Design and Development of Artificial Intelligence Physical Education Teaching Resources under Human-Computer Interaction Mode

Shuang Hao[1,*]

[1] College of Physical Education and Health, Chengdu University of Traditional Chinese Medicine, Chengdu, Sichuan, 611137, China

Corresponding authors: (e-mail: 18608023307@163.com).

Abstract The digital society has been better developed, and has also caused changes in different fields. Reasonable and effective use of rich and varied Physical Education (PE) resources is an important means to improve the quality of PE. Reasonable and effective use of rich and varied PE resources is an important means to improve the quality of PE. According to the current demand for sports TR, this article discussed the way to optimize the design and development of sports TR from the development status of sports Teaching Resources (TR), the application of Artificial Intelligence (AI) and Human-Computer Interaction (HCI) in sports TR. Therefore, this article put forward the design and development of AI sports TR under HCI mode, and verified its feasibility through research. The final research results showed that the overall PE test scores of the classes designed and developed with this method were better than those with traditional methods. In the third and sixth tests, the average scores of the classes with this method were 2.1 points and 5.29 points higher than those with traditional methods, respectively. It can be seen that the method in this article was more conducive to the improvement of students' performance, and can also improve the satisfaction of the design of PE TR and the richness of resource development, and ultimately improve the teaching quality. In addition, the discussion of AI in HCI mode in this article can also promote the wider application of digital teaching methods and promote the development of digital society.

Index Terms Physical Education Teaching Resources, Human-Computer Interaction Mode, Artificial Intelligence, Design and Development

I. Introduction

As the current digital development theory is gradually mature, the digital society has also got a better development space, which also caused the digital reform in the teaching field. People's way of thinking, learning and cognition are undergoing subtle changes. In the eyes of the students, the teacher is not the master of the students' learning experience anymore, and at the same time, the students' own inner emotional appeals are increasing. At present, the modernization of teaching also puts forward different requirements for the design and development of TR. In the face of the constantly developing information society, it is of practical significance to vigorously design and develop sports TR to make sports teaching more vivid and colorful. In this article, the PE TR is deeply explored. According to the AI under the current popular HCI mode, the design and development of PE TR are discussed. This research can provide more theoretical basis for the design and development of sports TR.

For the development of TR, many scholars have discussed it from different aspects and said that the development and construction of TR would help promote teaching reform. Peng Wang studied the construction and application of the teaching resource database. He also described the construction process of the accounting skills resource database under the background of the Internet, and expressed the need to make full use of the information TR, promote the reform and innovation of the teaching model, and improve the quality of education and teaching [1]. Wang Yang was studying the application of virtual reality technology in the construction of modular TR. He said that the TR built through virtual simulation resources is visual, interactive, extensible, renewable, and optimized, and can provide a good reference for modular teaching [2]. Acosta Hazel studied classroom TR. Through analyzing the TR used by teachers in the classroom, he said the design, development, selection and application of TR are extremely important. They can provide reference for the reform of teaching models [3]. Qu Jia studied the construction of teaching information resource service system. He combined big data-driven and mobile learning to build the system, and said that the system can integrate mobile learning infrastructure and TR, and serve applications and students, ultimately improving students' learning ability, promoting teaching reform, and

achieving teaching according to their aptitude [4]. These scholars' discussion on the development of TR can enrich their theoretical content, but there are also certain deficiencies.

However, some scholars have studied it from the perspective of PE TR and put forward different views. Huang Wenlang studied the application of online teaching resource platform in college PE. He integrated the online teaching resource platform and the multiple linear model to put forward the multimedia network mixed teaching method, and said that this method can improve college students' physical learning ability [5]. Liu Huaijin studied the construction and application of digital TR in regional basic education. Taking PE as an example, he analyzed the problems in the construction and application of digital TR in regional basic education, and put forward corresponding countermeasures and suggestions to provide reference for the reform and development of basic education information teaching in relevant regions [6]. Scholars' research on PE TR can provide some theoretical support for this article, but because scholars have not combined AI and HCI technology in their research, the research results are difficult to meet the current needs and have little reference value. It can be seen that the application of HCI and AI in the design and development of PE TR is currently a relatively new field, which needs further discussion.

To better enhance the design and development of PE TR, this article proposes a new method to promote the design and development of PE TR on the basis of theoretical analysis, combining HCI mode and AI. Through empirical research, it is found that the method proposed in this article is better. Compared with the traditional methods of designing and developing physical education resources, the innovation of this article is to focus on the importance of digital teaching devices and AI and use them in the design and development of TR.

II.   Theoretical Evaluation on the Design and Development of PE TR

II. A. Overview of Sports TR

II. A. 1)   Meaning of TR

TR generally refers to various conditions or facilities that can be applied in the process of teaching and are conducive to teaching activities [7]. In a broad sense , TR can also relate to the educational policies issued by the country. In a narrow sense, TR includes teaching environment, teaching materials and teaching auxiliary systems. The main types of TR are shown in Figure 1:
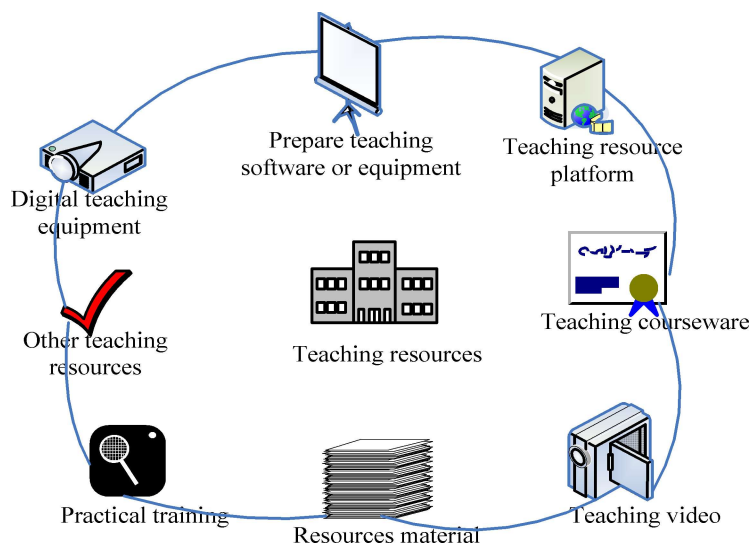

Figure 1: Main types of TR

II. A. 2)   Design of PE TR

With regard to sports TR, some scholars believe that sports TR is the general term of various conditions to ensure the smooth implementation of sports teaching innovation activities, including the support of teachers, sports facilities, sports equipment, sports courses and other intelligent equipment or resources for the smooth implementation of sports teaching [8]. Other scholars believe that PE TR is the general name of various resources that can be used to provide services for PE, such as school resources, social resources, family resources and the environment that can be used in sports activities. This article believes that today's sports TR is an important part of sports resources, and is the general name of human, material and information resources that can provide conditions for sports teaching and ensure that sports activities can be carried out.

Teaching resource design is to control teaching content, teaching process and teaching process in the way of teaching design [9]. The teaching design is to take the teaching process as a research object, and use the system theory method to analyze and study the teaching problems.

II. A. 3)   Development of PE TR
The development of sports TR is a variety of measures or activities to maximize and utilize the advantages of various forms of sports resources, and improve their utilization rate, so that sports teaching activities can be carried out normally.

II. B. Current Situation of PE TR
School PE is an important place to cultivate excellent sports talents and implement sports policies, and also an important way to promote the development of PE [10]. Relevant research shows that there is an imbalance in the distribution of PE TR due to population size, regional economy and other factors. It is shown in four aspects:

First, in terms of sports teaching facilities, in places with better economic conditions, general schools have regular track and field fields, and sports equipment and facilities. However, in some economically backward areas, such as the west, it is difficult to guarantee basic sports equipment, let alone equipped with advanced sports teaching equipment. Second, in terms of school sports software, some key schools, demonstration schools and other schools have relatively reasonable sports teachers, and the level of teachers is also relatively high. Third, in terms of the guarantee of school sports funds, in economically developed areas, school sports funds have been fully guaranteed. However, in economically backward areas, sports funds often cannot be completed in time or according to standards. Fourth, there is an imbalance between PE and sports. Most of the time, the class hours and quantity of school PE are difficult to complete due to other reasons.

At present, many unbalanced problems in PE TR have become the important reasons that affect the quality of PE teaching. Therefore, finding the causes and countermeasures of these problems has become an important way to solve the current situation of PE TR. To address the above problems and improve the quality of PE, this article proposes to use AI under HCI mode in the development and design of PE TR, so that it can develop PE TR well and solve the current imbalance of resource allocation.

II. C. HCI Mode and AI
II. C. 1)   Meaning of HCI and AI
HCI refers to the direct or indirect communication between users and devices, interfaces, operating systems, etc. [11]. In the late 20th century, due to the continuous emergence of new technologies such as the Internet, mobile communications and computers, user experience has become a new discipline and is called interactive design.

AI, referred to as AI, is a new technical discipline, which mainly studies the theory, technology, method and application system of simulating, extending and expanding human intelligence [12]. It aims to explore the essence of intelligence and thus create an intelligent machine that can simulate human thinking mode. The research of AI has become more and more in-depth, and the understanding of AI has become more and more profound [13]. In this article, the main research is the design and development of PE TR by AI. The main application of AI in education is shown in Figure 2:
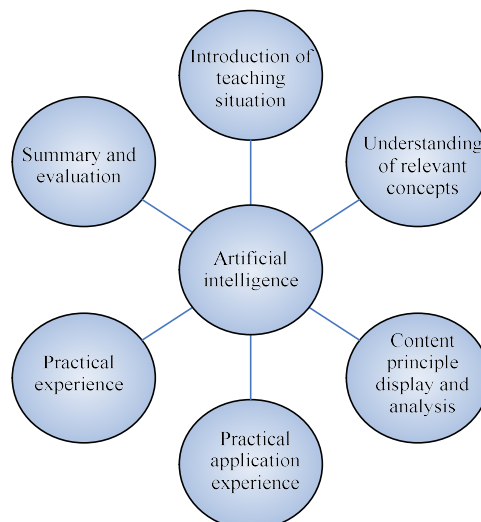
Figure 2: Main applications of AI in education

II. C. 2)   Application Evaluation of HCI and AI in Sports TR

Various AI technologies currently used in PE and sports activities often need various resources to support their implementation in order to achieve the basic purpose of PE activities [14]. The application of AI in PE TR can generally be divided into three types. First, motivational cognitive resources mainly include text, tables, pictures, animation, video and other visual materials. The second is experience and feeling resources. This mainly includes AI open platform, intelligent terminal application program, WeChat widget, etc., which can enable students to experience the charm of AI while learning AI applications, thus establishing the professional ethics of AI. Third, practical inquiry resources can enable students to experience how to use AI to solve problems in practical operation, initially master the basic knowledge of AI technology, and plan for simple AI applications. The specific application process of AI PE resources is shown in Figure 3:
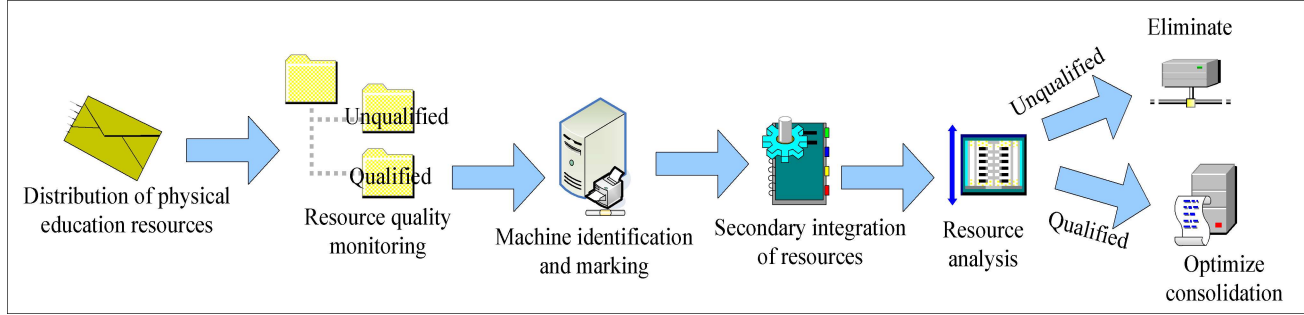

Figure 3: Application process of AI PE resources

II. C. 3)   Design and Development of AI PE TR

The traditional PE TR can not well adapt to the personalized learning demands of students, and it is difficult to enhance the reform of teaching mode. The use of AI in teaching can improve the shortcomings, thus realizing the need for students to obtain personalized resources, and providing some guidance for the intelligent upgrading and transformation of TR.

At present, HCI and AI have a good application in optimizing PE teaching mode [15]. This article specially combines the two. With the increasing popularity of HCI technology, AI technology is also developing. Among them, Convolution Neural Network (CNN) has a unique role in the development of PE TR.

Generally, sports resources are divided into three categories: human resources, physical resources and information resources, and then they are converted into a classification vector by random initialization method or pre-training method. Finally, the data of PE resources are linked into a dense digital matrix by the vector in the information of PE resources. The formulas are:

$$R_m \in Z^{q \times k} \tag{1}$$

$$R_m = [\, v_{n-1} \; v_n \; v_{n+1}] \tag{2}$$

Among them: q is the vector dimension;
k is the classification vector.

Due to the great difference between the information characteristics of PE TR and the characteristics of image, sound and video information, it must be corrected through convolutional network. Assuming that the overall feature $a_n^m \in Z$ of PE TR is obtained by the m-th shared weight $V_a^m \in Z^{q \times \sigma}$, and its window size can be replaced by σ, the following conditions need to be met:

$$a_n^m = fun\left(V_a^m \otimes B_{(n:(n+\sigma-1))} + c_a^m\right) \tag{3}$$

Among them: $\otimes$ is convolution operation;
fun is the nonlinear excitation function.
Because the disappearance of gradient would cause some problems during gradient descent operation, relevant methods can be used to avoid the disappearance of gradient. A global eigenvector a^m with weight V_a^m can be constructed, and its construction formula is as follows:

$$a^m = [a_1^m, a_2^m \cdots, a_n^m, \cdots, a_{k-\sigma+1}^m] \tag{4}$$

Because the characteristic information of PE TR obtained by using only one shared weight is very limited, a series of shared weights are introduced in the convolution layer to obtain multiple attribute vectors, so as to better provide more characteristic information vectors of PE TR. Then, using the pooling layer, the most representative features are extracted from each feature vector, and a fixed-length feature vector is constructed. Among them, the resource data is reduced to a fixed length feature vector, and the specific formula is:

$$h_x = [max(a^1), max(a^2), \cdots, max(a^m), \cdots, max(a^{i_a})] \tag{5}$$

On this basis, nonlinear mapping is also needed. Therefore, it is necessary to map h_x in the f-dimension space of the combined probability matrix decomposition model, so that teachers can complete the recommendation task of PE TR and realize the allocation of PE TR. The formula is:

$$H_m = tanh\big(V_{x2}\{tanh\big(V_{x_1 h_x} + c_{x_1}\big)\} + c_{x2}\big) \tag{6}$$

Among them: c_{x_1} is the deviation vector of V_{x_1}.

Finally, by using the convolution and nonlinear transformation of the above hidden layers, a nonlinear function with the PE teaching resource vector as the input and the corresponding implicit feature vector as the output is obtained. The expression is as follows:

$$H_m = N(V, R_m) \tag{7}$$

Among them: V is all weight and deviation vectors;
H_m is the implicit eigenvector.

The above in-depth exploration of PE TR through the convolutional neural network of AI in HCI mode can not only promote the development of its PE TR, but also enable teachers to interact with students based on this to better understand the situation of students.

II. D.Design and Development Methods of PE TR

The design of AI sports TR under HCI mode should follow certain principles, based on comprehensive teaching content and according to certain design principles, so as to make AI sports TR more scientific and effective.

The first part is the analysis of the earlier stage. In the design of PE TR, it is necessary to fully understand the characteristics of students, analyze their learning characteristics and their classroom learning conditions, and compare the design schemes of AI PE TR under various HCI modes. It is also necessary to deeply analyze the teaching content, combine various modules and different subjects as much as possible, and strive to make the teaching objectives at all levels consistent with the design principles.

The second part is the phased design process. In the design of curriculum objectives, it is necessary to focus on the knowledge that students have mastered and the overall physical quality and ability of students. In the implementation of teaching, people should pay attention to what kind of teaching methods should be adopted and whether the classroom teaching activities meet the requirements. According to the PE teaching objectives, people can determine the teaching design idea guided by AI PE TR under HCI mode, and further refine it.

The third part is the design of interaction, feedback and evaluation. In order to improve students' participation and immersion, learners need multiple interactions in the AI learning environment under HCI mode. In the process of learning, people should pay attention to formative assessment and summary assessment, and pay attention to self-monitoring and self-regulation of students. The registration key can be set on the startup interface. Students can carry out physical exercises without the restrictions of time and place, so as to find problems in physical learning in time. The specific design and development process of AI PE TR under HCI mode is shown in Figure 4:
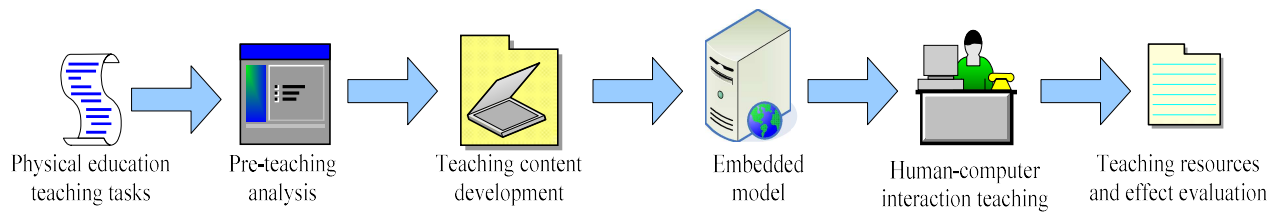

Figure 4: Specific design and development process diagram of AI PE TR under HCI mode

III. Empirical Evaluation of the Design and Development of PE TR

On the basis of theoretical analysis of PE TR, this article put forward a new TR design and development method based on HCI mode, which can make TR more scientific and effective, and can effectively improve students'

learning interest and learning effect. However, the specific practical effect of this method needs to be given more reliable basis through empirical analysis.

III. A. Evaluation Methods of PE TR

In order to verify the effectiveness of the design and development method of AI sports TR under the HCI mode, this article compared it with the traditional design and development method of sports TR. Two classes of students from a local college of PE, Class 1 and Class 2, were selected as the research objects. Class 1 used the traditional method and Class 2 used the method in this article. This article compared the differences between the two classes of students in the design and development of PE TR in different ways, including their PE test results, satisfaction with the application effect of TR design and the diversity of TR development, and drew relevant conclusions. The basic information of the two classes is shown in Table 1:

Table 1: Basic information of students in two classes

Serial number	Class	Class 1		Class 2	
		Number of people	Initial Average	Number of people	Initial Average
1	Boy student	35		33	
2	Girl student	18	70.23	20	69.41
3	Total number	53		53	

III. B. Evaluation of the Design and Development Results of PE TR

III. B. 1) Comparison of Sports Test Results

PE test results can directly reflect the actual effect of the design and development of PE TR. In order to make the test results more reliable, this article conducted six physical tests for students in two classes, and the specific average scores of the six physical tests are shown in Figure 5:
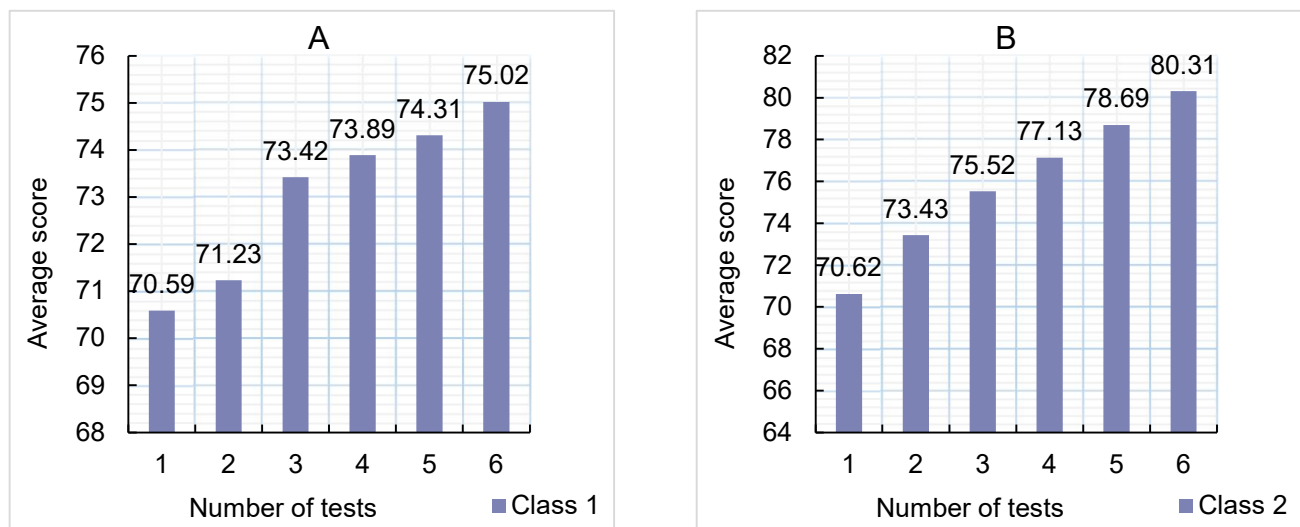
(A): The average score of the six physical tests of Class 1 under the traditional method

(B): The average score of the six physical tests of Class 2 in this method

Figure 5: Comparison of the changes in the average scores of the six sports tests of the two classes

It can be seen from Figure 5 (A) and Figure 5 (B) that the average score of the six physical tests of the Class 1 under the traditional method was 70.59, 71.23, 73.42, 73.89, 74.31 and 75.02, respectively. The overall average score of the students' physical education test scores in Class 1 was improved. Compared with the initial average score of 70.23 in Table 1, the average score of Class 1 increased by 4.79 points by the sixth test, but the overall score improved slowly. However, the average score of the six physical tests of Class 2 in this method was 70.62, 73.43, 75.52, 77.13, 78.69 and 80.31 respectively. Compared with the initial average score of 69.41 in Table 1, the average score of Class 2 has increased by 10.9 points by the sixth test. In addition, the average score of the six tests of this method was higher than that of the traditional method. The average score of the first test of Class 2 students was 0.03 points greater than that of Class 1 students. By the third test, the average score was 2.1 points

higher, and by the sixth test, the average score was 5.29 points higher. It can be seen that the method in this article is more obvious for the improvement of students' sports performance, which may be because the method in this article pays more attention to HCI, making students more interested in learning, and improving the learning effect.

III. B. 2) Satisfaction with the Design and Application Effect of PE TR

The satisfaction of the design and application of TR can effectively reflect the effectiveness and scientificity of PE TR. This article compared the satisfaction of students in the two classes with regard to classroom immersion and the overall application effect. The specific satisfaction of the two classes is shown in Figure 6:
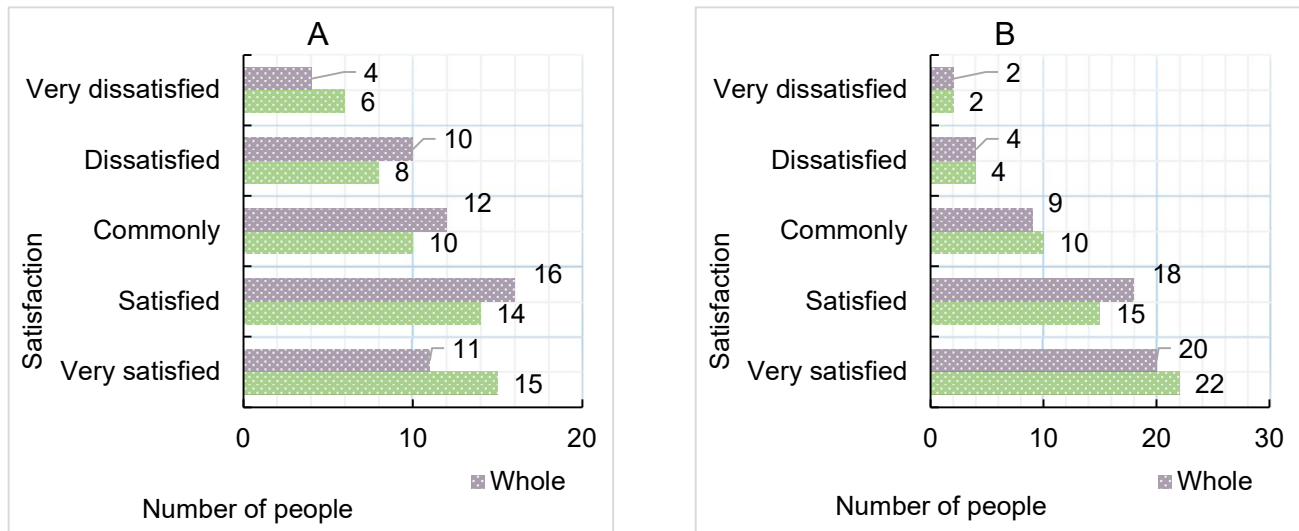
(A): Satisfaction of Class 1 with traditional methods   (B): Satisfaction of Class 2 under this method

Figure 6: Comparison of satisfaction of two classes

It can be seen from Figure 6 (A) and Figure 6 (B) that the number of students in Class 1 who were very satisfied with classroom immersion was 15, and the number of students who were very dissatisfied with classroom immersion was 6. The number of people who were very satisfied with the application effect of the overall teaching resource design was 11, and the number of people who were very dissatisfied was 4. It can be seen from it that compared with the method in this article, the number of students in Class 1 under the traditional method who were very dissatisfied with the classroom immersion and application effect was relatively large, and the number of students who were very satisfied was relatively small. However, the number of students in Class 2 under this method who were very satisfied with classroom immersion was 22; the number of students who were very dissatisfied was 2; the number of students who were very satisfied with the application effect of the overall teaching resource design was 20; the number of students who were very dissatisfied was 2. It can be seen that compared with the traditional method, the students' classroom immersion and application effect satisfaction under this method are higher. This may be because the method in this article focuses more on the design of AI sports TR, so that students can better maintain their energy, actively participate in classroom interaction, and focus more on classroom teaching content, so that the design effect of TR can be better played.

III. B. 3) Diversity of TR Development

Diversity is an important performance to measure the efficiency of the development of PE TR. By comparing the teaching environment, teaching materials, teaching cases, teaching tools, teaching courseware and teaching charts of the two classes of students in PE teaching, the diversity of their TR development can be well reflected. The specific number of TR used by the two classes is shown in Figure 7:
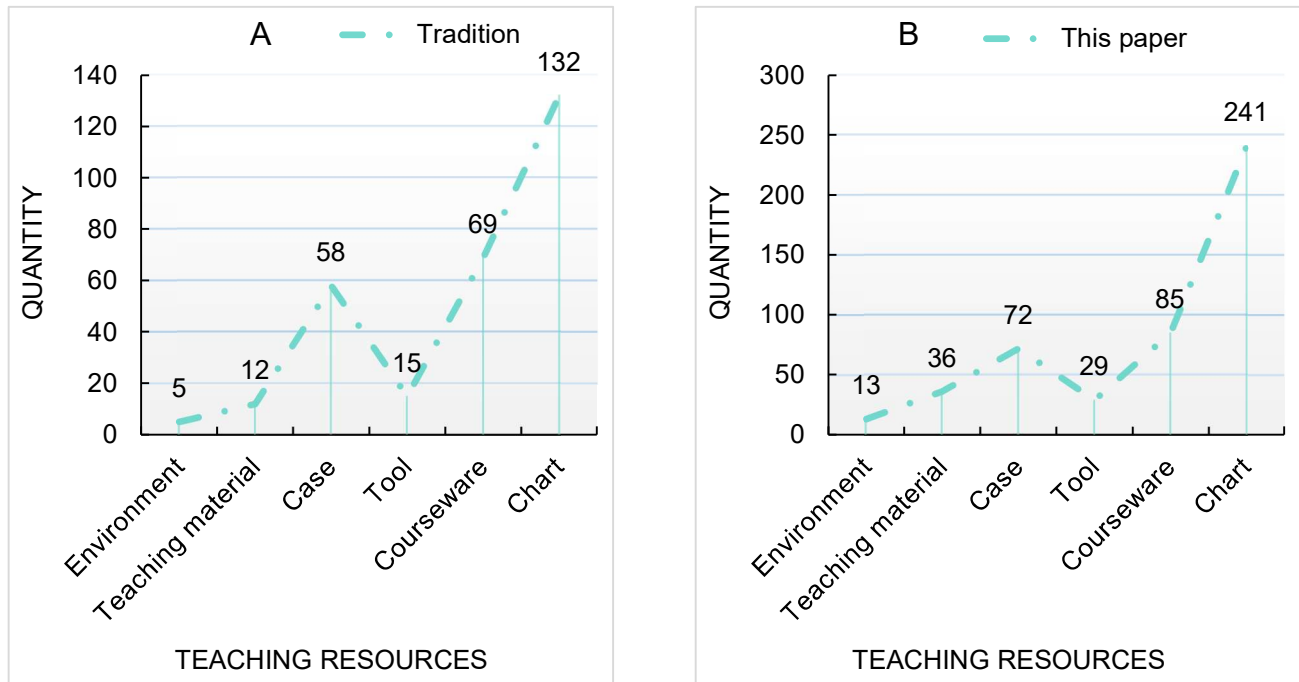
(A): The number of TR used by Class 1 of traditional methods

(B): The number of TR used in Class 2 of this method

Figure 7: Comparison of the number of TR used by the two classes

It can be seen from Figure 7 (A) and Figure 7 (B) that the number of teaching environments used by Class 1 of traditional methods was 5; the number of teaching materials was 12; the number of teaching cases was 58; the number of teaching tools was 15; the number of teaching courseware was 69; the number of teaching charts was 132. From it, it can be seen that the teaching environment, the number of teaching materials and teaching tools of traditional methods are relatively small, and the overall use of TR is not high. This means that the development of PE TR under traditional methods is not high, which limits the use of PE TR to a certain extent. However, the number of teaching environments used in Class 2 of this method was 13; the number of teaching materials was 36; the number of teaching cases was 72; the number of teaching tools was 29; the number of teaching courseware was 85; the number of teaching charts was 241. As seen in this, compared to traditional methods, the number of TR of various types in this method is higher. The teaching chart was 109 higher than the traditional method. This shows that the AI method under the HCI mode can better and more comprehensively develop the PE TR, make the TR more abundant and more conducive to the use of TR, promote the scientific and effective teaching, and improve the teaching efficiency.

To sum up, this article conducts an empirical study on the design and development of AI PE TR under HCI mode, and finds that this method is feasible. The average score of Class 2 students under this method is 2.1 points higher than that of Class 1 students under the traditional method on the third test, and 5.29 points higher than that of Class 1 students under the traditional method on the sixth test. At the same time, the number of teaching charts used by Class 2 students under this method is 109 more than that of Class 1 students under the traditional method. This shows that the method in this article can not only effectively improve the total score of students' physical testing, but also promote the richness of TR, so that more TR can be developed and used. In addition, this method can also improve students' satisfaction with the application of the design of PE TR, stimulate students' interest in learning, and promote learning efficiency.

IV. Conclusions

The digital society is also gradually coming, and the impact of digital equipment on people's daily life is also increasingly different, especially in the field of teaching. Digital teaching equipment can effectively improve teaching quality and promote teaching reform. The theme of this article is the design and development of AI PE TR under HCI mode. The article first gave a brief overview of its research background, then comprehensively analyzed the advantages and disadvantages of previous scholars in this research, and then made a theoretical analysis of

sports TR, HCI and AI. On this basis, this article put forward a new idea, that is, to design and develop PE TR through AI in HCI mode. This article also carried out a practical verification. The experimental results showed that the idea proposed in this article has certain feasibility. It can better enhance students' concentration in the classroom and improve students' satisfaction with the design and application of sports TR, thus promoting students' sports performance.

References

[1] Peng, Wang. "Construction and application of accounting computerization skills teaching resource database under the background of." Curriculum and Teaching Methodology 2.1 (2019): 1-4.

[2] Wang, Yang. "Application of virtual reality technique in the construction of modular teaching resources." International journal of emerging technologies in learning (ijet) 15.10 (2020): 126-139.

[3] Acosta, Hazel, and Diego Cajas. "Analysis of teaching resources used in EFL classes in selected Ecuadorian universities." Indonesian Journal of Applied Linguistics 8.1 (2018): 100-109.

[4] Qu, Jia. "Research on mobile learning in a teaching information service system based on a big data driven environment." Education and Information Technologies 26.5 (2021): 6183-6201.

[5] Huang, Wenlang, and Weiyuan Ying. "Application of multimedia network teaching platform in college physical education." Curriculum and Teaching Methodology 4.3 (2021): 11-15.

[6] Liu, Huaijin, Yongbo Li, and Jing Tang. "Construction and application of digital teaching resources in regional basic education—taking physical education courses as an example." Creative Education 10.6 (2019): 1192-1204.

[7] Yang, Xuelin. "A sports teaching mode based on social networking service teaching resources." International Journal of Emerging Technologies in Learning (iJET) 15.8 (2020): 180-194.

[8] Jing, Zhihui, and Lirong Chen. "Research on the innovative development of intelligent physical education teaching in universities." International Journal of Higher Education Teaching Theory 2.4 (2021): 1093-1098.

[9] Lv, Taizhi, Xuejun You, and Jun Zhang. "Design and implementation of teaching resource platform for higher vocational insitute." International Journal of Social Science and Education Research 2.8 (2019): 1-5.

[10] Wilkinson, Shaun D. "The enactment of setting policy in secondary school physical education." Sport, Education and Society 26.6 (2021): 619-633.

[11] Seinfeld, Sofia. "User representations in human-computer interaction." Human–Computer Interaction 36.5-6 (2021): 400-438.

[12] Yang, Xin. "Concepts of artificial intelligence for computer-assisted drug discovery." Chemical reviews 119.18 (2019): 10520-10594.

[13] Yi, Yumi. "Establishing the concept of AI literacy." Jahr–European Journal of Bioethics 12.2 (2021): 353-368.

[14] Nadikattu, Rahul Reddy. "Implementation of new ways of artificial intelligence in sports." Journal of Xidian University 14.5 (2020): 5983-5997.

[15] Wang, Yujia. "Exploration on the Operation Status and Optimization Strategy of Networked Teaching of Physical Education Curriculum Based on AI Algorithm." International Journal of Information Technologies and Systems Approach (IJITSA) 16.3 (2023): 1-15.