with the principles of information technology in modern Chinese education and is anticipated to play a pivotal role in the educational sector.

This reform is expected to redirect the educational paradigm from one that is instructor-driven to one that empowers learners, fostering a more interactive and engaging learning environment. The integration of virtual reality technology is seen as a significant step forward, offering immersive and interactive experiences that can transform the way knowledge is conveyed and absorbed. As such, it is poised to become an integral part of the educational landscape, aligning with the progressive educational strategies and technological integration advocated in China's modern educational framework.

Table tennis, as one of China's most dominant sports, enjoys immense popularity among college students, particularly in elective physical education courses, where it constitutes a significant proportion. Mastering the forehand attack and backhand block techniques is fundamental to university table tennis curricula and is essential for acquiring practical table tennis skills. However, current table tennis teaching in Chinese universities is confronted with several pressing issues that require resolution. The teaching methods are often outdated and simplistic, the training approaches lack innovation, and there is an overemphasis on technical skills at the expense of tactical instruction. Moreover, there is a discrepancy between teachers' expectations and students' learning outcomes, with students often having a weak foundation in table tennis theory. The evaluation of skills tends to overlook the assessment of attitude and emotion, which is detrimental to stimulating students' interest and engagement in learning.

This study aims to investigate how to enable students to fully grasp the knowledge and skills of table tennis forehand and backhand techniques within the class hours stipulated by the curriculum objectives. Additionally, the research will focus on establishing the student's central role in learning, enhancing their interest in physical education, and fostering a consciousness for lifelong physical exercise.

The reform and innovation of table tennis teaching methods are crucial for aligning with modern educational strategies that emphasize student-centered learning and the development of a holistic approach to physical education. By addressing these challenges, the study seeks to contribute to the advancement of table tennis education and its integration into the broader goals of nurturing a healthy and active student population.

## Objectives

1. Main objective

Investigating the impact of virtual reality technology on physical fitness, sports learning interest, and skills in table tennis: a focus on forehand and backhand techniques.

2. Subsidiary objectives

2.1 To investigate the virtual reality could improve the subjects' physical fitness.

2.2 To explore the virtual reality technology and whether could increase the subjects' sports learning interest.

2.3 To verify that virtual reality technology could enhance the subjects' skill test.

## Literature Review

*1. Virtual Reality Technology*

The scholar Li (2019) proposed that: Virtual reality technology is a simulated environment generated by a computer, and users can "enter" the simulated environment by wearing a motion-sensing device linked to a computer, which can provide experiments with interaction with things in the simulated environment. An emerging technology for experiencing immersion. Users are immersed in the simulated environment of virtual reality technology, which has the characteristics of interactivity and imagination (Foley, 1987: 132).). Virtual reality technology has become a new term for advanced human-machine interface interaction technology in the computer industry, which is committed to establishing network interactivity, immersion, and imagination. Great progress has been made in virtual reality technology to enable users to have a truly immersive experience. Chen and Yao (2006) proposed that users can use various high-quality technologies, such as computer network technology,



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artificial intelligence, physics engines, multi-sensor technology, and computer graphics. The application of virtual reality technology to sports and education is considered to be a revolutionary development of educational technology.

It creates a completely different learning environment, changes traditional teaching methods, opens up new ways to acquire knowledge and skills, and stimulates people's interest in learning. Most of the scenes in virtual sports facilities created by virtual reality technology are proposed, and the training content can be updated according to the needs of teaching content so that education and teaching can keep up with the pace of The Times. At the same time, virtual reality technology has strong interactivity, and students can devote themselves to the virtual environment and experience the fun brought by sports. In a virtual learning system, students can practice over and over until they acquire skills. The introduction of virtual reality technology has brought a revolution to traditional teaching methods and teaching means. As proposed by the Ministry of Education in China (2016): "The application of information technology in teaching is an important way and means to improve teaching quality."

*2. The Development of Virtual Reality Technology in Sports Training*

Fink and Warren (2009) mentioned that in various sports, cooperation between teammates is particularly important in the process of competition, which affects the application of tactical decisions. Through the MASCARET virtual reality platform, a virtual reality 3D environment CopeFoot was designed to support the learning and practice of football tactical decision-making. CopeFoot uses situational reasoning as an educational platform on which virtual characters activated by players perceive, decide, and act to create and respond to situations on the football field. CopeFoot is designed to mimic the process of how elite players make decisions and act in real environments. Bossard et al. (2011) demonstrated the use of virtual characters to create a virtual reality environment to train football players to make tactical decisions. The "CopeFoot Virtual Person" trains new football players to make tactical decisions by presenting various tactical problems during the interaction between the virtual person and the player. It can train novice soccer players to make tactical decisions by presenting various tactical issues during virtual human interaction with the player. For example, a virtual person can initiate an attack, forcing the player to think about counterattack tactics.

In various sports events, to enable athletes to have excellent athletic performance and make effective play for the victory of the game on the field, effective and scientific training is needed in the peacetime training process. In addition to excellent physical quality, many sports also have high requirements for athletes' ability to predict. The "outfielder problem" refers to the ability of a football outfielder to decide where to run to catch the ball. By using virtual reality technology to study open skills to solve the "fielders problem", the virtual reality environment projected a flying rugby ball in 16 modes, designed to train the fielders' ability to anticipate, and the results showed that half of the balls (50%) were recorded as successful catches. Zaal et al. (2010) used another virtual reality system (CAVE) to study the "fielder problem" and found an 80% success rate.

By comparing subjects' performance in learning several Tai Chi movements in a two-dimensional video system and a three-dimensional immersive environment. Subjects were randomly assigned to either two-dimensional or three-dimensional conditions, and the subjects learned Tai Chi movements by imitating the "teacher" in each system. Practice performance was videotaped during the learning process and evaluated by two experts using a 13-point scoring system. Results showed that participants in both conditions improved their skills, but those in the 3D immersive environment achieved better results than those in the 2D environment (Patel et al., 2006: 89-91). By analyzing the characteristics of sports items, virtual reality technology simulates sports situations close to reality, so that athletes can practice various conditions in the process of sports, and transfer them to the training or competition in reality, to achieve the purpose of improving sports performance and competition results. It can be seen that the effect of virtual reality technology on solving problems in sports training is obvious.

*3. The Application of Virtual Reality Technology in Table Tennis*

To enable users to interact stably with table tennis in a virtual reality environment, an algorithm for direct interaction between reality and virtual objects is proposed. By using a virtual environment locator as the main input device, a data exchange channel between devices is constructed, so that the



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state of racket motion can be updated in real-time (Huang & Zhang, 2022: 168). The results show that the algorithm and the data transmission channel between the real and virtual objects can provide a high-precision and real-time interactive table tennis activity in the virtual reality environment. Compared to the real environment, the user can pick up the ball with just one click, and the virtual ping-pong ball is not disturbed by the wind (Wang et al., 2020: 54).

The development of virtual reality technology and the sports industry promotes virtual reality products to enter the "consumer level", and sports applications related to virtual reality technology provide new choices for people to face future sports (Yang et al., 2020: 95). The sports application of virtual reality technology integrates the characteristics of gamification, and provides a rich variety of personalized sports environment for the experiment in a more novel way. The application of virtual reality technology in the field of table tennis is developing steadily, especially the most representative of simulation training, simulation competition, and scene experience.

## Conceptual Framework

The conceptual framework of this research is as follows:

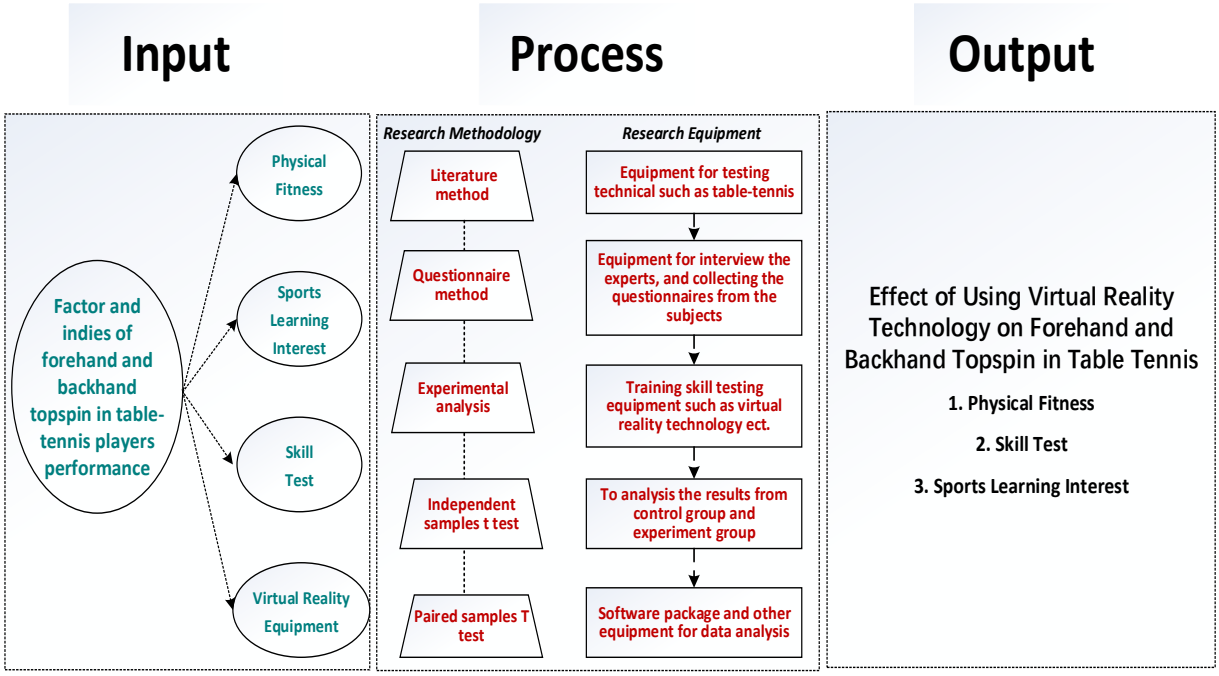


**Figure 1** Conceptual framework

## Methodology

### 1. Research Tools

1.1 Experts interview: to interview 7 experts setting some interview outlines, and preparing some pens and papers.

1.2 Questionnaires: after the subjects finished the experiment, they were asked to fill out some questionnaires.

1.3 8-Week Training Program: distribute the training plans to the control groups and experimental groups separately.

1.4 Virtual reality technology machine equipment: virtual reality technology control platform, through the import of external video remote operation output, to achieve one-to-many background control function. Projection screen computer-assisted display, a transmission device display to the screen and then reflected to the human eye display AIDS.

1.5 Virtual reality technology glasses: Pico-Neo 3 virtual reality headset, also known as virtual reality glasses, its headset is designed to close people's vision and hearing to the outside world and guide users to immerse in a virtual environment.



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1.6 Table tennis equipment: table tennis rackets 20 pairs, table tennis tables 10, table tennis balls 10.

1.7 Test scales.

**2. Population and Sample**

The subjects are non-sports majors in grade 2023 of Guang Dong Engineering Polytechnic, and they are all selecting table tennis courses. There are a total of 279 students divided into 9 classes, who are learning the table tennis physical education course for one semester, and there are 176 male students. The sample size was determined to be 30 subjects for an effect size of 1.06 based on the suggestions from Cohen (1988) and a previous study that educated nurses on pressure injuries using the G*Power 3.1.9.2 program, calculated for power 0.8 and significance level 0.05. However, considering a 30% dropout rate. For the table tennis skill testing, 40 subjects were systematically method into two groups, the experimental group and the control group, with 20 people in each group.

**3. Data Collection and Analysis**

3.1 To find the literature review to collect the relevant indicators and learning status of the training program, set questions and verify the IOC value = 0.571-1.00

3.2 To distribute some questions to 5 professional table tennis coaches, the suggestions for the training plan were collected, and the preliminary draft of the training plan was designed.

3.3 To collect the data after an 8-week experiment.

3.4 Descriptive statistics, calculating mean and standard deviation of subjects from collected questionnaires.

3.5 The pre-test before the experiment and the post-test after 8 weeks of training were analyzed by ANOVA repeated measurement.

**4. Qualitative analysis method**

Based on the guidance of authoritative papers, this paper analyzes the collected materials by consulting and quoting relevant arguments, using methods such as induction, deduction, and abstraction, selecting materials useful to the thesis, and discussing from the outside to the inside, to provide theoretical support for the innovative construction of physical education classroom teaching model.

**5. Exploratory approach**

This paper uses the existing authoritative research and virtual reality technology information to seriously explore and create new knowledge on the existing materials, discusses the feasibility of virtual reality technology on the construction and application of college physical education courses, and proposes feasible applied research plans.

## Results

*1. Virtual reality technology in table tennis forehand and backhand topspin teaching application object homogeneity detection*

Before the experiment, the virtual reality group and the traditional group showed good consistency in all aspects, to lay a good foundation for the subsequent intervention teaching of virtual reality technology. Based on this situation, the homogeneity test was carried out on the physical quality, learning interest, and motor skills of the tested students to ensure the fairness and reliability of the experiment. In this study, one-way analysis of variance was used for data analysis to test whether the differences between the mean values of multiple groups were statistically significant. If the univariate analysis results were statistically significant ($p<0.05$), it indicated that at least one group had a different mean from the other group, and the difference between different groups was obtained by further combining the least significant difference method. If the results of one-way ANOVA were not statistically significant ($p>0.05$), it indicated that there was no statistical difference in the mean difference between the groups.



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**Table 1** Analysis results of the t-test on all indexes of two groups before the experiment (*n*=40)

| Test Item | Group (mean ± standard deviation) | | *t* | *p* |
|---|---|---|---|---|
| | Control (*n*=20) | Experiment (*n*=20) | | |
| **Physical fitness** | | | | |
| Vital capacity | 3851.15±625.34 | 4122.35±519.95 | -1.491 | 0.144 |
| Sit in a forward bend | 240.05±23.38 | 239.40±20.24 | 0.094 | 0.926 |
| Standing long jump | 23.75±7.58 | 23.21±5.00 | 0.271 | 0.788 |
| Pull-up | 7.30±4.91 | 7.00±4.21 | 0.208 | 0.837 |
| **Sports learning interest** | | | | |
| Active interest | 29.40±6.92 | 29.40±3.80 | 0.000 | 1.000 |
| Negative interest | 41.80±10.64 | 37.80±9.47 | 1.256 | 0.217 |
| Independent and inquiry learning | 30.40±6.32 | 28.55±4.67 | 1.053 | 0.299 |
| Sports participation | 28.05±4.87 | 28.35±3.22 | -0.230 | 0.819 |
| Concern for sports | 18.10±4.98 | 18.25±2.31 | -0.122 | 0.904 |
| **Skill test** | | | | |
| Forehand topspin | 3.57±1.68 | 3.70±1.64 | -0.252 | 0.802 |
| Backhand topspin | 5.91±1.69 | 5.70±1.63 | 0.412 | 0.682 |

"*" means $p<0.05$, the difference is significant. "**" means $p<0.01$, the difference is very significant.

Through the sorting and analysis of the experimental data, the homogeneity of the physical fitness, sports learning interest, and skill test of students in the virtual reality technology teaching group and the traditional teaching group was tested. The test results are shown in Table 1 above: The results showed that there was no significant difference between the virtual reality technology teaching group and the traditional teaching group in the homogeneity detection of physical fitness, sports learning interest, and skill test, which met the research conditions.

**2. The influence of virtual reality technology in the teaching method of table tennis forehand and backhand topspin**

2.1 The influence of the virtual reality technology experiment group and traditional group on physical fitness after the experiment

After 8 weeks of teaching training, it can be seen from the statistical results of the table: After the independent sample t-test, the physical fitness difference between the virtual reality technology teaching group and the traditional teaching group after the test is shown in Table 2: vital capacity ($p=0.348>0.05$), standing long jump ($p=0.005<0.01$), sit in a forward bend ($p=0.893>0.05$), pull-up ($p=0.649>0.05$). The results showed that there was no significant difference between the experimental group and the traditional teaching group in physical fitness test data values except for the standing long jump. It can be seen that after the addition of virtual reality technology based on traditional teaching, the physical quality of the tested subjects has not been significantly improved.

**Table 2** Analysis results of the test on physical fitness indexes of two groups after experiment (*n*=40)

| Group (mean ± standard deviation) | Vital capacity | Standing long jump | Sit in a forward bend | Pull-up |
|---|---|---|---|---|
| Control group (*n*=20) | 4275.75±763.15 | 243.30±18.62 | 24.41±8.00 | 7.10±4.44 |
| Experiment group (*n*=20) | 4093.10±386.00 | 223.70±22.63 | 24.70±5.22 | 6.50±3.80 |
| *t* | 0.955 | 2.991 | -0.136 | 0.459 |
| *p* | 0.348 | 0.005** | 0.893 | 0.649 |

"*" means $p<0.05$, the difference is significant. "**" means $p<0.01$, the difference is very significant.



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2.2 The influence of virtual reality technology experiment group and traditional group on sports learning interest after experiment

Table 3 shows the data changes of the test subjects' physical education sports learning interest before and after the experiment, and the results are shown: the t-test results showed that there were no significant differences in the 5 sub-dimensions of sports learning interest in the traditional group, and the results showed that the improvement of physical education learning interest did not change much under traditional teaching.

However, the t-test results showed that there were significant differences in the 5 dimensions of sports learning interest in the experimental group compared with the previous ones (active interest=-2.954, $p<0.01$; negative interest=-5.019, $p<0.01$; independent and inquiry learning=-4.837, $p<0.01$; sports participation= -5.897, $p<0.01$; concern for sports=-3.419, $p<0.01$). Overall, there was no significant change in sports learning interest (sports learning interest=-6.520, $p<0.01$), and the results showed that the students in the experimental group significantly improved their sports interest in physical education learning with the assistance of virtual reality technology.

**Table 3** Analysis results of paired sample t-test of sports learning interest after two groups ($n$=40)

| Group (mean ± standard deviation) | Sports learning interest | Active interest | Negative interest | Independent and inquiry learning | Sports participation | Concern for sports |
|---|---|---|---|---|---|---|
| Control group pre-test ($n$=20) | 147.80±22.89 | 29.40±6.92 | 41.80±10.64 | 30.40±6.32 | 28.05±4.87 | 18.10±4.98 |
| Control group post-test ($n$=20) | 154.10±28.94 | 31.95±5.48 | 41.55±12.68 | 31.85±6.33 | 30.35±5.98 | 18.40±4.85 |
| $t$ | -0.764 | -1.292 | 0.068 | -0.725 | -1.334 | -0.193 |
| $p$ | 0.450 | 0.204 | 0.947 | 0.473 | 0.190 | 0.848 |
| Experiment group pre-test ($n$=20) | 142.55±16.67 | 29.40±3.80 | 37.80±9.47 | 28.55±4.67 | 28.35±3.22 | 18.25±2.31 |
| Experiment group post-test ($n$=20) | 177.40±17.13 | 33.35±4.61 | 52.20±8.66 | 35.20±3.99 | 35.25±4.13 | 21.40±3.41 |
| $t$ | -6.520 | -2.954 | -5.019 | -4.837 | -5.897 | -3.419 |
| $p$ | 0.000** | 0.005** | 0.000** | 0.000** | 0.000** | 0.002** |

"*" means $p<0.05$, the difference is significant. "**" means $p<0.01$, the difference is very significant.

2.3 The experiment group was compared with the traditional group in all dimensions and the total sports learning interest group after the experiment

In the analysis of the effect of virtual reality technology on the forehand and backhand topspin of table tennis on the various dimensions of college student's interest in physical education classrooms, after 8 weeks of teaching training, it can be seen from the statistical results of table 4 that after the independent sample t-test, the sports learning interest of the experiment group and the traditional group was different. As shown in table 4, the dimensions of active interest were $p=0.388>0.05$, the dimensions of negative interest were $p=0.004<0.01$, the independent and inquiry learning were $p=0.054>0.05$, the dimensions of sports participation were $p=0.005<0.01$, and the dimensions of concern for sports were $p=0.029<0.05$. The results showed that after 8 weeks of experimentation, the sports learning interest of students in the experimental group was significantly higher than that of the traditional group, $p=0.004<0.01$. It can be seen that the intervention of virtual reality technology based on traditional teaching has a certain impact on the improvement of college students' sports learning interest in table tennis forehand and backhand topspin.

**Table 4** Analysis results of t-test of independent samples of sports learning interest in two groups after the experiment ($n$=40)

| Group (mean ± standard deviation) | Sports learning interest | Active interest | Negative interest | Independent and inquiry learning | Sports participation | Concern for sports |
|---|---|---|---|---|---|---|
| Control group ($n$=20) | 154.10±28.94 | 31.95±5.48 | 41.55±12.68 | 31.85±6.33 | 30.35±5.98 | 18.40±4.85 |



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| Group (mean ± standard deviation) | Sports learning interest | Active interest | Negative interest | Independent and inquiry learning | Sports participation | Concern for sports |
|---|---|---|---|---|---|---|
| Experiment group ($n$=20) | 177.40±17.13 | 33.35±4.61 | 52.20±8.66 | 35.20±3.99 | 35.25±4.13 | 21.40±3.41 |
| $t$ | -3.098 | -0.874 | -3.101 | -2.002 | -3.017 | -2.263 |
| $p$ | 0.004** | 0.388 | 0.004** | 0.054 | 0.005** | 0.029* |

"*" means $p$<0.05, the difference is significant. "**" means $p$<0.01, the difference is very significant.

**3. The influence of virtual reality technology on students' learning of table tennis skills of forehand and backhand topspin**

After 8 weeks of teaching training, it can be seen from the statistical results of the table that: After the independent sample t-test, there is a significant difference between the forehand topspin of the experiment group and the traditional t-group after the test experiment. Table 5 shows that the results showed a significant difference between the experiment group and the traditional group in the test data of forehand topspin skill level ($p$=0.027<0.05), and the experiment group was 1.17 higher than the traditional group. It can be seen that after adding virtual reality technology based on traditional teaching, the forehand topspin skills of the tested subjects have been significantly improved; There was also a significant difference between the experimental group and the traditional group in the test data of backhand topspin skill level ($p$=0.043<0.05), and the experiment group was 1.45 higher than the traditional group. It can be seen that after the addition of virtual reality technology based on traditional teaching, the backhand topspin technology of the tested subjects is also significantly improved.

**Table 5** Analysis of Variance of virtual reality teaching methods in table tennis forehand and backhand topspin techniques ($n$=40)

| Test item | Pairing (mean ± standard deviation) | | Difference | $t$ | $p$ |
|---|---|---|---|---|---|
| | Pre-test | Post-test | | | |
| Control forehand topspin | 3.57±1.68 | 4.77±1.70 | -1.20 | -5.052 | 0.000** |
| Experiment forehand topspin | 3.70±1.64 | 5.94±1.50 | -2.24 | -4.784 | 0.000** |
| $t$ | -0.252 | -2.304 | | | |
| $p$ | 0.802 | 0.027* | | | |
| Control backhand topspin | 5.91±1.69 | 7.97±2.24 | -2.05 | -7.403 | 0.000** |
| Experiment backhand topspin | 5.70±1.63 | 9.42±2.15 | -3.72 | -10.339 | 0.000** |
| $t$ | 0.412 | -2.089 | | | |
| $p$ | 0.682 | 0.043* | | | |

"*" means $p$<0.05, the difference is significant. "**" means $p$<0.01, the difference is very significant.

The findings indicate that there were no significant differences in physical fitness or interest in sports learning within the control group between the pre-test and post-test measurements. However, a significant difference was observed in the skill test. Following 8 weeks of training, the teaching methods employed by the control group were effective in enhancing students' skill levels.

In contrast, the experimental group exhibited no significant changes in physical fitness pre-experiment and post-experiment. Nevertheless, there were highly significant differences in sports learning interest and skill test outcomes, demonstrating that the integration of VR technology can substantially elevate students' interest in sports learning and their skill levels.

Furthermore, the results revealed no significant differences in physical fitness between the two groups after the experiment. However, the experimental group showed a markedly higher level of interest in sports learning and skill test performance compared to the control group.



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## Conclusion

1. Significant skill improvement in the control group: After eight weeks of training, the teaching methods utilized by the control group effectively enhanced the student's skill levels, although there were no significant differences observed in physical fitness tests or interest in sports learning.

2. Marked increase in interest and skill in the experimental group: The experimental group showed a significant improvement in interest in sports learning and skill test outcomes, indicating that the integration of Virtual Reality technology can substantially increase students' enthusiasm for sports learning and their proficiency in skills.

3. No significant difference in physical fitness between groups: Post-experiment, no significant differences were found in physical fitness between the two groups.

4. Superior interest and skill performance in the experimental group: Compared to the control group, the experimental group demonstrated a notably higher level of interest in sports learning and superior performance in skill tests.

In summary, the application of VR technology has shown positive effects in increasing students' interest and skill levels in sports learning, while traditional teaching methods have been effective in improving skills but have had little impact on physical fitness and interest.

## Discussion

The superior performance of the experimental group in terms of interest in physical education and skill test results holds significant implications across various dimensions. Firstly, it indicates that the innovative teaching methods or technologies employed by the experimental group effectively stimulated students' motivation and engagement in learning. Specifically, the experimental group may have adopted more interactive and immersive teaching approaches, such as Virtual Reality technology, offering students a novel learning experience that has enhanced their interest in physical education.

Furthermore, the outstanding performance of the experimental group in the skill tests also reflects the effectiveness of these teaching methods or technologies in improving students' athletic skills. This could be related to the teaching strategies employed by the experimental group, which place a greater emphasis on practical application and refined skill training, allowing students to rapidly improve their skill levels through repeated practice and immediate feedback.

In contrast, although the control group also showed some improvement in skill tests, the overall enhancement was not as pronounced as that of the experimental group. This may suggest that the traditional teaching methods used by the control group have certain limitations in stimulating students' interest and improving their skills. The control group may have relied more on theoretical lectures and standardized training, which might not be sufficient to fully engage students' enthusiasm for learning and innovative thinking.

In summary, the excellent performance of the experimental group underscores the importance of adopting innovative methods in physical education teaching. Not only does this enhance students' interest in learning, but it also promotes the comprehensive development of their skills. Therefore, educators and policymakers should consider integrating these innovative methods into physical education to achieve higher-quality educational outcomes. At the same time, this also suggests that in conducting educational research and practice, we need to continuously explore and try new teaching strategies to adapt to the ever-changing educational demands and the characteristics of learners.

## Recommendation

### 1. Applying research results

Virtual reality technology provides a variety of teaching methods for indoor physical education courses on rainy days. The teaching methods of physical education teachers on rainy days are generally based on sports competition video appreciation, sports skills theoretical knowledge lectures, students' free speech, and other modes. To a certain extent, the introduction of virtual reality technology in physical education classes can enhance students' interest in physical education courses on rainy days. Meet the needs of teachers' theoretical teaching. The state encourages universities to carry out professional courses in e-sports games, and physical education teachers can apply them in indoor classes on rainy days according to the needs of social sports development and add ways for



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small groups to expand e-sports games, to make indoor sports classes more interesting and enhance students' collective cohesion.

**2. Future research**

Virtual Reality technology demonstrates immense potential in table tennis training. It enhances athletes' tactical comprehension and decision-making capabilities by simulating a variety of competitive scenarios and opponent strategies. Concurrently, the immersive environment is utilized for psychological conditioning, bolstering self-confidence and concentration to cope with high-pressure matches. Moreover, continuous refinements in VR equipment and software, particularly advancements in haptic feedback and motion capture, provide athletes with more realistic and interactive training experiences. The establishment of VR social platforms offers athletes new avenues for communication and online competition, further enriching practical experience. Synthesizing these applications, VR technology contributes to the holistic enhancement of competitive standards for college table tennis players.

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