Scholar Publishing Group
International Journal of Educational Innovation and Science
https://doi.org/10.38007/IJEIS.2022.030308
ISSN 2789-7184 Vol. 3, Issue 3: 68-91

Data Fusion Wearable Technology in the Teaching of College Table Tennis Elective Courses

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Keywords: Ping-Pong, Wireless Sensor, Teaching Methods, Intelligent

Abstract: In this paper, Intelligent sensors are used in college ping-pong teaching. The use of intelligent sensor-assisted teaching can effectively stimulate students' interest in learning and improve learning initiative. At the same time, combined with data fusion wearable technology to monitor sports conditions The use of intelligent sensor-assisted teaching plays an active role in the application and mastery of student ping -pong techniques, and the improvement of basic physical quality is not significant. The use of intelligent sensor-assisted teaching can form a continuous guidance with the improvement of students' ping-pong technical level, which is conducive to maintaining the enthusiasm of students to learn ping-pong for a long time and establishing a sense of lifelong participation in ping-pong.

1. Foreword

The rapid development of science and technology has brought about rapid changes in our production and life. More and more industries are opening up modern smart models. Intelligent transportation provides a real-time, accurate and efficient comprehensive transportation management system. Intelligent and healthy, we outline the remote digitalization, service network, diagnosis and culture of the medical field, and revitalize the country through science and education. Education is among the top strategies of China. Change is the first to bear the brunt. Taking computer and multimedia teaching aids as an example in traditional classroom teaching, the teaching content is changed from flat to stereo [1], from static to sports, from text to sound and image, which greatly enhances the vividness and interest of education and teaching. Mobilized the enthusiasm of students to learn. However, sports as a special education subject (with the training ground as the classroom and physical exercise as the main means), the changes in the new era are not impressive. Looking at the technical teaching of college physical education classrooms, most of

them use a fixed single teaching mode to guide all students in the class. It can't be denied [2], this traditional teaching practice mode can effectively complete the teaching tasks and help students to acquire the basic skills of ping-pong. However, from the perspective of the subjectivity, interest and the cultivation of life-long sports awareness, if we continue to adhere to the traditional single teaching mode, it is bound to be severely impacted [3].

1.1. Statement of Problem

At the beginning of the century, China carried out basic education reform. The comprehensive implementation of quality education marks the beginning of the reform of science education. The important goal of the reform is to change the traditional classroom teaching and learning methods, change the attitude change of students from passive acceptance of knowledge to active learning knowledge, and advocate students to spontaneously integrate into knowledge learning, and advocate that “student through self-practice [4-5], constantly improve inquiry and Innovative awareness, learning the methods of scientific research, and developing the ability to use knowledge comprehensively." Therefore, the quality education will be further promoted. In recent years, with the continuous deepening of Internet thinking in the entire education industry, the emergence of a variety of intelligent teaching aids and the rapid advancement of IoT technology have made it possible to rationally apply these modern devices in the classroom and in what form to impart knowledge and skills to students. It has become another major issue facing the current education reform [6-7].

As an important part of scientific research, data changes in the way of data will inevitably affect the changes in scientific research. With the rapid development of information technology and computer technology, human beings have achieved tremendous leap in their ability to collect, store, analyze, and use data. The wearable devices on the athletes, the sensors on the exercise equipment, the cameras inside and outside the training field, the terminal devices in the hands of the coaches, and the Internet have all promoted the application of big data in the field of sports science, and a large amount of data for sports training is widely used [8-9]. The collection, storage and application have injected new vitality. As a typical representative of intelligent emerging products in the information age, MEMS sensors are multi-disciplinary cross-cutting research fields based on microelectronics technology. They are small in size, light in weight, low in power consumption and high in reliability. High sensitivity and low price. Its combination with the conventional ping-pong racket greatly enriches the information resources on the ping-pong court in the era of big data. Under the premise of not limiting the specific hitting position and the number of hits on the field, the effective collection of the swing The dynamics and kinematic parameters of the ball process improve the objectivity of the quantitative evaluation of the player's performance feedback, and have the advantage that traditional high-speed photography can't match [10].

With the continuous research and development of sensing equipment, the data that can be collected is more and more abundant and accurate. Combined with the matching evaluation system and the simultaneous establishment of related APP application software, this kind of intelligent sensing equipment is provided to enter the college physical education classroom auxiliary teaching. There is no limit to possibilities. Intelligent sensor-assisted teaching is a reasonable application of wireless sensing technology in the traditional ping-pong technical action training session, helping students to objectively record the mechanical parameters such as speed, strength and arc of action during each ping-pong swing and hit the ball. The specific trajectory of the shot process will more clearly reproduce each 3D simulation of technical movements. This design not only enriches the

information resources of ping-pong training in the era of big data, but also feedbacks the performance of players in real time. On the other hand [11], it also deepens the education reform and builds a new teaching situation for the means and methods of big data in physical education. The value of sports science has been raised to a new level.

1.2. Research Purpose and Significance

At present, the teaching of ping-pong technology in colleges and universities still mostly stays in the single professor mode based on the subjective experience of teachers. In the process of teaching practice, many technical movements are completed in an instant, and there are many students in the classroom. Students' understanding and mastery of technical movements only follow the teacher's simple language expression and corrective guidance one by one. The self-perception and impromptu imitation of the actions they have learned are difficult to identify. Such learning is easy to float in appearance, and it is not easy to solidify to form a correct concept of movement, which directly affects the effectiveness of teachers' classroom teaching and the efficiency of students' mastery of technical movements [12-13].

Research combines traditional teaching methods and creatively uses intelligent sensor-assisted teaching methods. The study selects 26 boys in a special class of table tennis in a sports college as experimental subjects (age 21.88+-1.03 years old, height 174.80+-4.01 cm, weight 67.36+-7.09 kg), in the practice of ping-pong special course in normal teaching plan, according to The time requirements of the syllabus (see the appendix for the syllabus and teaching plan), using intelligent sensor-assisted teaching methods to compare with traditional teaching methods, complete ping-pong technology teaching [14-15]. Through the comparison of the effects of the experimental objects before and after the experiment, the students' learning effects in the teaching process and the specific application of smart sensors in college ping-pong teaching are explored. Verification of this kind of comparative analysis of numerical feedback parameters during the practice process, whether it can effectively guide students to correctly understand the action force, clarify the differences in the various aspects of ping-pong batting technique teaching, and recognize in a short period of time The essence and key of the technical action in this link, the ability to enhance learning initiative and master the essentials of ping-pong technology, and thus achieve the purpose of improving teaching effectiveness and learning efficiency. It provides theoretical research and practical basis for the implementation and development of intelligent sensor-assisted teaching methods in physical education in the future [16-17].

1.3. Research Hypothesis

Hypothesis 1: Using intelligent sensor-assisted teaching can help stimulate students' learning motivation and improve their interest in ping-pong learning.

Hypothesis 2: Using intelligent sensor-assisted instruction can achieve better teaching results.

Hypothesis 3: The use of intelligent sensor-assisted teaching can effectively stimulate students' self-evaluation awareness and enhance lifelong learning concepts.

1.4. Literature Review

1.4.1. Overview of Sensor Technology

As we enter the 21st century, information has become the first production factor and constitutes

an important technical material basis for the information society. Human social activities mainly rely on the development, acquisition, transmission and processing of information resources. It is based on this situation that sensor technology has penetrated into major fields such as production, life, and scientific research, and has been included in the three pillars of the information age.

1.4.1.1. Sensor Definition

Transduce / sensor Baidu Encyclopedia is defined by the "Popular China" authority: it is a kind of information that can feel the measured information, and can transform the perceived information into an electrical signal or other required form of information output. A detection device that satisfies requirements for transmission, processing, storage, display, recording, and control of information. Several common sensors are shown in Figure 1:

Figure 1. Several common sensors

1.4.1.2. Sensor Classification

Up to now, there are no fewer than 30,000 varieties of sensors, and their classification has not been clearly defined. We often divide into physical sensing, chemical sensing, and biosensing according to its working mechanism.

{Table 1 Sensors divided by measurement}

According to different measurements, the three types of sensors formed have their own technical fields. Biosensors are widely used in the military, medical, food industry, etc.; chemical sensors are often used in environmental protection, medical care, etc.; physical sensors are the earliest developed in the above-mentioned sensors, with extremely fast development and the widest coverage of application fields. The application areas of smart sensors are shown in Figure 2:

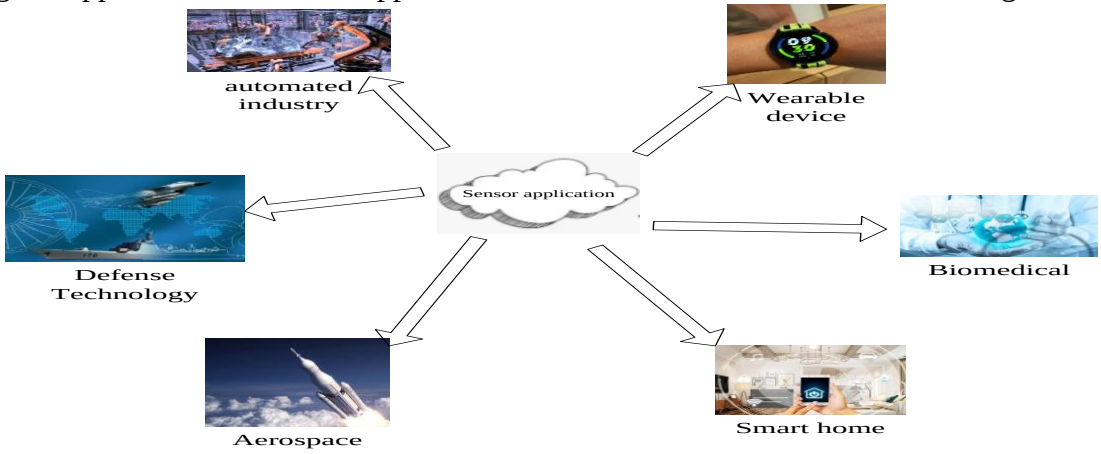

Figure 2. Application areas of smart sensors

1.4.2. Development History of Sensor Technology

With the improvement of our understanding of things and the continuous development of science and technology, sensor technology has generally gone through three stages:

The first generation is a structured sensor that uses structural parameter changes to sense and transform signals. For example, a resistance strain sensor, which converts an electrical signal by utilizing a change in resistance when a metal material is elastically deformed.

The second-generation sensor was a solid-state sensor that was developed in the 1970s. It consists of solid components such as semiconductors, dielectrics, and magnetic materials. It is made of certain properties of the material. Such as: using thermoelectric effect, Hall effect, photosensitive effect, respectively, made of thermocouple sensor, Hall sensor, photosensitive sensor. In the late 1970s, with the development of integration technology, molecular synthesis technology, microelectronic technology and computer technology, integrated sensors appeared. The integrated sensor consists of two types: the integration of the sensor itself and the integration of the sensor with subsequent circuits. For example: charge coupled device (CCD), integrated temperature sensor AD 590, integrated Hall sensor UG3501 and so on. These sensors are mainly characterized by low cost, high reliability, good performance and flexible interface. Integrated sensors are evolving very rapidly and now account for about two-thirds of the sensor market, moving toward low price, versatility and serialization.

The third-generation sensor, that is, the smart sensor, refers to its ability to detect, self-diagnose, data, and adapt to external information. It is a combination of microcomputer technology and detection technology. The early intelligent measurement mainly focused on the microprocessor, integrating the sensor signal conditioning circuit, microcomputer, memory and interface into a chip, so that the sensor has certain artificial intelligence. In the 1990s, the intelligent measurement technology was further improved, and the sensor level was intelligent, which enabled it to have self-diagnosis function, memory function, multi-parameter measurement function and network communication function. The evolution of sensor technology is shown in Figure 3.

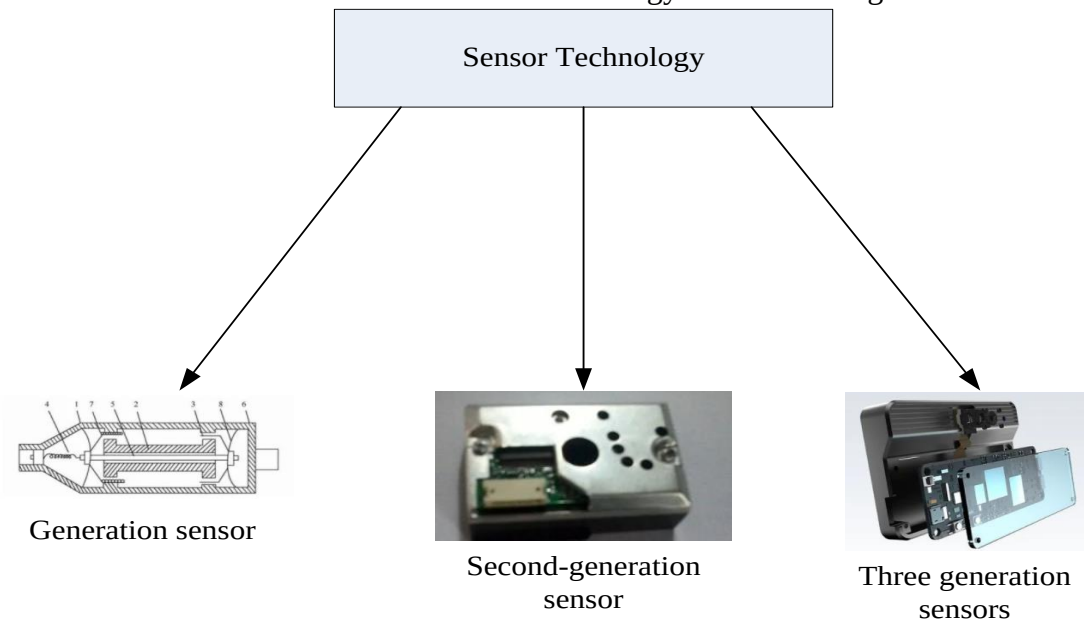

Figure 3. The evolution of sensor technology

The emergence of new technologies has made the development of sensors not only promote the transformation and upgrading of traditional industries, but also hope

The establishment of a new type of industry has become a new economic growth point in the 21st century. At present, China's sensor industry is in the critical stage of the development from traditional to new sensors, and the new technology is changing, which has led to the development of new sensors towards miniaturization, multi-functionality, digitization, intelligence, systemization and networking. The miniaturization is based on the micro-electromechanical system.

As a typical representative of the emerging products in the intelligent era, the MEMS sensor (Micro-Electro. Mechanical System) is based on the multi-disciplinary cross-cutting research field developed by MEMS based on microelectronics technology. The integration of related sensing elements such as inertial sensors (gyroscopes), accelerometers, electronic compass sensors and GPS receivers complements each other's interactions, making motion monitoring simple and more detailed and efficient. The dynamic parameters and motion trajectory of human body movement have the characteristics of small size, light weight, low power consumption, high reliability, high sensitivity and low price, which are more common in the field of sports training.

1.4.3. Research Status of Sensors in Sports Training at Home and Abroad

Foreign research on the application of sensors in sports training has been at the leading level. Earlier, Carlin V.C.Bouten and other scholars in the exploration of the relationship between human body motion acceleration and energy consumption, through the use of piezoresistive multi-axis acceleration sensor equipment to achieve the human body in the walking, running and other daily activities of motion acceleration records, Furthermore, the relationship between the obtained acceleration value and the human body's energy consumption is compared.

In important kinematic parameters that reflect human motion information, it is often used to obtain acceleration information for specific joint parts during human motion. Jim Ostrowski introduced an EGA (Enhanced Graphics Adapter) compact accelerometer. Such accelerometers are often found in conventional sports such as boating and hockey. Take the boating project as an example. When using the EGA sensor at the key points such as the shoulder, waist and paddle of the crew, the measured acceleration value is processed to realize the digital feedback of the force and the moving speed. In the hockey sport, the accelerometer is mainly placed on the hockey athlete's helmet to record the collision and injury in the measurement movement. In general, the device has the characteristics and functions of low cost, low power consumption, compact structure, etc., but it also puts high requirements on the sensitive axis direction of the acceleration sensor during installation.

Foreign scholars also try to use the sensing technology in golf to achieve the monitoring of swing technology. Watanabe et al. assembled the gyroscope on the head, arms, shoulders, back, and hips to analyze the motion technical diagnosis of the golf swing. The research results show that the golf technology quantitative analysis system based on the sensing device is feasible and can swing. The action forms an effective monitoring. Two foreign golf swing detectors are shown in Figure 4

Figure 4. Golf swing detector

With the rapid advancement of science and technology, sensor technology has also been widely used in the field of sports training in China.

Cao Xiaohu mentioned in the article "Design and Implementation of Motion System Based on Wireless Sensor Networks" that China's sports industry has made great strides towards sports informationization under the impetus of social informationization and knowledge. The real-time sports data monitoring network has become the core of sports informationization, which can achieve the purpose of quickly obtaining data. By extracting information that is useful for the scientific management of athletes in a large amount of data, and then making scientific sports training management decisions, the goal of improving athletes' skills and tactics is finally achieved.

Wang Yanxiu pointed out in the "Application Status and Research of Sensor Technology in Sports Field" that the application of sensor technology is following

China's emphasis on sports and sports science and technology has been continuously improved, and its scope of application has also achieved continuous breakthroughs. According to the different measurement quantities of sensors, it has been successfully applied in sports training, physiological and biochemical monitoring, competition referee systems, etc., and has also greatly promoted the development of sports in China.

Qin Yong explained in the article "Design of Sports Training System under Wireless Sensor Network" that in the design of sports training system, through the rational use of wireless sensor network technology, it can effectively improve the system application performance and enhance the sports training system. Interactivity in practical use. The conclusion shows that the sports training system designed by wireless sensor network technology can meet the needs of actual sports training and can exert positive influence. Liu Weimin described the application of the displacement velocity sensor in the real-time analysis of the lifting and pulling force process. Using the sensor technology, it is possible to test and obtain various data and corresponding data on the training of athletes without analyzing the muscle tissue of the athletes. The kinetic parameters have a high value.

Zhang Ruiming explained in the article "Multi-sensor and use in sports training, taking boating as an example", taking boating as an example, the action is completed in an instant, the quality of the athletes (especially the ability of the paddles), It is difficult to judge by the naked eye alone. With the society entering the information age, coupled with the reasonable use of motion training for accelerometers and pressure sensors, the instantaneous movements are digitized, allowing these abstract sports qualities to be intuitively quantified.

In the "Application and Development of MEMS Sensors in Tennis Training in the Background of Big Data", Jiang Ting stated that there are many types of MEMS sensors. Through the design

combined with tennis rackets, it is possible to effectively collect motion data for the characteristics of tennis sports. Among them, the mechanical sensor part can effectively collect the kinematics and dynamic parameters of the hitting process without restricting the player's hitting position and the number of hitting on the court, and has the advantage that traditional high-speed photography can't match. It can help to improve the objective evaluation of the player's batting performance; the sensing element used to record the change of the racket speed during the swing of the player and measure the acceleration of the carrier can effectively reflect the speed parameter during the swing process, and judge the ball The specific position of the contact with the racket and the vibration of the racket; the sensing part of the gyroscope can record the direction and trajectory of the player's swing, combined with the speed curve during the stroke, to evaluate the technical movement……

Although the sensor technology has been greatly developed in the field of sports training, the application research in the field of physical education in colleges and universities is still rare.

1.4.4. Research Status of ping-pong Teaching in Domestic Universities

As an important place to develop and promote ping-pong, colleges and universities play a pivotal role. However, most of the current high

The effect of the school's ping-pong course is not optimistic, and more or less problems restrict the efficiency of college ping-pong classroom teaching.

Li Mingzhe stated in the "Study on the Status Quo and Countermeasures of ping-pong Specialized Teaching in Physical Education Majors in Colleges and Universities in Jilin Province" that there are the following defects in the current situation of ping-pong special education in colleges and universities of Jilin Province: there are fewer ping-pong classes in school; the teaching content is single; There is not much time for practice, and there is a lack of enthusiasm for learning ping-pong courses; and because the gap between students' technical level is relatively large, teachers have not been able to use teaching methods flexibly.

Chai Chengjun stated in the "Study on the Present Situation of ping-pong Teaching in Some Universities in Shanghai" that the curriculum of ping-pong in Shanghai's colleges and universities is different. Some colleges have short class hours, boring teaching content, relatively monotonous teaching methods and means, venue equipment and other resources. Can not meet the actual teaching needs of ping-pong and other issues. Students are not satisfied with the overall evaluation of teachers' ping-pong teaching methods and methods.

In the "Investigation and Research on the Present Situation of ping-pong Teaching in Colleges and Universities in Jiangsu Province", Lin Dong pointed out that Jiangsu college ping-pong teachers are good at combining academic conditions and creating independent teaching materials. They can not be combined with the basic situation of ping-pong teaching in their own schools and the basic physical quality of students. Focus on differentiated treatment and targeted teaching.

Zhao Zhiqiang pointed out in the article "Current Situation and Suggestions of ping-pong Teaching in Colleges and Universities" that under the unified teaching mode of class, because the level of mastery of ping-pong skills of class students is not uniform, it is difficult for college teachers to meet the needs of all kinds of students in the teaching process. Different needs, to achieve teaching in accordance with the material. Moreover, the traditional ping-pong teaching method is monotonous, and the practice content is boring, which is difficult to effectively stimulate students' enthusiasm for learning.

Zhou Yu pointed out that the research on the status quo and development countermeasures of ping-pong teaching in colleges and universities in Hunan Province pointed out that the content of ping-pong practice teaching in colleges and universities has not changed much compared with

previous years, and it is difficult to reflect the innovation in teaching content. The organizational form is similar, and it has not been able to change with the development of ping-pong. From a macro perspective, it has not been able to fundamentally break away from the "one size fits all" phenomenon, directly or indirectly restricting the teaching effect.

The above research reflects that the ping-pong course taught by many colleges and universities is a bit boring, lacking novelty, complicated technical movements, and students' lack of interest in learning. The most prominent contradiction is that the teaching methods are too traditional, the teaching method is too single, and the interest in the learning process is not high and is in a passive learning state. Then, if we want to activate the classroom atmosphere and improve students' interest in learning, the primary concern is to make reasonable use of the fun of ping-pong teaching, not only to ensure that the content of the courses taught meets the learning needs of students, but also to pay attention to the novelty and universal of teaching methods in the teaching process.

1.4.5. Research Status of ping-pong Teaching Methods in Domestic Universities

In view of the current situation of college ping-pong teaching, domestic and foreign sports experts and scholars also actively try to use different teaching methods and methods to lead the traditional ping-pong classroom teaching, to a certain extent, directly or indirectly improve the learning effect of students' ping-pong.

In the "Research on the effect of self-suggestion on the basic skills of ping-pong beginners", Xie Jun proposed self-emphasis intervention on the key technical difficulties and error points in the ping-pong technical action training session. Test results. The results show that the self-imposed teaching method plays an active role in improving the enthusiasm, stability and accuracy of ping-pong beginners. In the actual teaching process, in view of the different behaviors of the practitioners, different self-suggestion should be proposed to promote the level of technical action.

Wang Wenjiao stated in the article "The Application of Experiential Teaching Method in ping-pong Teaching". In recent years, the sports workers of major universities have carried out a lot of practice and exploration around classroom organization and teaching methods. “Experience-based teaching method” As a form of interactive teaching that emphasizes the bilateral emotional experience of teachers and students, it has achieved good results through a one-semester teaching practice in the ping-pong optional course of non-sports colleges. Three suggestions were made for it. First, it is recommended to continue to adopt the experiential teaching method in the ping-pong option class of ordinary colleges and universities, and to promote it. Secondly, it is recommended to organize more ping-pong matches on campus and enhance the promotion of ping-pong games when students have more leisure time. Popularization; Thirdly, it is recommended that physical education teachers should focus on improving students' interest in learning in the ping-pong teaching process, focusing on the students' internal needs.

Gong Chunyan concluded in the "Innovative Experimental Study of the "ping-pong Forehand Hanging Ball" Induction Training Device" that when the ping-pong practitioners perform the hanging ball training, through the reasonable use of the "sling ball assisted training equipment", It can speed up the practitioners' understanding of ping-pong technical movements, enhance the effect of exercises, improve the efficiency of exercises, help practitioners to clear the drop point and direction of the ball, and improve their practical effects in the daily ping-pong game.

Lu Youzhi stated in the "Experimental Study of WeChat in the Assistant Teaching of ping-pong Optional Courses in Colleges and Universities" that WeChat is an instant messaging service platform. Its communication is not restricted by location, the content of learning is not restricted by textbooks, and communication is not restricted by form. Can also be used in ping-pong classroom

teaching. It not only raises the interest of students in the form of teaching and organizational teaching, but also borrows the instant synchronization of the platform and the diversity of sharing themes, and subtly transfers the pictures and videos of the world's elite athletes and ordinary practitioners. . The information channel has many channels, which enables teachers and students to share and communicate at any time, which has played a good role in promoting the establishment of the correct technical action concept of ping-pong.

Wang Xingxin's "Experimental Research on the Technology Chain Combination Teaching Method and ping-pong Teaching", using the characteristics of the ping-pong project, based on the "technical chain" as the theoretical basis, combined with its combination characteristics, created such as "forward chain", "offensive chain", etc. Organizing teaching methods helps to improve the teaching effect, organically combines basic technology with tactical use in competitions, and changes the hidden dangers of technical movements and tactical use that are easily caused by traditional teaching methods. After the experiment, the students' technical movement standard and the hitting quality were better than the traditional teaching methods, and they were more suitable for the technical needs of the ping-pong sports.

Wang Longhua pointed out in the article "Application of Multimedia Technology in College ping-pong Teaching" that multimedia can present the visual impact of movement, enrich students' vision and mobilize students' enthusiasm, optimize the teaching structure of ping-pong classroom and improve teaching quality. It has been actively promoted. It is conducive to giving play to the leading role of teachers and the main role of students, improving students' ability to represent, and also helping to develop students' thinking ability and ability to analyze and solve problems.

In summary, no matter what kind of sports, the selected teaching method can generally play a better role as long as it conforms to the movement law and action structure of the project. ping-pong sports, as a technology-oriented sports competitive sport, has the characteristics of strong confrontation and high flexibility of sports posture. Its high sensitivity and weak repeatability of the swing technique make the practitioner unable to objectively learn the traditional ping-pong learning process. Measuring the self-assessment of each swing technique, relying on large-scale repetitive actions to complete their own understanding of ping-pong technology. The essential attribute of the sensor device is to use multi-axis tracking (built-in gyroscope, accelerometer and geomagnetic tracker, etc.) to complete the omnidirectional data acquisition in the motion, and realize the motion trajectory generated by the motion through the wireless sensing technology. Dimensions (hitting speed, hitting strength, force curve, hitting angle, etc.) numerical measurement and synchronous feedback. This self-evaluation and self-correction method of numerical information feedback has been used in the professional training process of athletes in the past. With the advent of related products such as smart ping-pong rackets and smart ping-pong sensors, the majority of sports enthusiasts can also access such information feedback during daily ping-pong learning and sports. Realize the digitization of instantaneous movements, visualize the abstract sports quality, and achieve the acquisition and self-evaluation of these objective sports data. In order to shorten the time of discovering and correcting the wrong movements during the practice, improve the effect of the exercises, and accelerate the mastery of the correct technical movements, it is possible to provide more possibilities for such intelligent sensing devices to enter the auxiliary sports classroom teaching in colleges and universities.

It is quite obvious that trying to use sensor-assisted teaching in college ping-pong classroom teaching is extremely pioneering and implementable.

2. Research Objects and Methods

2.1. Research Objects

The application of intelligent sensors in college ping-pong teaching is the research object.

2.2. Research Methods

2.2.1. Literature Method

In order to better understand the current situation of college ping-pong teaching and the problems in the teaching process, we have reviewed and collected a large number of ping-pong teaching related documents through China Knowledge Network and Wanfang database, combined with modern sensor technology in the field of sports training. Relevant literature reading, in-depth understanding of the research development process and frontier of the topic, to explore scientific and rational physical education teaching methods. Read relevant books and journal materials in the library, carefully study the writing of papers, study classification analysis and Summing up, laid a solid foundation for the writing of the thesis.

2.2.2. Investigation Method

2.2.2.1. Expert Interview Method

In order to enhance the feasibility of the study, many people have been trained in ping-pong training by visiting, networking and instant messaging.

There are experts and teachers with rich training experience in the field of physical education, including 3 professors and 5 associate professors. Ask the experts about the ping-pong teaching mode of colleges and universities, the methods and methods of ping-pong routine training, the operation and implementation of auxiliary teaching aids in the ping-pong teaching process, and the development prospects. Please consult the experimental ideas, the design of the questionnaire content and the rationality of the evaluation indicators. While gaining a large amount of indirect experience, it also pointed out the direction for the development of the next experimental research.

2.2.2.2. Questionnaire Method

Pre-test questionnaires and post-test questionnaires were prepared by consulting relevant data and combining the actual situation of school ping-pong for comparative analysis of the results between the experimental group and the control group. 26 pre-test questionnaires were issued, 26 were collected after the site was filled, and 26 were effectively recovered. In the experimental group, 13 questionnaires were distributed, 13 were effectively recovered, 13 in the control group, and 13 were effectively recovered. The survey objects are shown in Table 1:

Table 1. Statistics of survey objects

Survey object	Play ping-pong	Not playing ping-pong
Child	4	3
Adult	12	2
Elder	3	2

2.2.2.2.1. Validity Test of the Questionnaire

In order to make the content of the questionnaire consistent with the research purpose, eight experts were hired to evaluate the validity of the questionnaire. Among them, they believe that the authenticity of the questionnaire is very high.

2.2.2.2.2. Questionnaire Reliability Test

Regarding whether the credibility of this questionnaire meets the standards of sports science research methods, the questionnaire was released twice, showing that the results of the two surveys are basically the same.

2.2.3. Experimental Method

This study selected 26 boys who voluntarily participated in the table tennis special class of a sports college as the experimental subjects, and obtained the consent of the parents of these children (age 21.88+-1.03 years old, height 174.80+-4.01 cm, weight 67.36+-7.09 kg), ping-pong special course in normal teaching plan. In the teaching practice, according to the time requirements of the syllabus (see the appendix for the syllabus and teaching plan), the teaching time: September-December 2019 (the first semester of the 2019-2020 school year), using intelligent sensor-assisted teaching methods as opposed to traditional teaching methods Than, complete the teaching of ping-pong technology. Before the experiment, the basic conditions of the learning motivation, basic physical fitness and ping-pong skill level of the two groups of students were tested and compared. The results were analyzed after the experiment to explore the actual teaching results produced by this teaching method. (See 3 experimental design for details) Whether to use together detection is shown in Table 2:

Table 2. Whether it will use the instrument to detect the situation

Age range	Will be used	Won't use
18-19	5	2
20-21	7	3
22-23	8	1

2.2.4. Mathematical Statistics

This study used EXCEL 2010 to conduct statistical analysis of the survey results, using SPSS 20.0 to test the correlation of the data, and follow the basic principles of sports science research methods to complete the data collation.

3. Experiment Design

3.1. Design Ideas

The study is based on the traditional teaching method in the actual teaching of college ping-pong classroom. The attempt is to find a scientific, novel and modern teaching mode applied in ping-pong basic technical action teaching. The intelligent sensor can provide in the ping-pong action practice. Real-time information feedback is a fit, designing a scientific and timely teaching experiment program. The aim is to solve the problem of traditional ping-pong technology in the traditional teaching, students in the learning process, the technical movements are weak, the perception of technical movements is complicated, the practice is boring, and the imitation is difficult. Exploring the practical application effect of the integrated feedback aid system realized by intelligent sensors in the teaching process of ping-pong technical action.

3.2. Experiment Purpose

Through the addition of intelligent sensor-assisted teaching methods in the technical action teaching of college ping-pong special classes, it is explored whether intelligent sensor-assisted teaching methods can effectively improve the practice feedback information, improve the skill level of students' ping-pong, and cultivate independent learning ability. The actual teaching effect of the classroom.

3.3. Experimental Objects and Grouping

The study selects 26 boys in a special class of table tennis in a sports college as experimental subjects Sports Institute as the experimental subjects (age 21.88+-1.03 years old, height 114.80+-4.01 cm, weight 67.36+-7.09 kg), pure random sampling were divided into experimental groups., control group. The experimental group used the intelligent sensor to assist the traditional ping-pong teaching as the basic method and means to train the students, while the control group used the traditional teaching method to conduct the ping-pong special teaching.

3.4. Experimental Time and Place

The experiment was conducted in a sports university.

3.5. Experimental Content and Organization

3.5.1. Experimental Content

ping-pong basic technical teaching.

3.5.2. Pre-experimental Testing

The basic body shape, special physical quality, and pre-experimental ping-pong skill level of the experimental group and the control group were compared, and the T test was used to determine whether there was a significant difference.

3.5.3. Post-experimental Testing

After the experiment, the physical quality of the two groups of students and the basic technical level of the ping-pong were tested. Combined with the questionnaires, the similarities and differences between the intelligent sensor-assisted teaching and the traditional teaching methods were compared.

3.6. Selection and Test Methods of Evaluation Indicators

3.6.1. Selection of Evaluation Indicators

According to the laws and characteristics of ping-pong movements, with reference to various scientific research results, the following indicators are selected for testing:

Pre-test indicators: body shape indicators (height, weight), physical fitness (one-minute skipping, ping-pong throwing away, five times touching the edge, one minute of the ball), ping-pong basic skills (forehand high ball, forehand high ball)

Late test indicators: physical fitness (one-minute skipping rope, ping-pong throwing away, five times to touch the edge), ping-pong basic skills (forehand high ball, backhand hair net front ball, forehand high ball, hanging ball)

3.6.2 Test methods for Indicators

(1) One-minute skipping test method: The tested students stand on the ping-pong court. When the feet are jumping off the ground, the hands are shaken and the skipping rope is counted once, and the time is limited to 1 minute. After the mistake, you can continue to take off, except for the number of mistakes, the total number of accumulated.

(2) ping-pong throwing away

Test method: The tested student stands in the ping-pong court doubles sideline position, the finger index finger pinches the ping-pong rubber head, the palm is vacant, the ball is lifted higher than the head, and the ball is thrown hard into the field, and the feet are not allowed to leave the ground when the ball is thrown. Throw 3 times per person, take the straight-line distance best score. Figure 5 shows the statistics of ping-pong throwing:

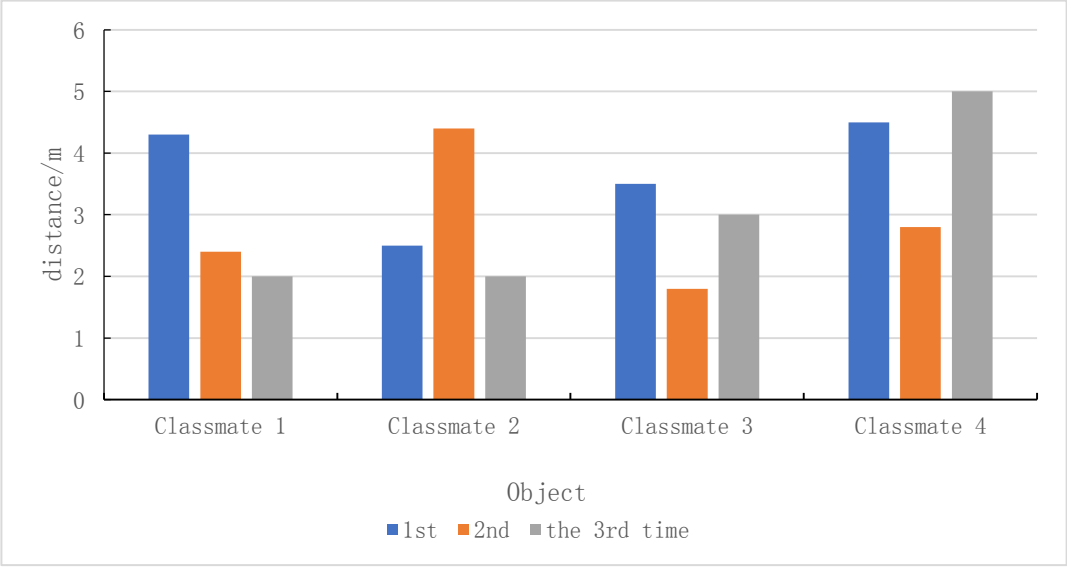

Figure 5. Ping-pong throwing situation

(3) Five times to touch the edge

Test method: The tested classmates stand at the center line of the ping-pong court, hear the move order (open the watch at the same time), use the footstep to the right side to move to the singles side line (take the right hand to take the classmate as an example), and use the clapping hands to touch the singles side line. Then return to the center line and face the net. Then use the step to move to the left side to the side of the other side of the singles, use the clapping hands to touch the singles side line, and then return to the center line, facing the net, at this time, it is calculated to complete the touch around 1 time. This was repeated 5 times. Stop the table to calculate the time when the 5th time is completed. It is required to run the reference instructor to unify the footwork.

(4) One-minute forehand ball test method: The height of the ball to be tested is 1 meter, the time limit is 1 minute, and the number of success is counted. The number of mistakes removed after the mistake continues to accumulate, counting the total.

(5) Basic technical test methods: See Appendix for details.

3.7. Experimental Control

3.7.1. Control of Variables

Ensure that the experimental group and the control group conduct teaching experiments in the same classroom with the same teacher, site, teaching tasks and time schedule. At the same time, the entire process of the experiment is required to be carried out without informing the students of the research objectives. Avoid experimenter effects and affect the measurement of real experimental data.

3.7.2. Selection of Sensing Equipment in the Experiment Group

In view of the differences in the brand, type, related wearing methods and data presentation and processing methods of ping-pong racket sensors on the market, the research selects the intelligent hardware developed by Shenzhen Cloud Computing Co., Ltd. - Cool Wave Xiao Yu 2.0 (smart ping-pong racket) Sensor) as an experimental motion sensing tracking device.

The relevant parameters of the sensing device are as follows: the main controller is M3 enhanced core, the material is low sensitive silicone material and Pc

Polymeric materials, based on Android 4.3 and IOS 7 or higher operating systems, use Bluetooth 4.0 low-power communication connection. The sensor measures 30*20*8.7 (mm), weighs 5 (g), and stands for 30 days. In terms of numerical feedback accuracy, the equipment is highly correlated with the high-precision three-dimensional motion capture system and by the authoritative test of Shenzhen Beibei Testing Technology Co., Ltd. The scientific and accurate feedback values are guaranteed. (See Annex 9 for details)

The feedback information of the sensing device mainly includes the following contents: average hitting power, swing speed, swing direction, swing angle, velocity curve, speed curve, space trajectory capture, space velocity reappearance, hitting type and frequency …… is used to assist the practitioner to have a comprehensive understanding of the action characteristics during the practice of the batting practice, and present it in numerical and graphical manners. With real-time synchronization, accurate recognition, voice broadcast, training recommendations, 3D simulation swing track and other features.

3.8. Intelligent Sensor Assists the Design Principle of Traditional Classroom Teaching

The famous American educational psychologist Gagne's research shows that the most striking feature of motor skill acquisition is that it is improved based on practice. As effective exercises progress, the practitioner's target actions are more accurate and punctual. The effective exercises here include two aspects of “repetition” and “feedback”. Repeated actions are repeated for a sufficient number of times to make the action solid and skilled. Accurate feedback helps the practitioner to find and correct deviations in the movements and achieve finer technical movements.

In the traditional college ping-pong technical teaching class, the teaching mode of teacher explanation and student repetition is used. In the early stage of technical movement teaching, there are more imitative exercises. For students with weaker performance representation, it is more difficult to get the correct action experience. However, the movement errors that students have during the practice process often rely on the teacher's language description and demonstration feedback to guide the students to correct. This simple linguistic description does not allow students to clearly understand and understand the accuracy of their actions, and it is easy to increase the probability that teachers will repeatedly guide corrections. At the same time, it causes the teachers to carry out heavy work tasks, and also greatly reduces the efficiency of classroom teaching.

Using intelligent sensor as a novel teaching aid, the basis of its function realization also follows the law of the formation of sports skills. The main task is to use the intelligent sensor as a modern detection device in the course of technical movement learning and practice. Provide intuitive and effective information feedback for practitioners to deepen the recognition of appearance. Through the sensing device attached to the bottom of the ping-pong racket, the interconnection with the intelligent mobile terminal is achieved, and the real-time monitoring of the action during the ping-pong practice of the student is realized. Each student's swing action is recorded in the form of motion trajectory, and is displayed numerically with indicators such as swing speed, velocity, and radiance. Instead of the teacher's simple linguistic description, the teaching feedback information is visually and specifically presented. . Optimize teacher explanations and enhance student practice experience.

3.9. Traditional Teaching Method and Intelligent Sensor-assisted ping-pong Teaching Program

3.9.1. Process of Traditional Teaching Method in ping-pong Teaching

At present, most of the college sports technology teaching courses in China still use this traditional teaching mode. It is mainly embodied in the educational thought represented by the Herbart School and advocates that teachers are the main body of classroom teaching. Most of them use the teacher to explain the demonstration, and the students imitate the practice. They show a relatively simple teaching mode. From the flow guidance in the above figure, we can see that under this model, teachers can easily control and organize ping-pong classes. Students are taught basic skills using conventional teaching methods and methods, and students continue to imitate them until they master the movements. This kind of teaching mode can help students to acquire the basic skills, but it is not good to give full play to the students' subjective initiative in the teaching process. It does not promote the students' interest in learning and the cultivation of learning initiative. The use of smart sensors in motion monitoring is shown in Figure 6

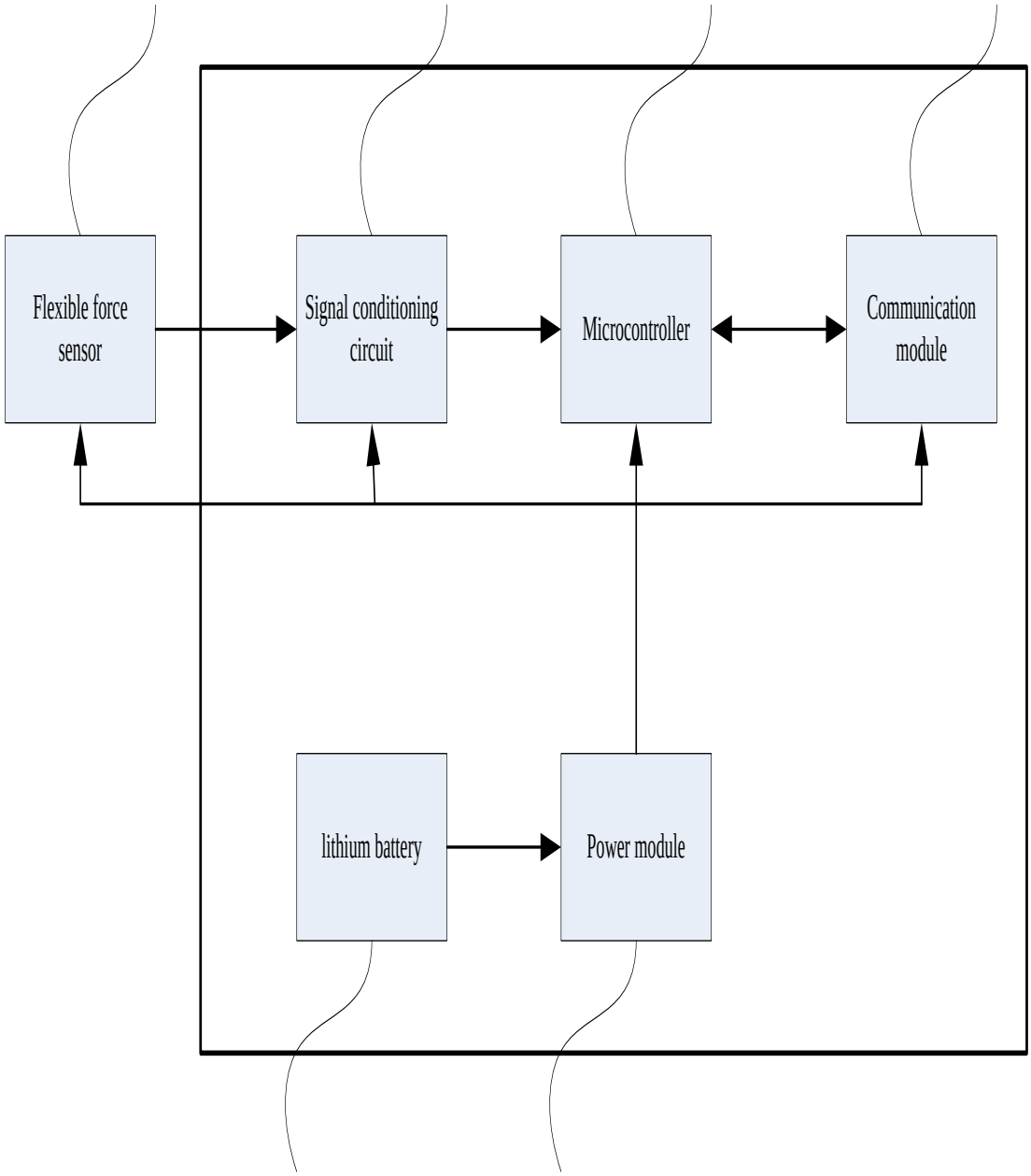

Figure 6. The use of smart sensors in monitoring

3.9.2. Intelligent Sensor-assisted ping-pong Teaching Process

The use of intelligent sensors to assist ping-pong teaching requires teachers to actively create research-based learning models and try to achieve simple guided teaching. Encourage students to make full use of the real-time numerical information feedback provided by the sensor (such as the speed, strength, and curvature) and the evaluation of the motion standard during the practice process to form a conscious self-evaluation, and to explore the standard ping-pong technical action and appropriate force. Mode and timing through the effective collection of kinematic parameters

during the swing process, students are encouraged to explore and communicate with each other, deepen the understanding and grasp of correct ping-pong technical movements, and return to the main position of students in the classroom.

3.9.3. Sensor-assisted Teaching Steps in Traditional Classroom Teaching

The main goal of the technical teaching of ping-pong is to let students master the basic skills and skills of ping-pong and switch to the sensor-assisted teaching mode. The role of teachers is more inclined to teaching assistants and guides.

(1) The beginning of the lesson: Focusing on the curriculum, the students of the experimental group will be introduced to the operation methods, main functions and purpose of the sensing equipment to deepen the students' behavioral ability and thinking, and guide the students to their own use during the use of the equipment. Behavioral actions produce subjective analysis and judgment, which in turn enhances research practice.

How to guide students to use the vibrating angular velocity rate sensor to record the swing direction and trajectory during the practice, combined with the speed & velocity curve during the stroke, to evaluate the technical movements? Let us take the high-ball in the hand as an example. Combined with Figure 8, through the numerical display of strength, speed and angle, it can be directly judged that the right-hand exerciser has better batting effect than the left-hand exerciser; and by the speed & velocity curve recorded by the sensor, we can easily move to the practitioner. Show the actual effect and mastery of the ping-pong technical action.

In the traditional mode, after the teacher completes the technical action teaching, he will focus on asking the students to improve the proficiency and stability of the action, and often will use such words one-to-one "high-efficiency force". It is true that as a highly sporting net, the mastery of each individual action of ping-pong technology ultimately serves the high-quality hitting effect. However, as far as practitioners and teachers are concerned, there is no objective evaluation criteria to analyze and judge the effect of this exercise.

(2) Conducting the lesson

The guidance of intelligent sensor-assisted teaching on ping-pong technical action teaching is carried out in four stages: “generalization-division-solidification-automation”.

Take the high-ball in the hand as an example. In the generalization-differentiation stage, the teacher first performs demonstration exercises of correct actions and briefly describes the precautions. It is not appropriate to emphasize the details of the actions too much. In the classroom technical action practice session, the students are guided by the sensor information feedback to form a complete technical action impression. They do not directly evaluate the students' practice movements, and stimulate students' curiosity and active exploration. As much as possible to meet the students' freedom of practice, students are required to learn to improve themselves for each exercise.

In the practice of differentiation and solidification, attention is paid to guiding students to experience the process of coordinating the force and improving the perception of muscles. Establish a group cooperation model to encourage students to develop independent thinking, problem finding, and problem-solving skills in mutual help, mutual help, and mutual learning.

In the certain stage of curing, the mastery of the technical movements of the students has become stable, and the combination with other technical movements should be strengthened to prepare for the flexible use in actual combat. At this stage, attention should be paid to the development of personal technical style.

(3) The end of the lesson

The teacher observes the practice situation of the students in the class, points out the common errors that occur during the practice of the students at the end of each class, does not propose solutions, and encourages students to analyze and discuss the phenomenon around them. Students are required to think about their own inadequacy and direction in the aftermath.

4. Experiment Results and Analysis

4.1. Pre-experiment Results and Analysis

4.1.1. Comparison of ping-pong Learning Experience Between Experiment Group and Control Group Students before Experiment

4.1.2.

Table 3. Comparison of ping-pong Learning Experiences Between Two Groups of Students before Experiment (N=13)

Items	Experiment Group		Control Group	
	Yes	No	Yes	No
Number of people who have participated in ping-pong professional training	0	13	0	13
Has participated in the school ping-pong club	6	7	7	6
Number of professional ping-pong players	0	13	0	13
Number of professional ping-pong referees	0	13	0	13

The experimental group and the control group did not experience the ping-pong general training course before the experiment, and combined with the statistical results in Table 5, it can be seen that the two groups of students in the ping-pong professional training, participating in the school ping-pong club training, obtaining the sports level, the referee level, etc. before the experiment. The experience is quite the same, there is no obvious difference.

4.1.3. Comparison of Physical Quality of Experiment Group and Control Group Students before Experiment

Table 4. Comparison of Physical Fitness of Two Groups of Students before Experiment (N=13)

Physical fitness	Group	$\bar{X}$	T	P
Height (cm)	Experiment Group	175.79	1.344	0.204
	Control Group	173.82		
Weight (kg)	Experiment Group	69.39	1.570	0.142
	Control Group	65.35		
One-minute skipping (times)	Experiment Group	141.31	-0.761	0.451
	Control Group	144.23		
Ping-pong throwing away (m)	Experiment Group	7.43	0.392	0.702
	Control Group	7.32		
Touching left right edges five times (s)	Experiment Group	18.67	-1.870	0.086
	Control Group	19.00		

Physical fitness is a prerequisite for learning various sports skills. According to the data in Table 4, the experimental group and the control group have the same level of body shape (height, weight) and basic physical quality (one-minute skipping, ping-pong throwing away, five times around the edge), and the P values are greater than 0.05.

4.2. Results and Analysis after the Experiment

4.2.1. Effect and Analysis of Students' ping-pong Learning Interest

Interest is an important factor in the success of ping-pong teaching. Students only have an interest in ping-pong and will maintain a positive and conscious attitude towards ping-pong for a long time. In order to verify the influence of intelligent sensor-assisted teaching methods on students' ping-pong learning interest, after the experiment, the students used the questionnaire to investigate the students, and the students in the experimental group and the control group were

subjectively self-evaluated (in combination with the frequency of ping-pong training, self-learning time)., learning objective reality such as initiative and enthusiasm, as shown below:

4.2.2. Effect and Analysis of Students' Basic Physical Quality

Table 5. Comparison of Physical Fitness between Experimental Group and Control Group after Experiment (N=13)

Physical Fitness	Group	$\bar{X}$	T	P
One-minute skipping (times)	Experiment Group	159.77	0.477	0.642
	Control Group	157.15		
ping-pong throwing away (m)	Experiment Group	8.42	1.545	0.148
	Control Group	7.95		
Touching left right edges five times (s)	Experiment Group	17.22	-1.484	0.164
	Control Group	17.50		

After the experiment, the experimental group and the control group were tested and recorded in three items: “One-minute skipping rope”, “ping-pong throwing away” and “Five times around the edge”. The results showed that the P values of the experimental group and the control group in the above three tests were all greater than 0.05, indicating that there was no significant difference in physical fitness between the two groups after the ping-pong special course of different teaching methods in one semester. Analysis of the reasons, regardless of the mode of teaching, teaching methods, need to apply a certain intensity of physical fitness exercises in the course of the teaching, after the basic body training of this semester, reflecting the two groups of students in the various tests, before the experiment the values are all improved. However, because the two groups of students had the same class time and had the same teaching objectives, the training style, exercise volume and exercise intensity were almost the same. Therefore, there was no significant difference between the two groups after the experiment.

4.2.3. Effect and Analysis of Students' ping-pong Technique

After the experiment, the score is combined with the technical assessment, and the specific scoring rules and test methods are referred to Annex 8.

The data obtained from the experiment showed that the students in the experimental class had higher scores than the control group in the four technical tests of the forehand high-ball, the backhand net, the forehand hitting the high ball and the hanging ball. After T-test analysis, it was found that the experimental group had four significant technical differences in the four technical movements such as forehand high-altitude ($P<0.01$).

The reason for the analysis is that the intelligent sensor-assisted teaching can more effectively target the actual situation of the students, formulate scientific and reasonable training, and

accelerate the practitioner's understanding and mastery of various ping-pong technical actions. The cognitive process of motor skills includes three stages, motion perception, motion representation, and motion concept. The appearance of motion plays an important part in the process of the formation of motor skills. The clarity of the motion representation largely determines the speed and accuracy of the formation of motor skills. The traditional ping-pong teaching is mainly guided by the teacher's linguistic feedback on the action. It is difficult for the students with weak representation ability to get the correct technical action experience. The intelligent sensing device assists the teaching through the practice process for the students. The specific technical image of the ping-pong shuttlecock is specifically restored, and the digital feedback on the relevant indicators such as swing arc, hitting power and hitting speed is formed, and the students' understanding of the technical movement is guided. With the cycle of "practice-feedback-self-analysis-targeted re-practice" mode, students' technical movements can be mastered and perfected, and finally determined. Effectively solve the shortcomings of students' poor understanding of technical movements and slow technical mastery under the traditional ping-pong teaching method. In addition, the number of active exercises after the students increased, which further promoted the mastery of students' ping-pong skills. Therefore, the sensor-assisted teaching method is significantly superior to the traditional teaching method in promoting the technical mastery of students' ping-pong.

Table 6. The Influence of Different Teaching Methods on Students' ping-pong Skills (N=13)

Items	Experiment Group $\bar{X}$	Control Group $\bar{X}$	T	P
Forehand raising high ball	7.76	6.81	5.839	0.000
Backhand raising net ball	7.69	6.50	3.484	0.005
Forehand heating high ball	7.73	6.80	5.482	0.000
Drop ball	7.15	6.31	4.247	0.001

4.2.4. Effect and Analysis of Classroom Question and Answer Situation

Good classroom interaction between teachers and students is an important part of a high-quality ping-pong teaching class, which can be reflected in the enthusiasm of teachers to ask students for responses. The above picture shows the statistical comparison of the students' response to the actual situation of the teacher's question in the ping-pong special class. The students in the control group are not optimistic about the initiative in responding to the problem.

The chart shows that in the 12-week ping-pong special course, the experimental group found that nearly 54% of the students in the ping-pong special class are actively answering the teacher's question status, and the remaining 46% of the students' attitudes have also participated actively. question answer. In comparison, in the ping-pong classroom teaching under the traditional method organization, only 23% of the students actively answer the teacher's questions, 46% of the students have a generally positive attitude in answering questions, and nearly 31% of the students are in the

special classroom teachers. The attitude in the question is not positive, and it is in a passive state to answer the question.

With the advancement of the new curriculum reform, the teacher's "one-word hall" has gradually evolved into a teacher-led, student-centered classroom form, and advocates positive interaction between teachers and students in the classroom. The enthusiasm of students to respond to teachers' questions is a major manifestation of students' passive change. In this semester, the use of sensors to assist traditional teaching methods is conducive to the active classroom atmosphere, promote students' active brainstorming and improve the classroom atmosphere of teachers and students.

5. Conclusions

Intelligent sensors are used in college ping-pong teaching. The use of intelligent sensor-assisted teaching can effectively stimulate students' interest in learning and improve learning initiative. The use of intelligent sensor-assisted teaching plays an active role in the application and mastery of student ping-pong techniques, and the improvement of basic physical quality is not significant. The use of intelligent sensor-assisted teaching can form a continuous guidance with the improvement of students' ping-pong technical level, which is conducive to maintaining the enthusiasm of students to learn ping-pong for a long time and establishing a sense of lifelong participation in ping-pong.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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