RESEARCH ON VIRTUAL REALITY-BASED BADMINTON TEACHING IN PHYSICAL EDUCATION COURSES

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Synopsis:

This research is to explore the effectiveness of Virtual Reality Assisted badminton instruction in physical course, with discussion on difficulties teacher may encounter into and their responses. With qualitative method, researchers found best practices including: "rehearsal and getting key points", "adjusting gesture and mastering the knack", "collaboration and inter-assisting", and "promoting initiative and enhancing learning" and related measures to overcome the difficulties.

Research on Virtual Reality-based Badminton Teaching in Physical Education Courses

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Abstract

Objectives: This paper aims to explore the effectiveness of virtual reality for badminton teaching in physical education and discover the difficulties and their coping techniques that teachers may encounter during teaching. Methodology: The research subjects in this paper are teachers and students in the seventh grade of a physical education class in a high school in Taipei City. The badminton course lasted four weeks and had two classes each week. The forehand serve was taught using virtual reality, digital teaching platform and tablets. The study follows a qualitative approach and collected data mainly from semi-structured interviews as well as course reviews, student feedback questionnaires, study sheets and cognitive tests. Data analysis was conducted based on various theories. Results: 1. Virtual reality-based badminton teaching in physical education can improve learning effectiveness from different aspects in terms of "repeated practice and understanding of essentials", "adjusting posture and mastering the knack", "teamwork and mutual support", and "promoting motivation and promoting learning". 2. Teachers may encounter difficulties in three levels: "moving", "playing" and "learning". Conclusion: virtual reality-based badminton teaching in physical education can effectively improve learning effect. However, teachers should still reflect on the design and implementation of teaching, and understand the students' perception of the curriculum in physical education to solve the difficulties of virtual reality-based badminton teaching.

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Keywords: virtual reality, physical education, badminton teaching

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I. Introduction

1. Research Background and Rationale

In the face of a complex and ever-changing world, countries from different parts of the word are committed to the education of talents. In terms of teaching, horizontal integration of cross-disciplinary/cross-curricular integrative learning has become a worldwide trend. The general outline of the 12-year basic education promoted by Taiwan specifically states that the flexible learning programs for secondary schools can include cross-disciplinary themes/questions/topics in teaching to foster horizontal integration of skills and cross-disciplinary learning (Ministry of Education, 2014). This is also in line with the trend of international education reform. For example, as a typical educational country, Finland has been promoting thematic courses as the main focus of teaching. Teaching should not only focus on single-level objectives. Instead, teachers must design and reflect on teaching from various aspects. Therefore, when it comes to the design of teaching, teachers must assist teaching with different supplementary teaching materials, and integrating information technology into teaching is a quite common way to achieve that. Wang Quanshi (2000) pointed out that information technology should be applied to curriculum, teaching materials and teaching methods, making information technology an indispensable teaching tool for teachers and a valuable learning tool for students. Using information technology would become a part of the daily teaching activities in the classroom. Information technology could be further developed as a method or a program to find questions and answers at any time and any place.

However, physical education curriculum has its special features compared with other disciplines, mainly because of bodily autonomy and the irreplaceability of physical activity. For instance, body movements are linked with spatiality, complexity, agility, coordination and other features, and they also involve the memory and automation of muscle cells. Therefore, using virtual reality for integrated teaching will be a trend that can be developed in the future. Virtual reality technology is designed to use computer technology to simulate a three-dimensional, high-realistic 3D space. When a user wears a special display device, it will produce an illusion as in reality, the operator can move or interact using a controller or keyboard in this virtual environment, making the analysis of physical education more realistic and accurate. For example, regarding slow motion or repetitive movements, learners can adjust the pace and method of learning according to their own ability. This method can tackle the instability of traditional physical education methods.

Traditional physical education emphasizes skills. Nowadays, it is necessary to think about the importance of its cognition and perception. In addition to the change of teaching methods, the use of equipment is also very important. Using equipment with emerging technologies to gradually improve the quality and value of physical education classes will be an important development trend of future physical education. However, currently most of the researches on physical education with virtual reality devices only focuses on theoretical discussions, and scare empirical studies have been found. In this regard, this study intends to perform an empirical research to explore whether virtual reality-based badminton teaching in physical education can improve the learning outcomes at the teaching site, which is the main research motivation of this study.

2. Research Aims and Questions

Based on the above research motivations, the main research purposes of this study are as follows:

a) To explore the effectiveness of using virtual reality to assist the teaching of badminton in physical education.

b) To explore the difficulties that may be encountered when using the virtual reality for badminton teaching in physical education.

Based on the above purposes, this study intends to discuss the following questions:

a) What is the outcome of using virtual reality to assist in the teaching of badminton?

b) What are the difficulties that may be encountered when using virtual reality to assist in the teaching of badminton?

3. Terminology

(1) Virtual reality

In this study, virtual reality (VR) refers to a highly realistic space simulated by a device, providing an immersive experience to the user using a VR case, which allows the user to adjust according to the distance between the eyes and images. In addition to a case for mobile phone, the device also has the functions for adjusting the distance between the eyes and pupils. Main functions are described below (see Figure 1):

1. Mobile phone case: The purpose of this function is to place the user's mobile

phone. Users can watch pre-recorded videos made by the physical education teacher. After watching the video, users actually can take badminton rackets and practice in groups. They can use tablets to record each other's badminton serve movements so that they can see their own movements and postures, and then discuss with their classmates and teachers to correct mistakes.

2. Adjusting distance between the eyes and pupils: This function is designed for preventing users from dizziness during viewing. Users can adjust according to their distance between the eyes, and then they watch videos with much more comfort.

Figure 1: VR case

(2) Badminton teaching in physical education courses

The teaching of badminton contains a variety of themes, such as lobs, smash, slice, drop shot, etc. In this study, badminton teaching refers to the teaching of the skills of the badminton forehand lobs for seventh-grade students. The course lasted four weeks with two lessons per week.

II. Literature Review

This study aims to understand the effectiveness of virtual reality for badminton teaching in physical education. This section will look at the literature related to virtual reality and badminton teaching.

1. Virtual Reality

Virtual reality means creating a virtual environment that makes people feel the real environment and interact with virtual objects through visual, auditory, and tactile senses. It combines graphics, sound, video, animation and interactive devices to create a virtual three-dimensional (3D) interactive environment. By viewing and moving the objects in the virtual environment, the user becomes a participant in the virtual space, allowing immersive experience of the virtual world. In recent years, virtual reality has been widely used. Using VR technology in teaching can let students get realistic feelings and break through the limitations of space, so that they can actually obtain the rare learning experience in reality (Nachimuthu & Vijayakumari, 2009). With respects to the application of virtual reality technology in physical education, many scholars have discussed the possible circumstances of its theoretical implementation. For example, the study by Wang Xuanzhi (2010) suggests that virtual reality can be used in physical education to bring contextualized learning to students, without space constraints, flexible choices of viewing angles and other advantages. Yu Yan (2016) also pointed out the lack of innovative teaching materials, equipment shortage and monotony in traditional physical education. If virtual reality can be used in physical education, it will improve the quality of teaching, enhance students' cognitive ability, improve the overall teaching environment, and make the demonstration of action more realistic and vivid in teaching. Therefore, virtual reality can help to break through traditional constraints and provide students with the possibility of personalized learning, so that students can absorb knowledge and master skills more quickly (Shang, 2014).

Virtual reality has three features (Jaron Lanier, 1987). The first is imagination. Through virtual images and sound and light effects generated by computers, users can imagine themselves being in the virtual space. Interaction is the second feature. Apart from the presentation of simulated scenes, the user can interact with objects in the virtual scene. The system offers real-time feedback to the user for a more realistic experience through different input devices. The third feature is integration. The combination of virtual scenes and various input devices provides a sensational experience and makes the user fully involved. In addition, virtual reality is also a technology based on computer technology that simulates real-world situations to explore the user's response and relevant changes. it has been widely used in training, teaching and research. This type of learning offers the following two functions. One is to provide alternative experience. If the school sports field is insufficient for training or the field training process is incomplete, students cannot receive necessary learning experience. In that case, visual reality can provide them similar experiences to produce

similar cognitive processes. The other function is to provide an excellent teaching tool for situational teaching. It is an excellent approach to immerse students in real or simulated situations for learning. Li Wei (1998) indicated that although situational teaching is not commonly used by Chinese teachers, it is a teaching method encouraged in constructivist teaching, whole language learning or multiple intelligence teaching. Situational teaching can take into account the learning objectives, learning situations and teaching materials, and it can enable students to become the active constructors of knowledge through the interaction between people and context in the learning process (Zhang Qingxu, Chen Wuzhou, 2009).

2. Virtual reality assisted physical education badminton teaching

Physical education is vital and important for students in the school. It is also an important medium for developing the habits of doing regular physical exercise nationwide. Nowadays, it is popular for young people to use mobile phones, tablets and other related information technology equipment. These devices usually have small screen sizes and are very portable and easy to use, which have had an impact on the way of learning. Schar and Krueger (2000) pointed out that combining visual and auditory multimedia can reduce the burden of students' cognitive learning, and it is easier to enhance concentration and learning outcomes. Due to the wide variety of physical education courses in schools, school physical education teachers may not be proficient in various sports, so that the demonstration actions may not be accurate and precise. Additionally, in the course of demonstration, not every movement of all types of sports can be slowed down for students to learn. Considering the above, using virtual reality equipment, can effectively improve the above situation, and it can also keep up with the changes in students' learning style.

In the past, virtual reality was applied to the learning of dance moves. During the learning process, real-time virtual reality feedback was provided, and the results show that virtual reality can effectively improve learning outcomes (Daniel L. Eaves, Gavin Breslin and Paul van Schaik Emma Robinson Iain R Spears, 2011). However, most of the studies on the application of information technology equipment in physical education only explored its feasibility in theory. For example, Wang Junjie, Lin Qidong, Yang Zongcheng, and Wang Yuansheng (2015) mentioned that in addition to providing guidance on sports skills, physical education teachers can also borrow information technology to make up for the lack of physical education. It is easier to deepen students' learning concepts and make physical education teaching methods more diverse and innovative in order to achieve optimal learning outcomes. Jian Shang (2000) proposed that using virtual reality technology in physical education is to use the technology to

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build a virtual learning situation where students can get a very realistic experience through visual operations and interaction with the environment, which are regarded as effective learning behaviors. Furthermore, Kai Zhang and Sai-Jun Liu (2016) believed that students can get real and precise feelings to achieve the purpose of learning. It can also attract more students to participate in sports activities, diversify physical activities, and ultimately improve the quality of physical education and the overall skills of students. However, these studies failed to provide evidence to support the theories.

Although there are related empirical studies on basketball teaching (Lin Yijun, Shi Dengjun, 2018), or on the applications for athletes in competitive sports (Jian Shang, 2014), no empirical study of badminton teaching in school physical education has been found. Therefore, this study will use virtual reality technology, combined with the tablets and the digital learning platform to explore whether it can really improve learning outcomes.

III. Research Design and Implementation

This research is an action research that seeks to understand the problems at the teaching site, and uses qualitative research methods to collect and analyze data. The research has adopted constructive teaching theories, and it is believed that knowledge is constructed through the reality of individuals in society. Therefore, pluralistic perspectives are valued (Yin, 2003); in addition, contextual context also affects how people add meanings to facts. Therefore, it is necessary to understand the significance of the facts from the subjective experience of participants and the context in which they are located (Guba & Lincoln, 1994). Based on this, the study has conducted with interviews, observation and analysis of documents. Taking the researcher as a research tool, qualitative research uses a variety of data collection methods to explore social phenomena in a natural context, and uses inductive analysis of data and formation theory through the interaction with participants in order to obtain explanatory understanding of their behaviors and implications (Chen Xiangming, 2004). The researchers in this research acted as interviewers, observers and data analysts.

1. Sample Selection

This study has adopted the sampling method according to the purpose of the study. Because the research field is a public high school in Taipei, the classes are S-type

normal classes, and students have relatively similar learning ability. Therefore, out of 66 classes, 4 seventh-grade classes taught by the same physical education teacher were selected. The research objects are one physical education teacher and 90 seventh-grade students in 4 classes, including 48 male students and 42 female students. The study was conducted from September 3 to September 29 in 2018. The course lasted a total of four weeks with two physical education classes per week. Forehand service techniques were taught in eight sessions (see Table 1). Although this study has adopted the sampling method, it does not affect its validity in the sense of qualitative research. The validity in qualitative research refers to the "relationship" of a connection, which refers to the "consistency" between the research results and the research questions, objectives, objects, methods and situations (Chen Xiangming, 2001). This study will also pay attention to this "consistent relationship" and use the trigonometric for validation. With regard to the promotion of this study, this paper intends to achieve the task of "promotion" through dialogues and resonance between readers and research results to a certain extent and in a certain form. Chen Xiangming (2001) suggested that promoting the significance of qualitative research is achieved based on the recognition and theoretical derivation of relevant people. Therefore, it is possible to achieve research purposes and answer research questions in the method of selecting samples.

Table 1 Timetable of the course

Session	Teaching Content	Dates	IT facilities
1.	Badminton forehand service - introduction/practice	2018/09/03~09/05	Projection equipment
2.	Introduction to IT facilities⁄forehand service practice	2018/09/06~09/07	Mobile phone⁄VR glasses
3.	Badminton forehand serve and motion analysis(1)	2018/09/10~09/12	Tablet⁄VR glasses
4.	Badminton forehand serve and motion analysis(2)	2018/09/13~09/14	Tablet⁄VR glasses
5.	Badminton forehand serve and motion analysis(3)	2018/09/17~09/19	Tablet⁄VR glasses
6.	Badminton forehand serve and motion analysis(4)	2018/09/20~09/21	Tablet⁄VR glasses
7.	Watch group motion analysis videos	2018/09/24~09/26	Projection equipment

Data source: designed by the teacher

2. Data Collection

The methods used to collect data in this study include interviews, observations, and document analysis. First, individual interviews were conducted on teachers and focus group interviews were performed on students. Interview procedures were outlined before the interviews (see Table 2) and were then adjusted according to the respondents' reaction. The study of experience was conducted in a semi-structured way. The content of the interview was designed based on students' feedback. Outstanding data and extreme values were calculated in the statistical software SPSS for Windows 23.0, which were determined after consulting experts and scholars. The focus group interviews with students can collect a large amount of interactive data in a short period of time, and it is also a relatively easy and stress-free interview method for high school students, so that they can provide more real feedback. Therefore, one student who provided more profound and responsive learning feedback was selected from each class. A total of 4 students participated in two focus groups, while the teacher conducted three individual interviews. All interviews were conducted after the completion of the four-week course. Their interviews are shown in Table 3.

Furthermore, according to research requirements, the observation in this study was performed by an observer and was recorded on-site on observation forms. The whole process was recorded during the observation to provide missing information in the forms. Finally, document analysis contained cognitive tests and study notes of students. Cognitive tests were conducted after the four-week course through the digital learning platform. The tests assessed the analysis of key badminton techniques and the concept of swinging the racket to evaluate whether students can accurately master relevant skills. Study notes were distributed after the four-week course for students to fill out in order to understand the effectiveness of the students' learning process from various aspects.

Table 2 Interview questions

[teacher part]
1. What is the motivation for using virtual reality in badminton teaching in

physical education?

2. Have you encountered any difficulties in implementing this pedagogy?

3. Will this teaching method be used in the future?

4. What do you want students to learn about this pedagogy?

5. How do you think such a teaching method should be promoted?

[student part]

1. Having completed the course, what do you think about virtual reality-based physical education courses for learning badminton?

2. Have you encountered any difficulties in your study?

3. Apart from badminton skills, what else did you learn from the course?

4. Is there anything that impressed you during this course?

5. What sports do you think this teaching method can be applied to in your physical education class in the future?

6. Would you like to learn in this way again in the future?

Data source: Researchers design their own

Table 3 Schedule of interviews

Date	Interview type	Subject	Duration	Location
2018/09/28	Focus group	J01- J04	90 minutes	high school classroom
2018/10/05	Focus group	J01- J04	40 minutes	high school classroom
2018/10/06	Individual	T01	90 minutes	high school office
2018/10/09	Individual	T01	50 minutes	high school office
2018/10/11	Individual	T01	45 minutes	high school office

Note: J refers to high school students; T stands for teachers.

3. Data Analysis

After the interview was completed, the researcher transcribed the interview recordings into text, and then classified and encoded the data according to the research purposes and questions. The interview data were first numbered by the sequence of classes and interviewees. Then the code was completed based on the sequence number of answers. For example, the third sentence on the second page of the verbatim script for Class 701 was encoded as J010203. Observation data were labeled according to the page number of the observation section and the page. For example, the second page of the observation of the first teaching session was labeled as O0102. The file data were numbered in sequence. For example, the number of the first document was d01. Then according to the method proposed by Bartlett & Payne (1997): the classification of data was first determined, and then the data were conceptualized by open coding. Concepts that describe the same phenomenon were temporarily classified into the same category, and they were given more abstract names. Then it came to data saturation, which means that the researcher analyzed the category of the names according to its nature and aspects to disclose its characteristics. The next step was abstract definition. The researcher gave the abstract definition according to the nature and aspect of each category. Then during theoretical sampling, relevant specific events were selected based on the proposed theories to verify the theories. Axial coding was the final step, where all the data were categorized and the connections between them were analyzed to form the final classification axis.

In this study, two researchers worked together as coders. The two researchers first discussed the decomposition unit of the original interview data, and then calculated the consistency reliability of data using the reliability formula adopted by Miles and Huberman (1994). The formula is A / (A + B), where A represents the same number of code by the two researchers, and A + B represents the total number of code by both researchers. The calculation stopped until the reliability reached an acceptable level of 0.70. In addition, the study has also adopted the situational approach, which avoids the results of the study from being constrained in the category framework by the above classification, which is conducive to establishing a more natural connection between categories (Chen Xiangming, 2004). Therefore, when the materials were organized, the researchers' own statements will be placed in a certain context, making their stories more complete without being fragmented by the classification. When extracting important concepts from the data as classification categories, the linguistic context occurred and its influence were also considered so that the research results in this

method are more complete.

IV.   Results and Discussion

Through interviews, observations and document analysis, this study has attempted to explore the effectiveness of virtual reality for badminton teaching in physical education from different aspects in terms of "repeated practice and understanding of essentials", "adjusting posture and mastering the knack", "teamwork and mutual support", and "promoting motivation and promoting learning". Difficulties that may be encountered will also be explained and discussed regarding "moving", "playing" and "learning".

1. The effectiveness of virtual reality-based badminton teaching in physical education
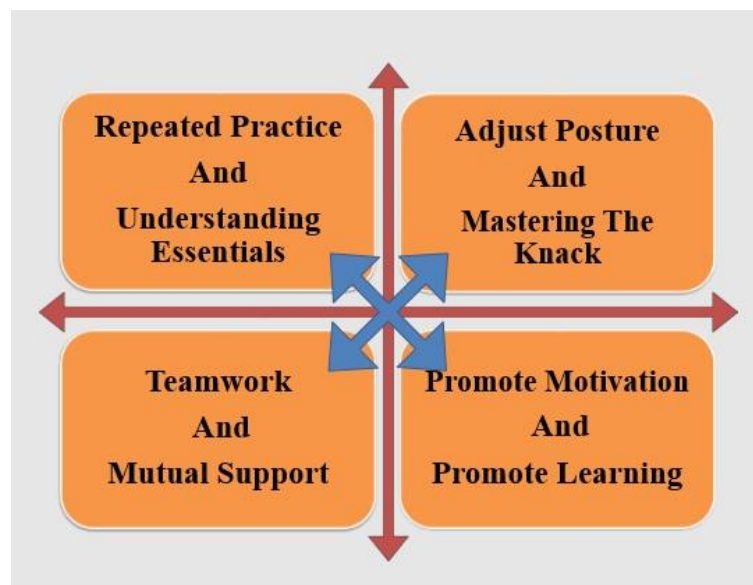

Figure 2: The effectiveness of virtual reality-based badminton teaching in physical education

(1) Repeated practice and understanding essentials

I have never used this method in elementary school before. It is very innovative and interesting. The information on the Internet provides clearer instructions, and I can watch videos and do quizzes anytime. Now, most of my classmates enjoy it, and they can continue to use it after they go home. You

may not have to learn with a teacher nearby. (J020102)

As can be seen from the above interviews, students believe that the use of virtual reality allows them to watch and practice repeatedly, even after class. This is the advantage of information technology equipment, where learning is not limited to the school. Even if you leave the teaching site, you can learn many times using the device. In addition, when repeating the exercise, it is more accurate to grasp the relevant skills, making the student be more skillful at swinging.

I like this way of teaching because the teacher lets us know the badminton movements and skills that I need to pay attention to. You can also understand the key points and concepts of playing badminton from the videos in virtual reality, because the instructions in the videos are very clear. I can take it with me and watch on the way. It is also more vivid. (J030204)

With the virtual reality device, students can have a correct understanding of the essentials of the badminton forehand service. In particular, through the video descriptions in virtual reality, they can learn the knowledge from the teacher and then meet teaching objectives set by the teacher. Therefore, learning at the cognitive level can be more advantageous than traditional teaching methods, and learning can be more effective.

It can be seen from the above that the use of virtual reality enables students to master the essentials of motion analysis during the movements, and they can clearly understand the concept of the forehand service and the steps of swinging, which improves the learning outcomes of their cognitive aspects. In addition, combined with the digital teaching platform, students can learn online at any time outside the classroom, allowing the original knowledge that can not be obtained in a physical education class accessible. Learning objectives can be achieved through repeated practice. Therefore, the two concepts of repeated practice and understanding essentials are complementary and inseparable, which form the first aspect of the effectiveness of virtual reality-based badminton teaching in physical education.

(2) Adjusting posture and mastering the knack

After watching VR videos and recording videos in groups, I could see my motions and then discuss correct motions with the teacher. It helps me have good posture and hit the ball. Some students repeated the videos and played the ball. After slowly adjust the posture, they can finally hit the ball. (J020301)

According to the interview, the students watched the virtual reality videos, and the students filmed each other's motions using tablets. They then watched the recorded

videos and discussed with the teacher and group members. After comparing with the moves in the video, they can effectively correct their movements and improve the move of swinging so that the racket can successfully hit the badminton ball. The learning goal of the forehand service can be achieved in that way. In addition, with the adjustment of the posture, the muscles of the hand can be properly trained, which greatly reduces the chance of injury to the hand. Many students also mentioned that point in the feedback, and it has also been recognized by the teacher. Because the posture can be constantly corrected by the student and the group, it is also very helpful for the student to master the knack of serving.

Using VR glasses can help me to get details of the motions. Otherwise, the teacher's instructions are too fast, so I can't see clearly. Through the slow motions and 360-degree view in the video, it is easier for me to imitate swinging. It is very clear. (J010202)

In the interview, the student mentioned that through the videos in virtual reality, especially when using slow motion and pause, the student can capture detailed feelings and movements of swinging. That helped them to watch the movement of swinging from different angles and directions before they learn the move. It is easier for learners to master the skills and can improve the learning effect and obtain better results in learning skills. This also highlights the advantages of virtual reality.

In summary, with the help of virtual reality devices, students can get more detailed and accurate information on the parts that were not previously demonstrated by the teacher. In particular, in the virtual reality videos, students are more likely to master the knack of serving by viewing the moves from various angles and in slow motion or static motion. If they can grasp the learning essentials of skills, they can naturally improve their posture and improve the coordination and fluency of the swinging movement. Then, the learning effect on physical performance can be enhanced. Therefore, adjusting posture and mastering the knack are other aspects of the effectiveness of virtual reality for badminton teaching in the physical education curriculum.

(3) Teamwork and mutual support

Everyone will work together and take turns to exercise to complete the task assigned by the teacher. This method has made the class better and more united. (O0201)

Based on my recent observations and reflections, I want them to have the concept of lifelong learning. When it comes to traditional physical education, students still have limited learning due to the pressure of learning progress and time. Instead, I want them to enhance the level of cognition and have a little more perception so that they want to actively learn or improve their participation. Moreover, I wish they could discuss more and cooperate with each other, gradually change ideas and

then their behavior. That's why technologies start to get involved. I can also provide a lot of teaching resources to students who are interested for reference. This is also in line with the development of education in our national education policy. (T010402)

It can be concluded from the interview that under the teacher's design of the course, students started to cooperate with peers in groups. Each student took different tasks in turns, which has improved the learning efficiency, and has made the class more harmonious. Teachers were also happy to see that and hoped that students can use the virtual reality to promote mutual support among themselves, so that the feelings of physical education can be better expressed.

Students who are better at skills will help those who can't play well. I think this is good because most of my classmates are very kindhearted and they help others. Other groups do the same. Everyone has different capability, but this way allows us to know each other better. (J030301)

According to the above comment, students with high achievement in learning will take the initiative to assist the students with lower learning capabilities, so that peers in the group can learn the motions together with the help of each other. Students in the group can support each other. This can prevent students with poor ability being isolated which often happens in traditional teaching courses.

From the perspective of emotional level, students and teachers had the most profound feelings in feedback, because students can greatly increase their interaction with other students through this kind of teaching method, and improve together in learning. This is also a very important learning goal in the teaching design of virtual reality-based physical education curriculum. It is hoped that students not only learn sports knowledge, but also enhance the overall learning environment and achieve deeper learning effects through the cooperation within small groups. Therefore, the third aspect of the effectiveness of the virtual reality for badminton teaching in physical education should be teamwork and mutual support.

(iv) Improving motivation and promoting learning

Everyone is keen on using these things. Some people who rarely do their homework will on login to the learning platform to complete the homework. Learning using such technology devices let us engage more in learning. (J010402)

I found a good way during this teaching experience. I had adjusted my teaching design and excluded some parts that students complained about. I am certain that I will continue to use it, because students begin to accept this method more and they are willing to take the initiative to learn, which is what I am happy to see. (T010301)

According to the interviews, it can be observed that students are highly interested in virtual reality devices and digital teaching platforms, which also promotes learning motivation. They start to expect physical education classes, enjoy physical education classes, and are more willing to participate in physical education activities. From the teacher's perspective, we can also notice that when students slowly change their perception of physical education classes and enjoy the fun of learning, they naturally no longer regard physical education curriculum as an activity to relax their minds. Instead, they began to actively learn sports skills and complete the learning tasks assigned by the teacher.

The content is more innovative and intriguing. Different things have been used for the physical education class, so that the students are very happy to see this. After all, this kind of technology is rarely used in physical education classes. (D05)

As seen from the above comment, virtual reality-based badminton teaching is novel for students. In their previous learning experience, they rarely used technology-related materials, not to mention using them in physical education courses, so they are curious and intrigued. In this sense, it not only improves the motivation of learning, but also enhances the learning outcomes because of students' willingness to learn actively. Compared with traditional teaching methods, it can improve the learning outcome. This part can also be confirmed from the results of the students' cognitive tests.

Based on the above four aspects, it can be concluded that the overall feedback from students and teachers on the virtual reality-based badminton teaching in physical education is positive. Its effectiveness can be seen from the improvement of motivation in learning and the learning process, the positive effect on repeated practice and understanding of essentials, the enhanced adjustment of posture and grasp of skills, and the improvement of teamwork and mutual support.

(2) Difficulties encountered in the reality-based teaching of badminton in physical education
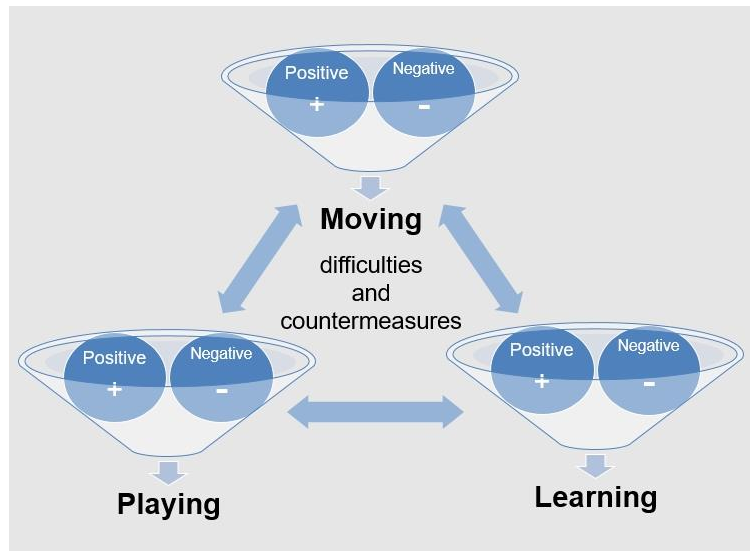
Figure 3: The dilemma encountered in the virtual reality-based teaching of badminton in physical education

i. Moving

The dilemma about moving refers to the situation where students believe that the use of virtual reality-assisted badminton teaching in physical education will reduce the time of their physical activities, resulting in too little physical activity in the physical education class. This is why there is a dilemma between moving and not moving. When using information technology equipment to assist in learning, if the activity is interrupted by watching or using the equipment, then the general time of doing activities for students will be reduced. Some students who are more active or expect physical activities in class will have a sense of rejection. There is a dilemma between the interest in IT equipment and real activities. Therefore, how to properly allocate time to balance the time for physical activities and equipment learning is an important key to use virtual reality equipment to learn for students.

I don't think it should be used too often, because a class is only 45 minutes. It takes too much time to use the technology, leaving too little time for physical activities. (D11)

I think it takes too long to use these things in class. Some students want to play, but they have been restricted. (J030202)

ii. Playing

The dilemma about playing refers to the situation occurred when students use virtual reality devices. They use the device too frequently, so the novelty will gradually decrease, and they will even feel tired and will not continue to use it. It's fun, but it will

bore students if it is used for too long. Therefore, in curriculum design and implementation, teachers must consider the frequency and time to find the balance between the two in order to maximize the learning effect of the device. The following comments reflect the true feelings of the students.

If it is used too often, I don't feel anything. It is not fun anymore. (O0102)

I don't want to use it during each session. Some students think that it is not fun to use in that way. I hope I can use the device in different activities. (J020201)

iii.   Learning

The dilemma in learning may occur when teachers use virtual reality to assist badminton teaching in physical education. Students think that the physical education class should be designed for stress relief, relaxing the body and leisure but not for study. Such prejudice against physical education classes makes the design and implementation of teaching difficult. Teachers need to find out the just right proportion of study leisure for students. Whether the teacher should cater the course to the students' expectations and let them have fun, or, to meet their own teaching objectives and let them learn something, is a dilemma in the design and implementation of courses.

I think the most difficult thing is students' perception of physical education. They think that physical education is for leisure not for study. It doesn't matter if you use traditional teaching or information-assisted teaching, they will reject it at the beginning because they don't want to learn and they just want to play. I have been done previous research on this, and the results show that they think it is useful and effective, and it helps them, but they just don't want to learn. They want to do activities themselves, because they think physical education should be designed for relaxing. However, I think equipment will become more advanced in the future, and that may help improve the situation. (J010203)

Based on my recent observations, if teachers only want students to move and do not want them to learn, of course, it is not necessary to use the device. Teachers' IT capabilities will also influence their motivation for using the devices. However, instructional design is the most critical point, because if teachers spend too much time using information technologies, students will show negative feedback. Therefore, our strategy will have an impact on students' ideas and practices. (T010602)

From the comments of the above teachers and students, it can be seen that the virtual reality-based badminton teaching in physical education has received more than positive feedback. After all, teaching is ever-changing, and the teacher's teaching design and implementation process will affect the effectiveness of the learning results. Therefore, when teachers use information technology equipment to assist teaching, they

must consider the amount of student activity, the balance of curiosity and burnout, and the difficulty of learning content, so that students will not face the dilemma and the effectiveness of the above four aspects can be best achieved.

V. **Conclusion and Recommendations**

1. Conclusion

(1) Using virtual reality-based badminton teaching in physical education can improve the learning outcomes from four aspects

Based on the above results, it can be found that the virtual reality-based badminton teaching in physical education can improve the learner's learning outcomes, including repeated practice and understanding of the essentials, adjusting posture and grasping the knack, team work and mutual support, as well as promoting motivation and learning. It is obvious that the virtual reality-based badminton teaching in physical education has a positive impact on student learning. This kind of teaching method can impress students deeply and it also greatly enhance their learning motivation and learning achievements. It can also lead to major breakthroughs of physical education in terms of cognition, skills and perception, and can effectively improve students' learning outcomes.

(2) Three dilemmas of reality-based badminton teaching in physical education

From the above research results, it can be known that teachers who use virtual reality to assist the teaching of badminton in physical education course will encounter dilemmas, regarding moving, playing and learning. When applying technology equipment into physical education, teachers should consider more. Perhaps students' passion comes from the curiosity of the novel devices, but after a long time, such passion may begin to drop. Therefore, teachers must have relevant teaching procedures to respond to that. It is recommended to use media materials appropriately in the physical education courses, while maintaining a certain period of time for students to do physical activities, so that the limited time of a physical education class can be used fully.

2. Recommendations

(1) Suggestions on the integration of virtual reality into the physical education

curriculum

i. Changing the perception of teachers and students about physical education curriculum through the integration of information technology

According to the research, there is still possibility for teachers and students to change the perception of physical education curriculum. Most of them still emphasize skills and neglect cognition and perception. Therefore, we should promote the essential meaning of physical education curriculum and change the perception of physical education curriculum for teachers and students. Using information technology is a relatively easy choice to achieve this goal. Therefore, it should be encouraged to be applied further to various sports during the teaching process to change the teacher's and students' perception of physical education curriculum.

ii. Improving the IT capabilities of physical education teachers to promote the effectiveness of physical education curriculum

Based on the results of this study, it can be concluded that the virtual reality-based badminton teaching is effective in physical education. Therefore, physical education teachers should have the relevant knowledge to facilitate teaching. First of all, we should start from the source of teacher training, laying a solid IT foundation before teaching. Secondly, teachers should have training about relevant skills in service, so that information technology can be integrated into the curriculum and become a norm for physical education teachers in order to promote the effectiveness of the technology.

iii. Providing different levels of virtual reality images to achieve differentiated teaching objectives

It can be noticed from the results that the difference in students' learning ability will affect the learning process and affect the effectiveness of the technology. Therefore, when using virtual reality to assist physical education, teachers can record different degrees of videos for students to watch and present more diverse teaching materials. Depending on the level of abilities of the students in the class, each student can participate in the course and achieve the goal of differentiated teaching.

(2) Suggestions for future research

i. Increasing research time

This study only lasted four weeks to collect data, which is tight in time. This can

be improved in the future. Qualitative research itself involves continuous accumulation and changes. Therefore, this research has been in a spiraling state of continuous circulation, repetition, overlap, and supplementation. As the final research results developed with time, there must be still imperfections that can be improved in the future.

ii. Increasing types of sports

This study is only for the seventh-grade students to study the badminton serving in a physical education course. Therefore, relevant research in the future can try to integrate the virtual reality devices into other sports projects, so as to discuss the benefits of applying information technology equipment into the physical education curriculum from a broader perspective and determine the possibility of promoting the research results of this study further.

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