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Multi-dimensional Evaluation and Practical Reflection on the Intelligent PE Class Model from the Perspective of Artificial Intelligence

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Abstract: As a popular trend of contemporary education and teaching, intelligent classroom has gradually become an indispensable part of the teaching system, and the traditional education model has been replaced by intelligent classroom in physical education. With the development of science and technology progress, the requirements for equipment and technology of sports intelligent classroom are also higher and higher. In order to match technology with sports wisdom teaching classroom, cultivate students' awareness of participation and stimulate students' enthusiasm for sports, the introduction of Artificial Intelligence (AI) technology in the classroom is the key. Therefore, this paper studied the intelligent classroom mode in which machine vision AI technology was integrated into sports teaching theory, and used machine vision AI technology to measure and record students' physical performance. According to personal characteristics, different training programs were developed. Machine recognition replaced human eye recognition, which improved accuracy and enhanced students' self-awareness. The relevant experimental scheme and questionnaire were designed, and the participation of students before and after the introduction of machine vision and AI technology was investigated and compared. The results showed that after the introduction of machine vision AI technology, students' sports level could be more accurately and effectively understood. The number of students interested in sports courses increased by 47, and the average score of sports test significantly improved. It could be seen that the introduction of machine vision and AI technology into the sports intelligence classroom would help stimulate students' interest and improve the classroom atmosphere and students' activity ability. This study provided a reference value for the intelligent classroom model in which AI technology was integrated into physical education teaching theory, which had a reference value for innovative teaching concepts.

1. Introduction

The traditional model of physical education can hardly encourage students to be interested in

sports, which leads to low participation rate. The physical quality of students is getting worse and worse. There are errors in measuring the results of activities, and sports evaluation is unfair. As one of the important means to change the traditional teaching mode, intelligent classroom has been gradually integrated into the teaching system, but students generally have insufficient perception of intelligent classroom. Therefore, advanced equipment technology is the basis of intelligent classroom, and AI technology is gradually infiltrating into education and teaching. In order to cultivate students' interest in sports and enhance their awareness of exercise, the problem of inaccurate judgment of activity participation results should be solved to integrate the development of AI technology and physical education teaching. By introducing machine vision AI technology, the recognition accuracy is improved. The machine is used to replace the human eye for measurement and judgment, which realizes automatic measurement of motion results. This would help to improve classroom efficiency and achieve teaching results.

The application of intelligent classroom model in teaching is particularly important, and the integration application of AI technology in it also attracts the attention of scholars. Yang J used Statistical Product Service Solutions (SPSS) 23 statistical software to conduct a large-scale intelligent classroom survey in China. The research results showed that digital equipment and the Internet were the basis of intelligent classroom equipment [1]. Phoong S Y believed that intelligent classroom was a technology based learning method, which was a solution to improve students' ability. The t-test was used for data analysis to study the impact of intelligent classroom on students' academic performance [2]. Xie M proposed that with the development of information technology, physical education teaching also needed breakthrough development in intelligent classroom [3]. According to the actual situation, Yang B analyzed the influence of intelligent classroom on the quality of college physical education teaching [4]. The intelligent classroom is becoming more and more important, and the new teaching model also has higher requirements for the physical education teaching theory.

As the existing teaching facilities and equipment have certain limitations on the new teaching mode, the AI technology can improve the existing sports teaching mode. Therefore, many scholars have conducted research on the application of AI technology into sports intelligence classroom. Bin Y believed that the integration of AI information technology and curriculum could improve the quality and effect of teaching [5]. Nadikattu R R believed that AI played an important role in the sports industry, which ensured the development of the sports sector from a traditional to a more modern way [6]. Li Z made a comparative analysis of physical education teaching in a university by using experimental methods, which showed that the physical education teaching of AI could significantly improve the quality of students in all aspects [7]. Claudino J G studied that AI methods could be used to study sports performance and injury risk [8]. This indicated that the application of artificial intelligence technology in college physical education would gradually be extensive. At present, the machine vision AI technology was gradually applied to the teaching of universities.

This paper studied the intelligent Classroom model in which the machine vision AI technology was integrated into the physical education teaching theory, and conducted a comparative experiment. The experimental data showed that when the machine vision AI technology was not introduced, only 96 sample students expressed their interest in physical education activities. After the introduction of technology, the number of students interested increased by 47; in the absence of the introduction of machine vision AI technology, the average scores of the sample students in physical education classes in the four sports of high jump, standing long jump, 100 meter dash and rope jump were generally low. After the introduction of technology, the average scores of students in physical education increased. The experiment proved that the machine vision artificial technology had a promoting effect on the intelligent Classroom model in the physical education teaching theory.

2. Evaluation of Intelligent Classroom Model in Sports Teaching Theory

2.1 Overview of Intelligent Classroom

The traditional teaching model is characterized by teacher-oriented and the students' passive learning. However, from the perspective of development, the traditional teaching model has lagged behind, and the new intelligent classroom emerged as the times require. Whether it is a new type of intelligent classroom model or a traditional teaching model, the classroom is the most classic place. The uniqueness and development of students that teachers should face in their educational activities result in the complexity of classroom teaching. The emergence of intelligent classroom requires teachers not only to retain the essence of some traditional classrooms, but also to improve their own connotation and external performance, so the requirements for teachers are also higher [9].

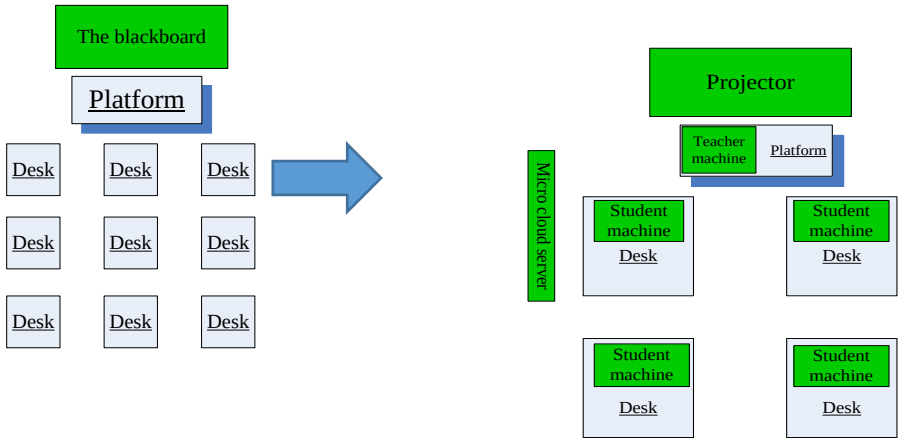

Figure 1: Comparison of traditional teaching and wisdom classroom

Figure 1 shows that the traditional classroom is "teachers teach and students learn", and they do not interfere with each other. Intelligent Classroom is a new model that students are divided into groups, and members of the group interact and cooperate with each other. This is student-centered, and students learn independently. Teachers should give guidance and feedback appropriately. Under the influence of big data, intelligent classroom has become the direction of education development and the mainstream leading the development of education informatization [10]. Smart classes have obviously gone deep into various fields of school education. The transition from traditional cultural courses to smart classes is an inevitable choice. Of course, professional cultural courses would not lag behind, such as music, art, physical education, etc.

2.2 Intelligent Classroom Model in Sports Teaching Theory

Physical education refers to a purposeful and organized education process jointly conducted by teachers and students according to a certain plan and curriculum standards, which is the basic form for schools to realize physical education. Its task is to strengthen students' physical fitness, so as to cultivate students' morality, will, and quality. In sports teaching, students not only need to master sports knowledge and skills, but also need to learn professional knowledge and theory; While teaching students basic sports knowledge and skills, it is also necessary to arouse students' interest in sports and cultivate their awareness and habits of physical exercise.

Physical education curriculum is firmly based on the two research fields of human biological science and social culture, and draws on a wide range of disciplines to study human movement. Therefore, physical education curriculum is similar to other disciplines in terms of discipline objectives, objectives, theoretical basis, specific content and evaluation [11]. Physical education

teaching is a complicated system optimization project, which involves many factors. Physical education teaching is evaluated scientifically, accurately and objectively [12]. The traditional physical education curriculum attaches importance to "teacher teaching", and it despises "student learning". The purpose of teaching is only to complete the teaching task [13] rather than proceeding from reality and taking students' health as the central goal. Obviously, as time goes on, the so-called physical indicators are no longer the mainstream of society. The teaching should start from the students' physical and mental health, which aims to strengthen the students' physique and cultivate their interest in sports. The teaching content and means should be constantly innovated, and the students' desire for exercise should be stimulated [14]. As a result, intelligent classroom arises spontaneously.

With the continuous improvement of China's higher education technology, rejuvenation and dissemination of national sports culture can not be separated from the strength of school physical education. The implementation of sports wisdom class has made sports education have a breakthrough development. On the one hand, the sports wisdom classroom has expanded the teachers' professional quality; on the other hand, its educational concept can meet the individualized and diversified learning needs of students. Sports wisdom classroom can show students sports skills and action essentials in an all-round way, which is of great benefit in attracting students' interests and improving teaching content. In addition, sports wisdom classroom has obvious effects on improving classroom atmosphere and teaching quality.

However, the research of contemporary education on intelligent classroom mainly focuses on the intelligent output of resources. Since intelligent classroom is the application and combination of big data, it is particularly important to reasonably allocate data resources. The multimedia data resources included in the intelligent classroom can well meet the personalized needs of students. Although the sports wisdom classroom improves the teaching quality, it lacks the popularization of electronic technology application and the intelligent classroom needs to rely on high-tech electronic platforms to achieve classroom construction, which is relatively limited for outdoor courses such as sports teaching. Therefore, the introduction of AI equipment is particularly important for physical education teaching.

2.3 Artificial Intelligence Technology

AI can be said to serve all aspects of society, so what is AI? The concept of AI is always in dispute. Academics progress in the debate, and ideas advance in the debate. Only by arguing can society develop, and only development can lead the world. Different people have different views on AI becoming the trend of society. A scholar once said, "As far as sports is concerned, AI would certainly help build a sports power. In this era, the combination of sports and AI is an inevitable trend of social development to conform to the new trend of AI development in the world."

AI can be deeply integrated with the research results of relevant sports disciplines to provide high-tech products and services for promoting the development of intelligent economy and sports industry. The sports industry is now facing the growing diversified sports needs of the people and the new trend of national fitness. In order to solve the problems faced by sports, AI technology should be relied on. In the era of intelligent economy, sports industry not only refers to social sports, but also includes campus sports teaching courses. The physical and mental health of teenagers is the goal that people should pursue. AI can develop different and scientific and effective training programs for each student.

2.4 Machine Vision

Machine vision is a kind of AI technology, which can replace human eyes to record students'

physical performance and upload it to the server terminal. The integration of AI into the teaching and learning process can greatly change the way students perceive knowledge [15].

The imaging mode of machine vision is actually the process of taking images with an electronic eye camera, which is also the process of optical imaging. This is a conversion process between world coordinate systems (Xa, Ya, Za), camera coordinate systems (Xb, Yb, Zb), image coordinate systems (Xc, Yc/Xd, Yd), and pixel coordinate systems (A, B). The machine vision model provides a basis for the calculation of the internal and external parameters of the electronic eye. The relationship between the coordinate systems in the linear electronic eye pinhole model is shown in Figure 2.

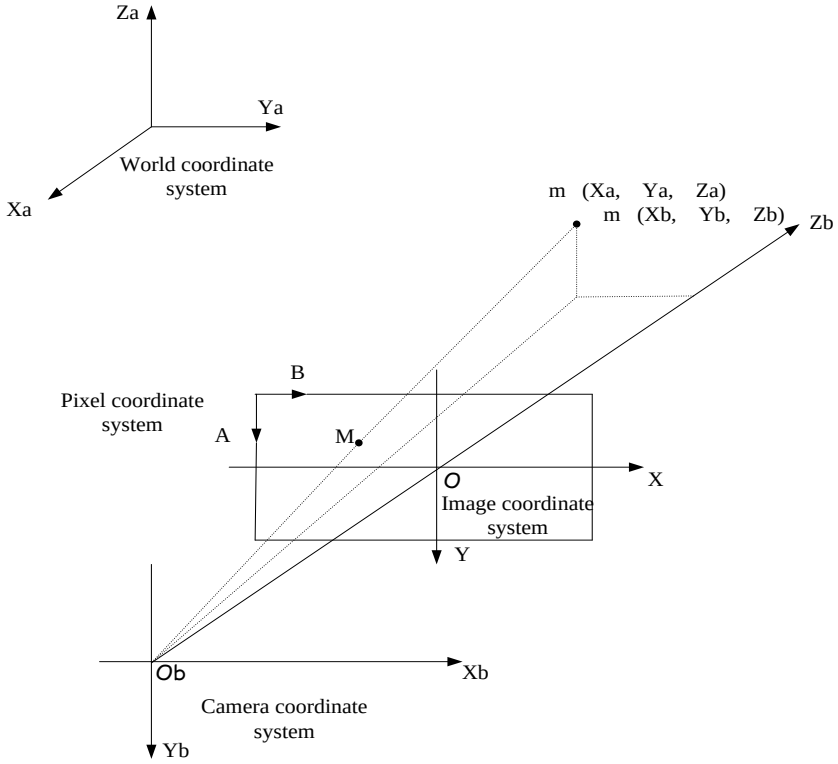

Figure 2: Diagram of each coordinate system in the electronic eye model

Based on the characteristics of coplanar points, this paper establishes a calibration model of machine vision electronic eye camera based on pinhole model. Through the linear pinhole model, the relationship between the pixel coordinates of the two-dimensional image and the scene point coordinates of the three-dimensional space can be known. The detailed transformation process between coordinates is as follows:

The transformation of a point in the world coordinate system (Xa, Ya, Za) to a point in the camera coordinate system (Xb, Yb, Zb) can be made by a rotation matrix P and a translation matrix T, as shown in Formula (1):

$$\begin{bmatrix} Xb \\ Yb \\ Zb \end{bmatrix} = P \begin{bmatrix} Xa \\ Ya \\ Za \end{bmatrix} + T \tag{1}$$

In Formula (1), P represents a 3×3 rotation matrix, and T represents a three-dimensional translation vector, which can be expressed by the homogeneous coordinate Formula (2):

$$\begin{bmatrix} Xb \\ Yb \\ Zb \\ 1 \end{bmatrix} = \begin{bmatrix} P & T \\ 0_3^t & 1 \end{bmatrix} \begin{bmatrix} Xa \\ Ya \\ Za \\ 1 \end{bmatrix} \tag{2}$$

Conversion from camera coordinate system to image coordinate system: According to pinhole model and imaging principle, the relationship between focal length F, object distance A, phase distance B, world coordinate system and points in camera coordinate system can be known, and Formula (3) can be obtained by combining Figure 2:

$$\mathrm{Xa} = \mathrm{F}_{\mathrm{Zb}}^{\mathrm{Xb}} \qquad \mathrm{Ya} = \mathrm{F}_{\mathrm{Zb}}^{\mathrm{Yb}} \tag{3}$$

The conversion relationship between the points on the camera coordinate system and the points on the image coordinate system (Xc, Yc/Xd, Yd) can be known from formulas (1)-(3), which can be expressed by the homogeneous coordinate Formula (4):

$$Zb \begin{bmatrix} XA \\ YA \\ 1 \end{bmatrix} = \begin{bmatrix} F & 0 & 0 & 0 \\ 0 & F & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} Xb \\ Yb \\ Zb \\ 1 \end{bmatrix} \tag{4}$$

The homogeneous coordinates of M and m in Figure 2 can be expressed as $\mathrm{M} = [\mathrm{A}, \mathrm{B}, 1]^{\mathrm{t}}$ and $\mathrm{m} = [\mathrm{X}, \mathrm{Y}, 1]^{\mathrm{t}}$ respectively. According to formulas (1)-(4), the conversion relationship between the 3D world coordinate system (Xa, Ya, Za) and the camera coordinate system (Xb, Yb, Zb) can be known. In combination with the homography between the template plane and the image in the pinhole model, the relationships between the three-dimensional point m and the image projection point M are shown in Formula (5) and Formula (6):

$$qM = S\begin{bmatrix} P & T \end{bmatrix} m \tag{5}$$

$$S = \begin{bmatrix} \frac{F}{Rx} & k & A \\ 0 & \frac{F}{Ry} & B \\ 0 & 0 & 1 \end{bmatrix} \tag{6}$$

In the formula, q is an arbitrary scale factor; S represents camera internal parameter matrix; [P T] represents the camera external parameter matrix; (A, B) is the coordinate of the principal point; F is the focal length of the camera lens; Rx and Ry respectively represent the physical dimensions of each pixel on the image plane in the x and y directions (due to technological reasons, each physical pixel is a rectangle rather than a strict square); k is a parameter describing the tilt angle of two coordinate axes.

The intersection of the optical axis and the image plane in the image physical coordinate system should ideally be located at the center of the image. Due to the camera manufacturing process, there would be deviation. If the coordinates of the origin of the image physical coordinate system (x, y) in the image coordinate system (A, B) are (A0, B0), the side length of each physical pixel cannot be consistent due to process reasons. Therefore, any pixel in the image satisfies the relationship of

Formula (7) in two coordinate systems:

$$\begin{cases} A = xA/Rx + A0 \\ B = yA/Ry + B0 \end{cases} \tag{7}$$

After it is converted into homogeneous coordinates and matrix form, the Formula (8) is as follows:

$$Z_b \begin{bmatrix} A \\ B \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{1}{Rx} & 0 & A_0 \\ 0 & \frac{1}{Rx} & B_0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} F & 0 & 0 & 0 \\ 0 & F & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{pmatrix} P & t \\ 0^t & 1 \end{pmatrix} \begin{bmatrix} Xa \\ Ya \\ Za \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{F}{Rx} & 0 & A_0 & 0 \\ 0 & \frac{F}{Ry} & B_0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{pmatrix} P & t \\ 0^t & 1 \end{pmatrix} \begin{bmatrix} Xa \\ Ya \\ Za \\ 1 \end{bmatrix} = m1m2 x_a = m x_a \tag{8}$$

m1 and m2 are the internal and external parameters of camera calibration respectively.

3. Intelligent Classroom Mode of Machine Vision AI Technology in Physical Education Teaching Theory

3.1 Machine Vision Electronic Eye Inspection Experiment

In order to reflect the influence of the introduction of machine vision AI technology on the intelligent classroom model in sports teaching theory, this paper studies the intelligent classroom model in which machine vision AI technology is integrated into sports teaching theory. As machine vision AI technology mainly uses intelligent vision technology to record students' physical performance with electronic eye camera, this paper has carried out relevant experimental research according to the characteristics of machine vision. A student with stable sports performance was selected for the 100 meter sprint test. Figure 3 shows the test results.

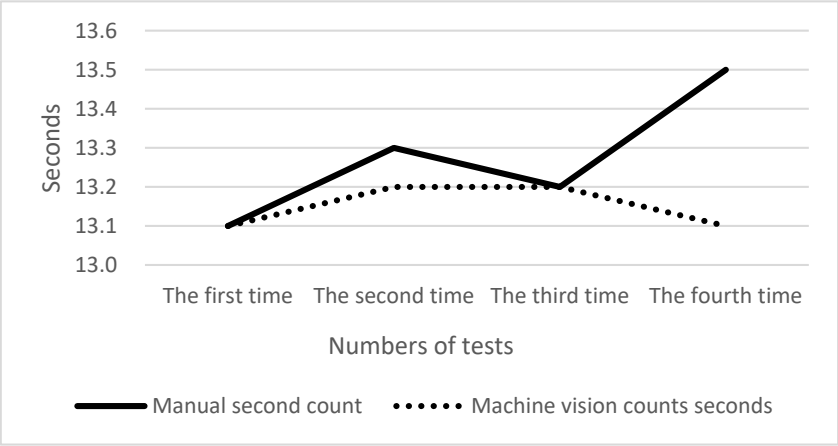

Figure 3: 100-meter dash performance chart

As can be seen from the results of the reaction in Figure 3, the student's 100 meter sprint performance fluctuates greatly when counting the seconds manually. When the machine vision AI technology counts the seconds, the student's running performance is relatively stable. This shows that there are some errors in the students' scores in the eye test. AI technology can greatly reduce this error and fairly evaluate students' performance.

3.2 Role of Machine Vision and AI Technology in Physical Education Teaching

In order to reflect the influence of machine vision and AI technology on physical education

teaching, the questionnaire survey (multiple choices) is designed.

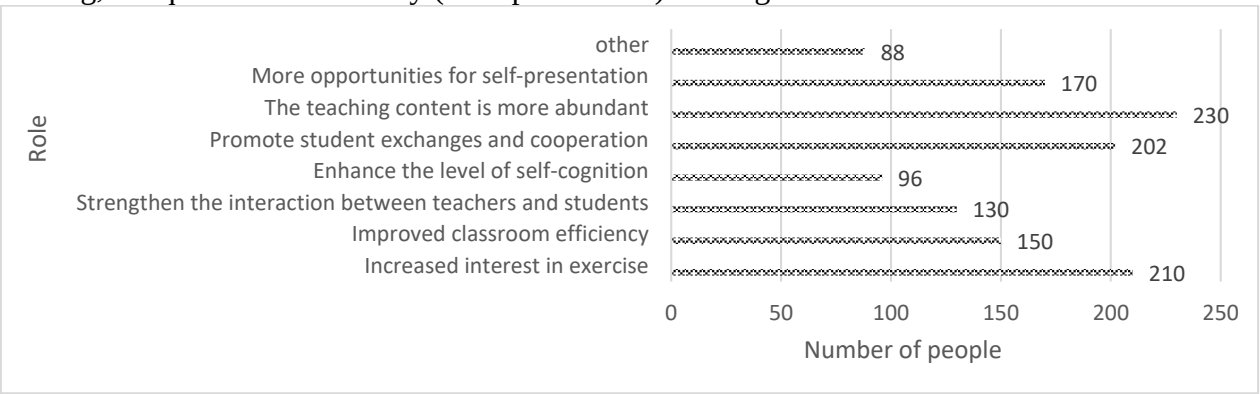

Figure 4: Results of questionnaire survey

Figure 4 shows the results of this questionnaire. The total number of people participating in the questionnaire is 246. It can be seen from the data of the questionnaire that 230 of them believe that the teaching content of physical education course after the introduction of machine vision and AI technology is more abundant; 210 people increase their interest in exercise; 150 students believe that AI technology improve classroom efficiency; 130 students believe that the interaction between teachers and students is strengthen; 96 students believe that the introduction of AI technology can help improve their self-cognition. This fully shows that the application of machine vision AI technology bring great improvement to the sports intelligence classroom, and students also enjoy the efficiency, convenience and freshness of AI technology.

In order to study the influence of machine vision AI technology integrated into physical education teaching theory on students' sports performance before and after the intelligent classroom, this paper conducts an interest survey on 246 students participating in the questionnaire, as shown in Figures 5 and 6.

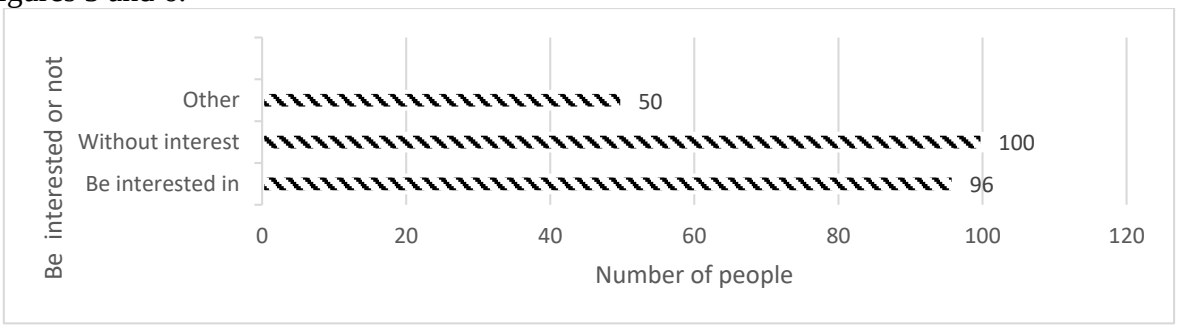

Figure 5: Statistics of the number of students interested in physical education class before the introduction of machine vision AI technology

Figures 5 and 6 show that 96 students express interest in physical education activities before the introduction of AI technology. After the introduction of technology, the number of people interested in sports activities increase by 47. It shows that machine vision and AI technology can significantly promote students' enthusiasm for sports. Through the change of interest in physical education curriculum, students' attitude towards AI technology is observed.

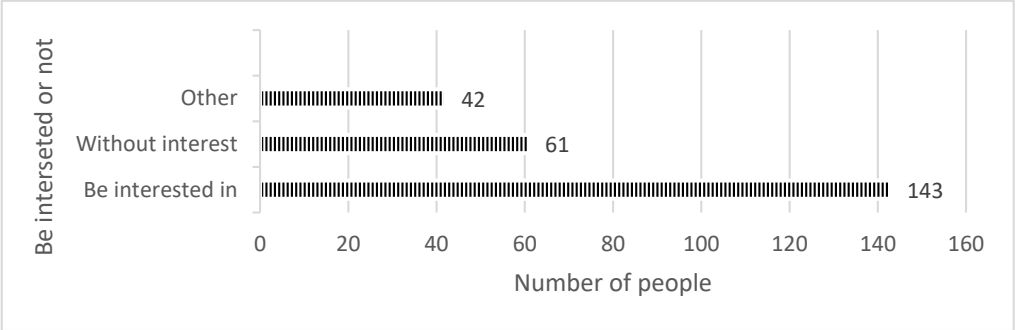

Figure 6: Statistics of the number of students interested in physical education class after the introduction of machine vision AI technology

In order to detect the influence of machine vision on students' sports performance, students from a certain class of a school are selected to conduct a controlled experiment. To ensure the accuracy of the results, independent variables are uniformly controlled. The total number of students in this class is 52. Before the introduction of machine vision AI technology, the change of the average score of the students in this class for four times in a month is detected; after the introduction of machine vision AI technology, the change of the average score of the students' four sports scores in this class in the past month is detected; the average sports scores of the two times are compared.

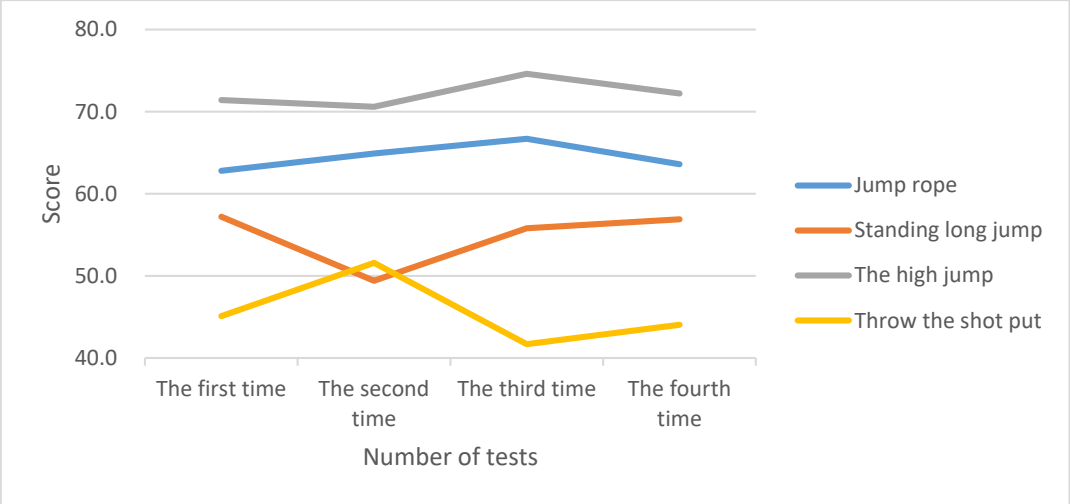

Figure 7: Average scores of sports before the introduction of AI technology

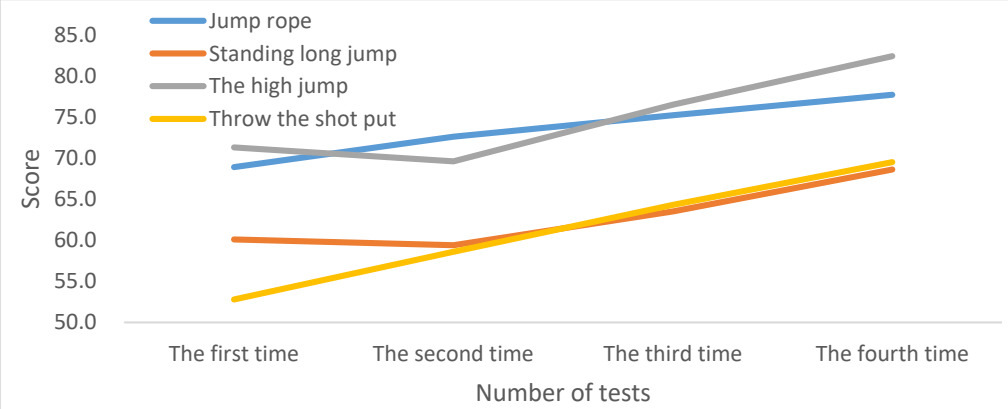

Figure 8: The sports average score after the introduction of AI technology

As can be seen from the results in Figures 7 and 8, the students' sports performance is generally low in the intelligent classroom without the support of AI technology. Relatively speaking, the average score of high jump is high, and the average score of shot put and standing long jump is not more than 60. The fluctuation of the four test results is small and stable. In the physical education teaching course with the introduction of machine vision AI technology, the test results of the four sports showed a relatively gentle linear upward trend. It can be seen that the machine vision AI technology has an obvious effect on improving students' physical education performance.

4. Conclusions

It can be seen from the experimental data that machine vision AI technology is an important and inevitable trend to integrate into the future physical education curriculum. The machine vision AI technology makes the evaluation of students' sports achievements more accurate and reliable. In order to create a personalized and intelligent sports teaching environment, machine vision and AI technology are integrated to optimize the sports teaching process. The research data shows that the machine vision AI technology has obvious advantages in improving students' sports performance and improving the sports teaching atmosphere. It is undeniable that the AI technology makes the physical education teaching go further towards the concrete construction direction. However, although this paper could prove that machine vision AI technology brought convenience to physical education teaching, there were also some problems. Firstly, due to the gradual improvement of modern science and technology, the price of AI technology was generally on the high side, which led to the fact that AI was not widely used in sports disciplines. Even if the efficiency and convenience of AI technology could be proved, it could not be denied that it had a disadvantage in the high price. Most universities would still choose the traditional teaching mode when they could not afford the high price; secondly, in terms of experimental data collection, this paper only selected the experimental data of a certain school, and it did not consider the data results of physical education courses in other campuses. The reliability of the experimental results was not high. Finally, in order to deeply analyze the intelligent classroom model of AI integrated into physical education teaching theory and make the research results more authentic and representative, the analysis results would be further improved from these perspectives in the follow-up study.

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