sustainability

MDPI

Article

Hybrid Physical Education Teaching and Curriculum Design Based on a Voice Interactive Artificial Intelligence Educational Robot

Dapeng Yang [1,2], Eung-Soo Oh [2] and Yingchun Wang [3,2,*]

1 College of Physical Education, HuaiNan Normal University, Huainan 232038, China; dapeng668@donga.ac.kr
2 College of Arts & Sport Sciences, Dong-A University, Busan 604-714, Korea; smpro21@dau.ac.kr
3 Sports Section, Zhejiang Dongfang Polytechnic, Wenzhou 325015, China
* Correspondence: ysy526@donga.ac.kr

Received: 24 August 2020; Accepted: 26 September 2020; Published: 27 September 2020

Abstract: In order to promote the development of individualized, accurate and intelligent physical education teaching, combined with artificial intelligence technology, the current physical education teaching mode has been improved. Through the establishment of an artificial intelligence educational robot based on voice interaction, a hybrid physical education teaching mode is constructed to realize personalized education for students. First, the speech recognition system is designed from three aspects of speech recognition, interaction management and speech synthesis, and the accuracy of recognition is improved by algorithm. Second, a new mode of hybrid physical education teaching is constructed. Through intelligent information technology, the advantages of traditional physical education teaching are combined to improve the classroom efficiency of physical education teaching and personalized education ability for students. Finally, the relevant experimental scheme and questionnaire are designed, and the actual situation of an educational robot introduced into physical education teaching is investigated and evaluated. The results show that the recognition accuracy of the artificial intelligence speech recognition system can reach more than 90%. It can communicate well with students and answer students' questions. An educational robot is introduced into physical education teaching, and students' learning attitude and interest are evaluated. The results show that before and after the introduction of an educational robot in physical education teaching, the average score of students' learning interest increases by 21 points, and the average score of learning attitude increases by 9.8 points. Therefore, the introduction of an artificial intelligence educational robot based on voice interaction in physical education teaching can help to improve the classroom efficiency of physical education teaching and students' interest. This study provides a reference for the development of artificial intelligence teaching and promoting the development of artificial intelligence.

Keywords: artificial intelligence; voice interaction; hybrid physical education; educational psychology; educational robot

1. Introduction

Learning motivation, learning interest and learning attitude are the key factors affecting the development of students' mental health. In the process of school education, schools and teachers should understand the characteristics of students' learning motivation, attitude and interest, and the formation mode and development law, so as to better carry out ideological education and teaching work for students. Learning motivation is the driving force to cause, maintain and promote students' action; learning attitude and enthusiasm are the direct manifestation of students' learning motivation, so stimulating students' learning motivation is the basic condition for forming correct learning attitude;

and learning interest is the conscious tendency of students to contact and understand new things, which can promote students to actively learn knowledge and establish a good learning attitude to improve the learning effect. The three are interrelated and influence each other. Therefore, learning motivation and learning interest are important factors that affect students' learning attitude. In the traditional physical education (PE) teaching mode, attention is paid to the cultivation of students' sports technology, the cultivation of students' interest is ignored, and the setting of teaching content lacks flexibility. With the continuous development of education informatization, the combination of artificial intelligence and education field has changed the teaching mode. In terms of teacher teaching, artificial intelligence can help teachers prepare lessons carefully, generate personalized teaching content, and realize intelligent and accurate teaching. To carry out intelligent practical teaching can carry out individualized counseling according to students, so that teachers can extricate themselves from heavy teaching affairs and invest more time in innovating teaching contents and teaching methods. For students, an intelligent teaching environment can guide students to create different learning tasks, create a personalized learning environment, help students preview and consolidate, deepen students' understanding of knowledge, and provide a personalized teaching mode. To a great extent, the influence of technology on education and teaching is realized by means of tools, media or environment. As a medium or tool, artificial intelligence plays an important role in education and teaching. Therefore, teachers in the era of artificial intelligence need to have the awareness and ability to use intelligent teaching tools and an intelligent teaching environment to carry out effective and innovative education and teaching [1–5].

Meghdari et al. (2019) designed a social robot assistant, and the educational social robot was designed to help hearing-impaired children learn Persian sign language. There were three design criteria. First of all, the robot was a fully functional perspective robot that took children as recipients of social services. Then, the robot had the ability to execute Persian sign language through its flexible mechanical parts. Finally, the development cost of the robot was low. The hardware design and performance of sign language teaching were evaluated. The results show that the machine can be used for children's sign language teaching [6]. Filippini et al. (2019) designed an educational robot based on thermal imaging for human emotion calculation and real-time evaluation of the human psychological state. This research was used to recognize and understand human emotions, and make appropriate responses to help establish human robot communication following social behavior and emotional interaction [7]. Huijnen et al. (2016) used the treatment robot in the treatment and education of children with autism spectrum disorder. Fifty-four sick children were tested. The results show that the treatment robot has additional value for the treatment of children with autism spectrum disorder in terms of communication and social relations, and has very effective results for the treatment and education of children with autism spectrum disorder [8]. Yi et al. (2016) developed an intelligent and high-performance dynamic humanoid educational robot. Students could understand the basic materials and machine tools of humanoid robots in the process of practice, which could help students improve their interest in learning the course [9]. Cheng et al. (2018) conducted a survey on the application of educational robots in teaching from the perspectives of researchers, experts and educators, and conducted a literature review, expert interviews and teacher questionnaires. The results show that educational robots can provide feedback and guidance to school education in language education, robot education, teaching assistance, social skills development and special education [10].

In order to explore the application of a voice interactive educational robot in physical education teaching, an artificial intelligence robot based on voice interaction is designed and introduced into physical education classroom teaching to assist teachers in sports teaching activities. First, the voice interaction system is designed, and the accuracy of speech recognition is improved by algorithm. Then, the teaching mode of hybrid physical education is constructed. Combined with the advantages of traditional physical education and intelligent information technology, a personalized and intelligent physical education teaching mode is established. Finally, the hybrid physical education teaching mode is tested, and the effect of sports teaching before and after the introduction of a robot is evaluated through questionnaire survey. This study can provide a reference for promoting an intelligent and personalized new classroom teaching mode.

2. Method

2.1. Design of AI Voice Interaction System for an Educational Robot

Automatic speech recognition is a process of transforming human speech signal into corresponding text or command through a computer algorithm, and its essence is a process of pattern matching. By processing and analyzing the suspected signal, the acoustic features in speech are extracted. Using the acoustic model and language model, the speech patterns to be recognized are compared with the known speech reference models. Combined with the relevant search and matching algorithm, the reference pattern with the best matching effect is obtained, and output as the recognition result. The purpose of speech recognition is to make the machine understand human language. However, due to the diversity and complexity of human language—as for speech recognition—pronunciation mode, vocabulary size, recognition object and other issues also need to be considered [11–13].

The common pronunciation methods can be divided into connected word recognition, keyword recognition, continuous speech recognition and isolated word recognition. As for connected word recognition, the pause between sounds can be felt, which can be solved by using string isolated word recognition technology. As for keyword recognition, it is only necessary to identify the key parts of the discourse. Isolated word recognition is a reference pattern for comparing syllables or phrases of isolated words. As for continuous speech recognition, it is necessary to fully consider the constraints between speech units. Generally, with the increase of vocabulary, the difficulty of recognition will increase greatly. If there are more words, the similar words will be confused when they are identified and the difficulty of system search and storage will increase correspondingly. The recognition objects are divided into speaker-dependent and speaker-independent. Speaker-dependent is to collect speech samples of specific objects for training, and the speech recognition model of training place can only recognize the speech of training objects. Speaker-independent is to recognize the voice of many people, so it can recognize anyone's voice, but the corresponding technical difficulty is also high.

The common speech recognition patterns are hidden Markov model and deep neural network model. The characteristic of Markov chain is that the state of the next step completely depends on the state of the current step, independent of the previous state, so its state and space are discrete and finite. In practical application, this kind of random state is described by a set of random probability distribution. This kind of probability model is hidden Markov model, which is a kind of double random process. In the process of speech recognition, the maximum likelihood probability of speech recognition and hidden Markov model parameters can be calculated, and then the best recognition results can be output. Its recognition pattern library is the best pattern parameter with matching pattern and pre-stored pattern sample obtained by training, which is a centrifugal speech recognition model [14–17].

Compared with hidden Markov model, the performance of neural network-based acoustic model has been greatly improved, so it has gradually become a common acoustic model for speech recognition. Deep neural network is a multi-layer perceptron with multiple hidden layers. Usually, unsupervised learning is used to allocate the initial weights of learning links. The initial weights are trained as the initial values of the top-down supervised learning, and the parameters of the neural network are adjusted. The deep neural network has high accuracy, but the throughput is large and the processing efficiency is low [18].

The voice interaction model of an educational robot is mainly composed of speech recognition module, interaction management module and speech synthesis module. Figure 1 shows the model structure.

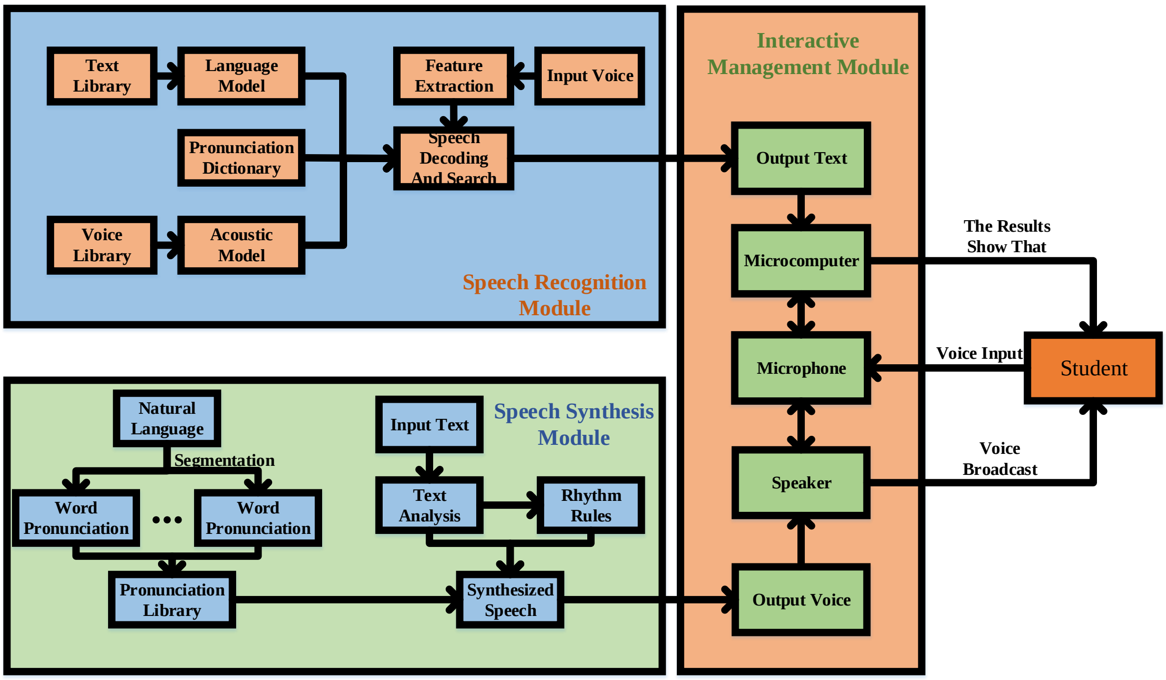

Figure 1. Voice interactive educational robot model.

The following describes the voice interactive educational robot model: (1) Speech recognition module. It consists of two parts: speech acquisition and recognition. Through a small microphone array, directional pickup is formed for the speaker in a certain range to reduce the impact of external noise. Speech recognition realizes the transformation from speech to text through the processing of speech signal. A special vocabulary library for the vocabulary in the professional field is established to store the professional vocabulary of different disciplines, and it is used in the training of speech model [19,20].

Speech recognition consists of three parts. First, the input speech is transformed into speech signal through a microphone, which is the reception and processing of speech signal. The second is the training of an acoustic model and language model, and the establishment of a pronunciation dictionary. Finally, the input speech signal is decoded, and the speech model to be recognized is searched and matched with the trained model to find out the optimal speech template. The output layer is used to identify results.

Among them, the acoustic model is an important part of speech recognition. The training process is to establish the model parameters for each voice of the voice data in the speech database, and compare with the voice parameters in the acoustic model, calculate the distance between them, and find the most similar results. In the acoustic model, the speech units have different characteristics. Therefore, the acoustic model designed according to the characteristics of speech pronunciation can improve the recognition rate of speech recognition. The modeling unit of the acoustic model includes phoneme, syllable and word. In speech recognition with a large number of words, phoneme is generally used as the modeling unit of the acoustic model. Although the acoustic model can record each supported speech feature parameter, it still has a low recognition rate for some homophones and near syllable words. Therefore, it is necessary to restrict the recognition system from grammar rules to improve the recognition rate. Language model can describe the internal relationship and transfer relationship between different speech units, eliminate the fuzziness of words and improve the discrimination of recognition. The common modeling methods of the language model include rule-based model and statistical-based model. The performance of the statistical language model is related to the content of the training model, so the recognition rate is very low when the recognition content is different from the training content. Therefore, for speech recognition in a specific field, it is necessary to establish a speech database of professional vocabulary, combine it with the relevant grammar and semantic rules to improve the ability and performance of speech recognition in specific fields through a language model, and reduce the search content of speech recognition. Through the pronunciation dictionary, the mapping relationship between words and phonemes is established, and the relationship between acoustic model and language model is established. The phonemes of the corresponding words can help to match the corresponding words in the acoustic model [21–25].

(2) Interaction management module. The results given by the speech recognition module may have deviation, so it is necessary to match the recognition results with the rules in the interaction management module, judge whether the user's results are correct according to the matching results and select the next step process according to different answers, and broadcast the corresponding answers of the process with a speech synthesis module. In the teaching environment of an educational robot, the robot needs to answer students' questions about the physical education course, but the performance of the speech recognition module will be affected by noise and other factors, which will lead to the robot's wrong judgment. Therefore, it is necessary to set the rules of voice interaction, judge students' intention and give reasonable answers [26,27].

(3) Speech synthesis module. It includes two parts: speech broadcast and speech synthesis. It uses prosodic analysis and synthesis algorithm to transform text into speech waveform, and then converts electrical signal into sound signal to realize voice broadcast. Chinese speech synthesis is realized by waveform splicing. First of all, the natural language is divided and the pronunciation of a single word is extracted as a phonetic unit. These units are combined into a pronunciation database. In the process of synthesis, the monosyllabic of the pronunciation database is adjusted, and the splicing algorithm is used to splice the complete sentences, so as to achieve the function of speech output [28–31].

The designed educational robot is used to solve the problems encountered by students in their daily physical education. It can complete roll call, read text, assign homework and other basic teaching activities, and push corresponding teaching resources to students according to their age, gender, interest and other information. Through the analysis of students' learning data, students' current learning attitude and interest are judged, and then whether further deep learning and extended learning are needed. Therefore, in order to reflect its characteristics in teaching and explore the voice interaction between students and robots, the actual application of voice interaction is tested. An educational robot is divided into three parts, including motion hardware layer, hardware management layer and microcomputer. The motion layer is used to realize the walking and speed control of the educational robot; the motion management layer can control the hardware such as level meter and tachometer, and control the overall motion state of the robot; and the microcomputer contains voice and action recognition system, which can communicate with students.

The voice interactive education robot is tested by question and answer, and Figure 2 is the communication flow. According to different teaching communication scenes, students and robots have dialogue like the following content:

Student: Am I doing this right? Robot: Well done.
Student: What should I do next? Robot: Please watch the teaching video.
Robot: Have you learned this? Student: Well, please see if I'm right.
Robot: You can show it. Student: Ok.

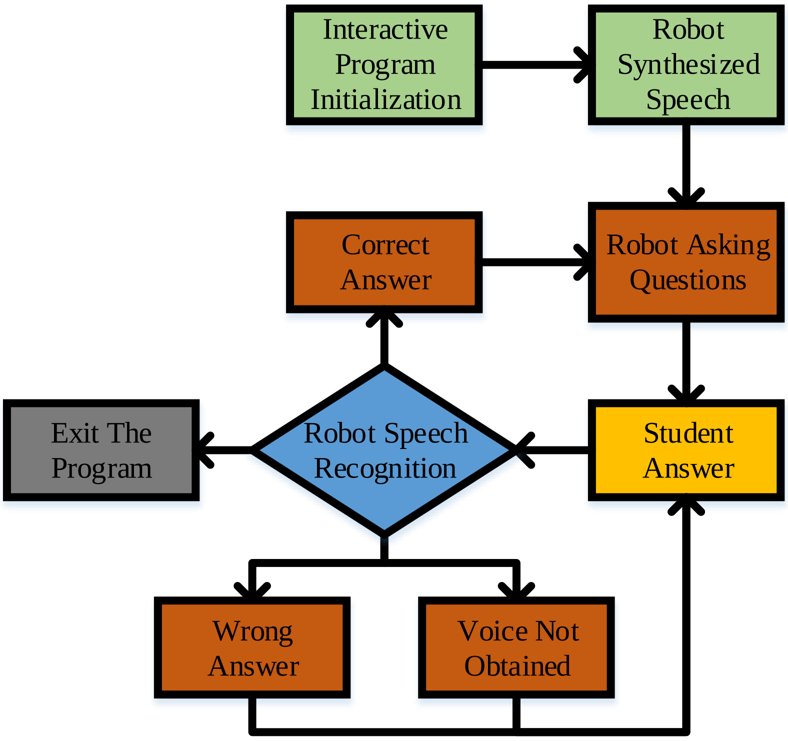

Figure 2. Question and answer process of an educational robot in physical education.

2.2. *Construction of Hybrid Teaching Mode in Physical Education*

Teaching mode refers to the fixed framework and procedure of teaching activities established under the guidance of teaching theory. It standardizes the whole teaching activity and the internal relations among various elements from a macro perspective, and highlights the orderliness and operability of the teaching mode. The traditional physical education classroom teaching is that the teacher demonstrates and explains the technical movements, and the students complete the learning of motor skills through imitation after the teacher's demonstration. However, many movements have continuity and space, which cannot be taught by decomposition. It is difficult for students to understand the essentials of movements in a short period of time only through eye observation. Hybrid teaching can solve this problem well. Using modern educational resources, teachers record movement essentials into videos, and mark the technical essentials in the process of movement with slow motion or words to help students learn movement essentials. The establishment of a hybrid physical education teaching mode is based on the theory of hybrid teaching. Through the analysis of the characteristics of physical education teaching and the development of information technology, the advantages of traditional classroom and online classroom are combined [32–35], and a hybrid physical education teaching mode as shown in Figure 3 is constructed.

In the hybrid physical education teaching mode, the teaching process is divided into three interrelated parts, namely, autonomous learning before class, practical learning in class and consolidated extended learning after class. The traditional classroom teaching mode of "teaching before learning" has been changed into the new classroom teaching mode of "learning before teaching". In the whole teaching process, teachers guide students to learn independently by designing teaching activities, organize classroom teaching content according to students' self-study situation, and guide students to consolidate the learning content after class.

In the process of learning independently before class, according to the course content and the analysis of the learning situation, the teacher records the relevant physical education teaching video, makes the teaching courseware, sets the related questions, defines the learning goal, and transmits them to the teaching platform. Through the teaching platform, students can find solutions to the problems assigned by teachers through self-learning, watch teaching courseware and teaching videos, conduct group discussion, and seek teachers' answers to the difficulties encountered online. In the process of autonomous learning, teachers need to guide and supervise students.

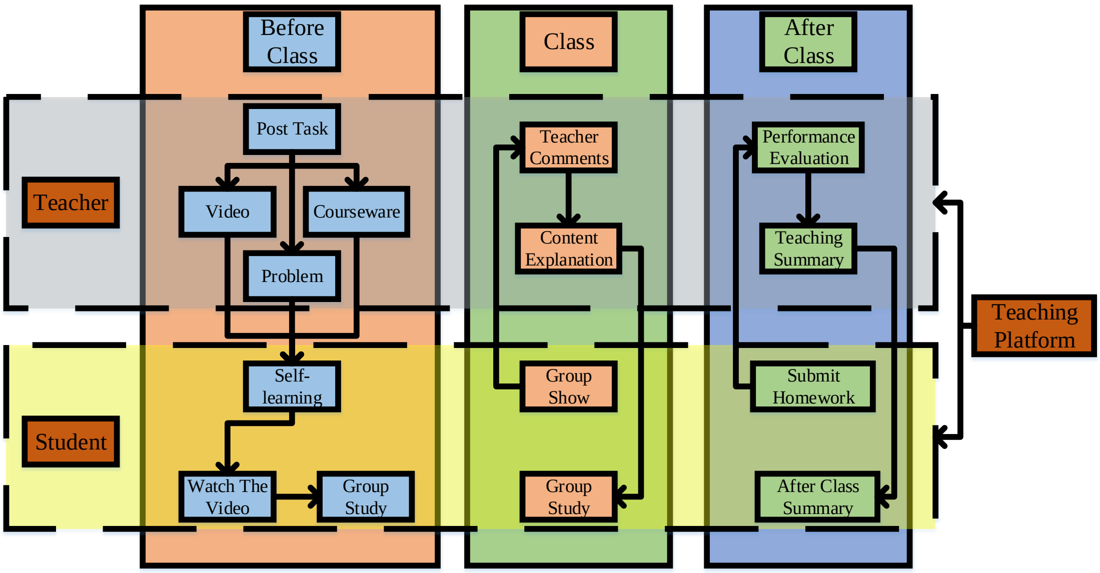

Figure 3. Hybrid physical education teaching mode.

In the classroom practice teaching, students will combine the content of autonomous learning with their own understanding, and display it in the form of groups. The teacher and other students make comments after watching. According to the feedback of the class, the teacher answers the students' questions and explains and demonstrates the teaching contents. Students learn the content of the course in groups, and further master the content of the course. In the guidance of students' learning interaction, the robot can follow the students and communicate with the students. By observing the students' performance in the course, the robot judges the students' learning state, identifies each action of the students, compares them with the standard actions in the system library, analyzes whether the students' actions are standardized, and guides them at the appropriate time to help them complete the teaching contents of physical education courses. When students have learning difficulties, the robot encourages students to adjust their learning attitude and weakens their fear and anxiety. Through the robot record of each student's learning state, learning progress, as well as course mastery, teachers can carry out personalized teaching guidance for each student.

During the consolidation after class, students record the contents of physical education courses according to their own learning situation and upload them to the course platform. The teacher comments on the students' videos and points out the existing problems. The students reflect and summarize according to the teacher's comments and improve the existing problems. In addition, teachers can upload the collected course materials to the teaching platform, allowing students to selectively watch according to their own learning situation, so as to realize the extension of the course [36–41].

In the process of physical education classroom teaching, students only need to describe the sports items learned by robots. The robots will analyze and introduce the action essentials and difficulties involved in the course in detail, and use the pre-loaded sports teaching video to assist with the explanation. The robot answers the problems encountered by the students, makes the originally boring teaching process easy to understand and improves the students' learning efficiency [42]. For example, for wushu exercise or gymnastics and other sports with many action standard essentials, the robot will play the video of action to be taught in the course, analyze the main points by slow motion, and correct the students' actions. For group sports, robots will tell students how to avoid personal mistakes that affect the overall performance of team games. In the future, with the development of artificial intelligence robots, robots will have the ability to surpass senior teachers and complete students' personalized teaching contents independently [43,44].

Hybrid physical education teaching can break through the limitation of teaching hours, allow students to take the initiative to learn, and let teachers carry out individualized teaching and guidance for students, so as to realize individualized teaching of students according to their aptitude and truly achieve individualized teaching with students as the main body. Moreover, the hybrid teaching can enable teachers to mainly solve the problems encountered by students, and enable students to study the conventional classroom warming up, physical knowledge and skills through video or courseware, making teaching more targeted, facilitating students to consolidate learning after class, and improving the classroom efficiency.

2.3. Research on Hybrid Teaching Mode of Physical Education Course Based on a Voice Interactive Robot

In order to study the actual situation of an educational robot as an auxiliary tool to guide students to learn physical education courses, two classes of grade five in a primary school are selected for teaching experiments. A total of 80 students from the two classes are divided into two groups with 40 students in each group. The two groups have four physical education classes every week, and a teacher uses the physical education teaching method of an educational robot and the traditional teaching method respectively for three months. Before and after the experiment, the two groups are given the *Evaluation Scale Of Primary School Students' Interest In Physical Education* (27 questions in total, with a score of 1–5 for each question) and the *Evaluation Scale Of Primary School Students' Learning Attitude Towards Physical Education* (12 questions in total, with a score of 1–5 for each question) compiled by Professor Wang Xiaozan. Students' interest in physical education and learning attitude before and after the course are scored, and the average score is calculated by adding the scores. Finally, four teachers are asked to grade the students' performance of wushu exercise in terms of the degree of completion and expression (total score 100 points). SPSS is used to analyze the collected questionnaire data. Confirmatory factor analysis is used to test the structural validity, AVE method is used to test the discrimination validity, and Cronbach's α coefficient is used to test the reliability of the scale. The distribution and recovery of the questionnaire meet the needs of scientific research.

3. Results and Discussion

3.1. Validity and Reliability Analysis of the Scale

In order to test the construct validity of the scale, the KMO value needs to be detected. The KMO value of this study is 0.967, and the KMO values of the other secondary potential variables are all above 0.7, which indicates that the test effect of the scale is good, and it is suitable for factor analysis. AVE method is used to analyze the discrimination validity of the scale. The computed results show that the AVE values of each dimension are greater than the correlation coefficient between the dimensions, that is, the square of standardized correlation. Therefore, the dimensions of the scale used have discriminant validity.

Cronbach's α coefficient is used to process the collected data, and the reliability of the total scale and each dimension of the scale is tested. The Cronbach's α coefficient is calculated to be 0.975, the reliability test value of each secondary potential variable dimension is above 0.8, and the overall α coefficient of each dimension is greater than the judgment standard of 0.7. This shows that the scale data used has high internal consistency, good stability and good overall reliability, which can meet the needs of scientific research.

3.2. Performance Test of Educational Robot Based on Voice Interaction

The designed educational robot is used in teachers' daily teaching, so in order to reflect its characteristics in teaching and explore the voice interaction between students and robots, the actual application of voice interaction is explored. The educational robot is divided into three parts, including motion hardware layer, hardware management layer and microcomputer. The motion hardware layer is used to realize the walking and speed control of the educational robot; the hardware management layer can control the hardware such as level meter and tachometer to control the overall motion state of the robot; and the microcomputer contains a speech recognition system, which can communicate with students.

An educational robot in the physical education teaching environment for students' speech recognition is studied. The commonly used 200 sentences of PE teaching commands are tested on 10 students, including five boys (the first five groups) and five girls (the last five groups). Each time, 40 sentences are randomly selected for recognition test. Figure 4 shows the specific recognition results. The recognition accuracy rate is the percentage of correct teaching commands identified in 40 teaching commands.

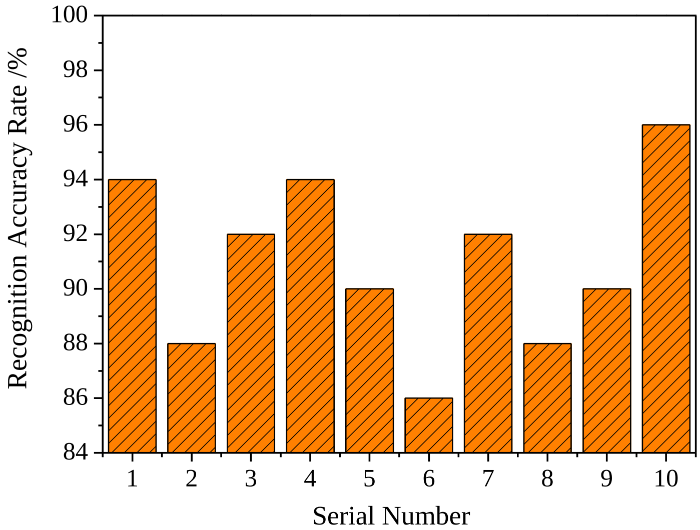

Figure 4. Recognition effect of common physical education commands.

Figure 4 shows that 36 out of every 40 physical education commands can be identified, and the overall recognition accuracy is more than 90%. In addition, the recognition of different genders and different sound characteristics can achieve the recognition effect of speaker-independent. However, the recognition effect of an educational robot will be affected when the environment is noisy and the standard Mandarin is not standard. This shows that its anti-interference ability and speech recognition ability needs to be further improved. Voice interaction technology is used to answer students' questions, which will deepen students' understanding of the problems and increase the interest of classroom teaching. Therefore, the application of voice interaction technology in the design of an educational robot is very meaningful.

3.3. The Influence of Different Physical Education Teaching Methods on Students

Students' interest in physical education represents the students' understanding of the physical education classroom and the positive degree of learning. Therefore, the cultivation of students' interest in sports is the key to physical education teaching. The changes of students' interest in physical education before and after using different teaching methods are compared between the two groups. Figure 5 shows the results.

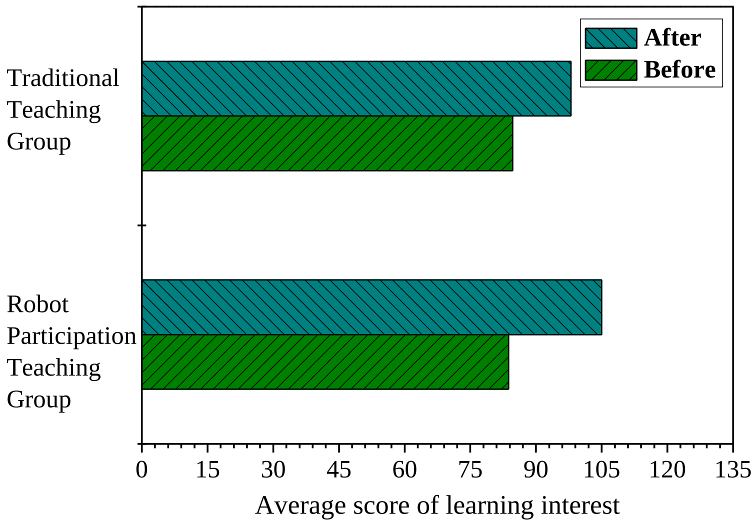

Figure 5. Comparison of learning interest in physical education between the two groups before and after the experiment.

Figure 5 shows that the average score of the robot participating teaching group before and after the experiment is 84 points and 105 points, an increase of 21 points; the average score of the traditional teaching method group is 84.5 points before the experiment, and the average score after the experiment is 98 points, an increase of 13.5 points. This shows that the participation of an educational robot can significantly increase students' interest in sports learning, and the effect is better than that of traditional teaching methods.

Students' learning attitude is the overall evaluation and internal tendency of physical education learning, and its score is related to students' academic performance. Therefore, cultivating a good learning attitude is the key to physical education teaching. Figure 6 shows the results of the two groups of students' sports learning attitude before and after the experiment.

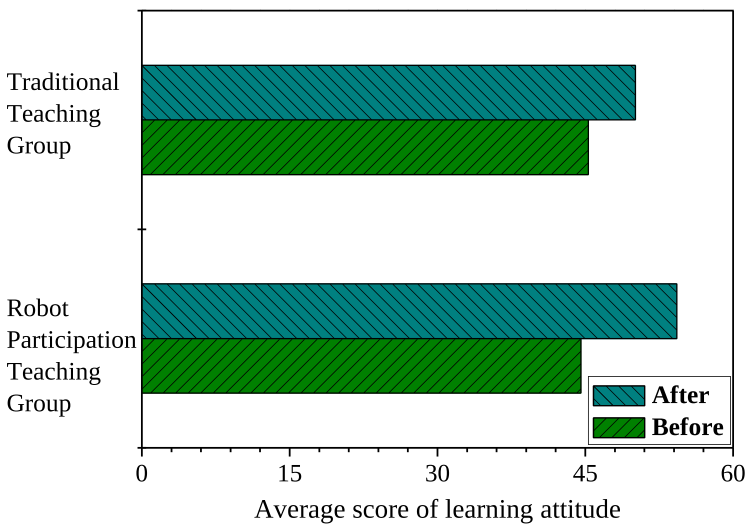

Figure 6. A comparison of the two groups of students' learning attitude towards physical education before and after the experiment.

Figure 6 shows that the average score of learning attitude of the robot participation group before the experiment is 44.5, and the average score after the experiment is 54.3, an increase of 9.8 points; the average score of the traditional teaching method group is 45.3 before the experiment, and the average score after the experiment is 50, an increase of 4.7 points. This shows that robot participation in teaching can improve students' attitude towards sports learning, and robot participation in teaching can enhance students' learning motivation.

The teacher scores the two groups of students on the degree of completion and performance of wushu exercise, and Figure 7 shows the results.

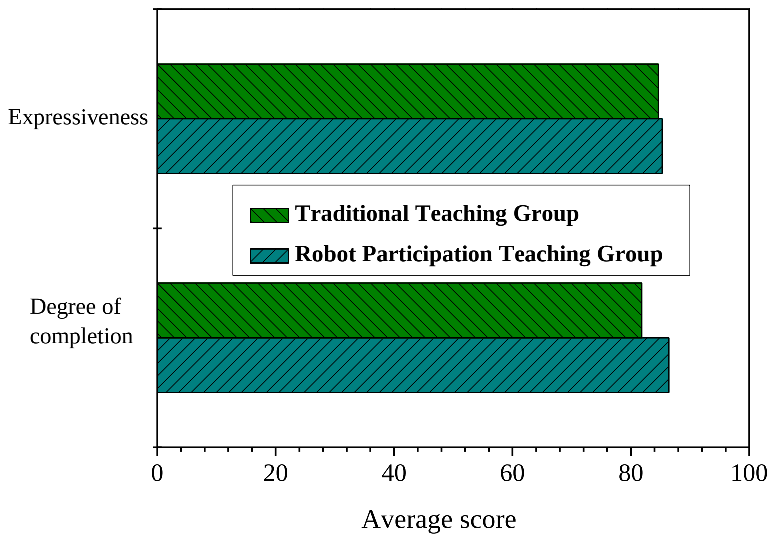

Figure 7. Comparison of the two groups of students' wushu exercise completion and expression.

Figure 7 shows that the average score of the robot participation group is 86 points, and the average score of the traditional teaching group is 81.83. There is a big difference between the two classes in the completion degree of wushu exercise. The average score of the robot participation group is 85 points, while that of the traditional teaching group is 84.5 points. There is no significant difference between the two groups. This shows that the introduction of an educational robot in physical education teaching can better improve the learning effect on students. However, to achieve a higher quality teaching effect and improve the expression of wushu exercise, teachers need to teach in person.

To sum up, the participation of robots in physical education teaching can enhance students' interest and attitude in sports learning and help students to memorize classroom knowledge. Moreover, robot participation in teaching is an attempt to integrate artificial intelligence technology into the physical education teaching method, which proves that the development of science and technology in the field of physical education teaching can promote students' learning enthusiasm, improve their interest in sports learning and sports learning attitude. However, robot teaching cannot improve students' performance.

4. Conclusions

In order to study the application of an AI educational robot based on voice interaction in physical education, and promote the development of physical education to intelligent and individualized education, first, the voice interaction system based on AI is designed from three aspects of speech recognition, interaction management and speech synthesis, so as to improve the accuracy of speech recognition and enhance the interactive experience. Then, the curriculum mode of hybrid physical education teaching is constructed. Combined with the advantages of traditional physical education and intelligent information technology, the individualized education ability of physical education teaching is improved.

Finally, the speech recognition accuracy of the designed speech interaction system is tested, and the actual effect of introducing an educational robot into a physical education classroom is investigated by questionnaire. The results show that the recognition accuracy of the designed speech interaction system based on artificial intelligence is more than 90%. It can recognize different genders and different voice characteristics, and can be used in a physical education classroom. The results of the questionnaire survey show that the introduction of an educational robot can significantly improve students' learning attitude and interest in physical education. Therefore, the introduction of an artificial intelligence education robot based on voice interaction in physical education teaching can help to improve the classroom efficiency of physical education teaching and students' interest. Finally, the speech recognition accuracy of the designed voice interaction system is tested, and the actual effect of introducing an educational robot into a physical education classroom is investigated by questionnaire. The results show that the recognition accuracy of the designed voice interaction system based on artificial intelligence is more than 90%. It can recognize different gender and different voice characteristics, achieve the recognition effect of a non-specific person, and can be used in a physical education classroom. The results of the questionnaire survey show that the introduction of an educational robot can significantly improve students' learning attitude and interest in physical education. Therefore, the introduction of an artificial intelligence education robot based on voice interaction in physical education teaching can help to improve the classroom efficiency of physical education teaching and students' interest.

The research reveals that students' interest in physical education is affected by many aspects. Therefore, in the further study of physical education participation, the influence of moral and social behavior on students should be considered. The significance of a physical education curriculum is not only to improve students' interest in sports and physical health, but also to strengthen students' awareness of fair competition, cultivate students' ability in teamwork, temper their willpower and cultivate their healthy mind.

However, there are still some deficiencies. The anti-interference ability of the designed speech recognition system is weak, which will affect the recognition accuracy in a noisy environment. In addition, its recognition accuracy for dialects is also low. Moreover, due to the small sample size, the conclusion of this study does not prove that the use of educational robots in the physical education classroom can enhance everyone's interest in sports, knowledge learning and physical health. Therefore, in the follow-up study, it is necessary to study a wider range of people, and prove the relationship between the variables by means of statistics or control group.

Author Contributions: Conceptualization, D.Y. and Y.W.; methodology, E.-S.O.; software, D.Y.; formal analysis, D.Y.; writing—original draft preparation, D.Y. and Y.W.; writing—review and editing, E.-S.O.; supervision, E.-S.O.; All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Hu, H. An educational Arduino robot for visual Deep Learning experiments. *Int. J. Intell. Robot. Appl.* **2019**, *4*, 73–81. [CrossRef]
2. Bautista, A.J.C. Blended Online and Offline Robotics Learning Program Using Low-Cost Mobile Educational Robot. *Int. J. Adv. Trends Comput. Sci. Eng.* **2020**, *9*, 278–282. [CrossRef]
3. Meghdari, A.; Alemi, M.; Zakipour, M.; Kashanian, S.A. Design and Realization of a Sign Language Educational Humanoid Robot. *J. Intell. Robot. Syst.* **2018**, *9*, 10–17. [CrossRef]
4. Wu, Q.; Wang, S.; Cao, J.; He, B.; Yu, C.; Zheng, J. Object Recognition-Based Second Language Learning Educational Robot System for Chinese Preschool Children. *IEEE Access* **2019**, *7*, 7301–7312. [CrossRef]
5. Wei, X.F.; Liu, Y.B.; Qu, L.J.; Wang, X.Y. Research on Idea and Teaching Application of Educational Evaluation Robot. *China Educ. Technol.* **2018**, *27*, 27.
6. Chen, J.; Ye, X.; Chen, M.; Liang, Y. Bibliometric analysis of the papers on urban education. *Libr. Hi Tech* **2019**, *37*, 894–905. [CrossRef]
7. Filippini, C.; Spadolini, E.; Cardone, D.; Merla, A. Thermal Imaging Based Affective Computing for Educational Robot. *Proceedings* **2019**, *27*, 27. [CrossRef]

8. Huijnen, C.A.G.J.; Lexis, M.A.S.; De Witte, L.P. Matching Robot KASPAR to Autism Spectrum Disorder (ASD) Therapy and Educational Goals. *Int. J. Soc. Robot.* **2016**, *8*, 445–455. [CrossRef]
9. Yi, H.; Knabe, C.; Pesek, T.; Hong, D.W. Experiential Learning in the Development of a DARwIn-HP Humanoid Educational Robot. *J. Intell. Robot. Syst.* **2015**, *81*, 41–49. [CrossRef]
10. Cheng, Y.-W.; Sun, P.-C.; Chen, N.-S. The essential applications of educational robot: Requirement analysis from the perspectives of experts, researchers and instructors. *Comput. Educ.* **2018**, *126*, 399–416. [CrossRef]
11. Edwards, C.; Edwards, A.; Stoll, B.; Lin, X.; Massey, N. Evaluations of an artificial intelligence instructor's voice, Social Identity Theory in human-robot interactions. *Comput. Hum. Behav.* **2019**, *90*, 357–362. [CrossRef]
12. Chang, R.C.-S.; Lu, H.-P.; Yang, P. Stereotypes or golden rules? Exploring likable voice traits of social robots as active aging companions for tech-savvy baby boomers in Taiwan. *Comput. Hum. Behav.* **2018**, *84*, 194–210. [CrossRef]
13. Edwards, C.; Edwards, A.; Spence, P.R.; Lin, X. I, teacher: Using artificial intelligence (AI) and social robots in communication and instruction. *Commun. Educ.* **2018**, *67*, 473–480. [CrossRef]
14. Aeschlimann, S.; Bleiker, M.; Wechner, M.; Gampe, A. Communicative and social consequences of interactions with voice assistants. *Comput. Hum. Behav.* **2020**, *6*, 106466. [CrossRef]
15. Yu, L.; Ding, J. Application of Music Artificial Intelligence in Preschool Music Education. *IOP Conf. Ser. Mater. Sci. Eng.* **2020**, *750*, 012101. [CrossRef]
16. Kim, N.Y.; Cha, Y.; Kim, H.S. Future English learning, Chatbots and artificial intelligence. *Multimed. Assist. Lang. Learn.* **2019**, *22*, 32–53.
17. Dou, X.; Wu, C.-F.; Lin, K.-C.; Gan, S.; Tseng, T.-M. Effects of Different Types of Social Robot Voices on Affective Evaluations in Different Application Fields. *Int. J. Soc. Robot.* **2020**, *2*, 42–57. [CrossRef]
18. Alu, D.; Zoltan, E.; Stoica, I.C. Voice based emotion recognition with convolutional neural networks for companion robots. *Sci. Technol.* **2017**, *20*, 222–240.
19. Edwards, B.I.; Cheok, A.D. Why Not Robot Teachers: Artificial Intelligence for Addressing Teacher Shortage. *Appl. Artif. Intell.* **2018**, *32*, 345–360. [CrossRef]
20. Gonzalez-Jimenez, H. Taking the fiction out of science fiction: (Self-aware) robots and what they mean for society, retailers and marketers. *Futures* **2018**, *98*, 49–56. [CrossRef]
21. Yang, J.; Zhang, B. Artificial Intelligence in Intelligent Tutoring Robots: A Systematic Review and Design Guidelines. *Appl. Sci.* **2019**, *9*, 2078. [CrossRef]
22. Guihot, M.; Matthew, A.F.; Suzor, N.P. Nudging robots, Innovative solutions to regulate artificial intelligence. *Vanderbilt J. Entertain. Technol. Law Forthcom.* **2017**, *20*, 385.
23. Pan, Y.-H.; Huang, C.-H.; Lee, I.-S.; Hsu, W.-T. Comparison of Learning Effects of Merging TPSR Respectively with Sport Education and Traditional Teaching Model in High School Physical Education Classes. *Sustainability* **2019**, *11*, 2057. [CrossRef]
24. Lukanova, G.; Ilieva, G. Robots, Artificial Intelligence, and Service Automation in Hotels. *Robot. Artif. Intell. Serv. Autom. Travel Tour. Hosp.* **2019**, *9*, 157–183.
25. Hales, P.D.; Anderson, M.; Christianson, T.; Gaspar, A.; Meyer, B.J.; Nelson, B.; Shilvock, K.; Steinmetz, M.; Timmons, M.; Vande Weerd, M. Alexa, Possibilities of Voice Assistant Technology and Artificial Intelligence in the Classroom. *Empower. Res. Educ.* **2019**, *3*, 4.
26. Belpaeme, T.; Kennedy, J.; Ramachandran, A.; Scassellati, B.; Tanaka, F. Social robots for education: A review. *Sci. Robot.* **2018**, *3*, eaat5954. [CrossRef]
27. Karsenti, T. Artificial intelligence in education: The urgent need to prepare teachers for tomorrow's schools. *Form. Prof.* **2019**, *27*, 112–116. [CrossRef]
28. Miller, E.; Polson, D. Apps, Avatars, and Robots: The Future of Mental Healthcare. *Issues Ment. Health Nurs.* **2019**, *40*, 208–214. [CrossRef]
29. Zheng, J.; Zhang, Q.; Xu, S.; Peng, H.; Wu, Q. Cognition-Based Context-Aware Cloud Computing for Intelligent Robotic Systems in Mobile Education. *IEEE Access* **2018**, *6*, 49103–49111. [CrossRef]
30. Damacharla, P.; Dhakal, P.; Stumbo, S.; Javaid, A.Y.; Ganapathy, S.; Malek, D.A.; Hodge, D.C.; Devabhaktuni, V. Effects of Voice-Based Synthetic Assistant on Performance of Emergency Care Provider in Training. *Int. J. Artif. Intell. Educ.* **2019**, *29*, 122–143. [CrossRef]
31. Tafazoli, D.; Gómez Parra, M.E. Robot-assisted language learning, Artificial intelligence in second language acquisition. *Curr. Future Dev. Artif. Intell.* **2017**, *23*, 370–396.

32. Pedro, F.; Subosa, M.; Rivas, A.; Valverde, P. Artificial intelligence in education, Challenges and opportunities for sustainable development. *Int. J. Artif. Intell. Educ.* **2019**, *3*, 38–45.
33. Lu, H.; Li, Y.; Chen, M.; Kim, H.; Serikawa, S. Brain Intelligence: Go beyond Artificial Intelligence. *Mob. Netw. Appl.* **2018**, *23*, 368–375. [CrossRef]
34. Striepe, H.; Donnermann, M.; Lein, M.; Lugrin, B. Modeling and Evaluating Emotion, Contextual Head Movement and Voices for a Social Robot Storyteller. *Int. J. Soc. Robot.* **2019**, *3*, 1–17. [CrossRef]
35. Lei, S.; Center, E.T.; University, S.P. The Application of Open Source Artificial Intelligence System Tensor Flow in Education. *Mod. Educ. Technol.* **2018**, *5*, 13–17.
36. Verde, L.; De Pietro, G.; Alrashoud, M.; Ghoneim, A.; Al-Mutib, K.N.; Sannino, G. Leveraging Artificial Intelligence to Improve Voice Disorder Identification Through the Use of a Reliable Mobile App. *IEEE Access* **2019**, *7*, 124048–124054. [CrossRef]
37. Li, S.; Liu, B.; Joseph, E. Aoun, Robot-proof, higher education in the age of artificial intelligence. *High. Educ.* **2019**, *5*, 12–17.
38. Pietrzik, S.; Chandrasekaran, B. Setting up and Using ROS-Kinetic and Gazebo for Educational Robotic Projects and Learning. *J. Phys. Conf. Ser.* **2019**, *2*, 468–475. [CrossRef]
39. Zhou, Y.; Zheng, S.; Zhang, G. Machine-learning based study on the on-site renewable electrical performance of an optimal hybrid PCMs integrated renewable system with high-level parameters' uncertainties. *Renew. Energy* **2020**, *151*, 403–418. [CrossRef]
40. Jiang, L.; Zhang, L.; Li, C.; Wu, J. A Correlation-Based Feature Weighting Filter for Naive Bayes. *IEEE Trans. Knowl. Data Eng.* **2018**, *31*, 201–213. [CrossRef]
41. Brewster, L.R.; Dale, J.J.; Guttridge, T.L.; Gruber, S.H.; Hansell, A.C.; Elliott, M.; Cowx, I.G.; Whitney, N.M.; Gleiss, A.C. Development and application of a machine learning algorithm for classification of elasmobranch behaviour from accelerometry data. *Mar. Biol.* **2018**, *165*, 62. [CrossRef] [PubMed]
42. Zheng, Y.; Liu, S. Bibliometric analysis for talent identification by the subject–author–citation three-dimensional evaluation model in the discipline of physical education. *Libr. Hi Tech* **2020**. [CrossRef]
43. Liu, Q.; Cheng, Z.; Chen, M. Effects of environmental education on environmental ethics and literacy based on virtual reality technology. *Electron. Libr.* **2019**, *37*, 860–877. [CrossRef]
44. Shen, C.-W.; Chen, M.; Wang, C.-C. Analyzing the trend of O2O commerce by bilingual text mining on social media. *Comput. Hum. Behav.* **2019**, *101*, 474–483. [CrossRef]

© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).