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Investigation on Potential Application of Artificial Intelligence in Preschool Children's Education

Ling Jin

Department of Education, Bozhou University, No. 2266 Tangwang Road, Bozhou, Anhui, China.

Email: anhuijl2008@163.com

Abstract. Artificial intelligence has been rapidly developed in the past years. The present paper aims to investigate the potential application of artificial intelligence in the preschool children's education. First, the critical technologies of artificial intelligence are reviewed and related to the preschool children's education. Then, the demand for artificial intelligence in preschool children's education is analyzed for children-centered learning activities, respecting children, and learning in accordance with children's development. Finally, some possible applications of artificial intelligence in preschool education are discussed.

1. Introduction

Artificial intelligence (AI), also called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals [1]. Artificial intelligence has developed rapidly and some milestones have been achieved in the past 50 years. In March 2016, AlphaGo won 4 out of 5 games of Go in a match with Go champion Lee Sedol, becoming the first computer Go-playing system to beat a professional Go player without handicaps. This marked the completion of a significant milestone in the development of artificial intelligence as Go is an extremely complex game. Artificial intelligence has obtained extensive attention in the past several years. Many strong economies in the world have invested a lot of money to promote the development of artificial intelligence, such as the United States, the European Union, Japan and China.

Artificial intelligence has a wide range of application background, such as scientific research, education, market layout based on big data analysis, bank card theft diagnosis, stock market analysis and management. Due to its very wide application, it is possible to use artificial intelligence in the preschool children's education [2,3]. The aim of the present paper, therefore, is to investigate the potential application of artificial intelligence in the preschool children's education.

The remainder of the present paper is organized as follows. Section 2 states the critical technologies of artificial intelligence. Section 3 describes the demand for artificial intelligence in preschool children's education. Section 4 proposes some possible applications of artificial intelligence in preschool education. Finally, the conclusions of the work are summarized in Section 5.

2. Critical Technologies of Artificial Intelligence

The critical technologies of artificial intelligence at least comprise natural language processing, computer vision and big data analysis [4]. The details of these technologies and their relationship to the preschool children's education will be discussed below in this section.



2.1. Natural Language Processing

Natural language processing (NLP) is critical to artificial intelligence because it concerns with the interactions between computers (or machines controlled by computers) and human (natural) languages, in particular how to program computers to process and analyze large amounts of natural language data. Challenges in natural language processing frequently involve speech recognition, natural language understanding, and natural language generation. For preschool children, natural language processing is even more challenge because the pronunciation and meaning of the natural languages of children may be quite different from those of adults and therefore are more difficult to analyze.

2.2. Computer Vision

Computer vision is an interdisciplinary scientific field that deals with how computers can be made to gain high-level understanding from digital images or videos. Computer vision include methods for acquiring, processing, analyzing and understanding digital images, and extraction of high-dimensional data in order to produce numerical or symbolic information, e.g., in the forms of decisions.

Computer vision is in some way similar to human vision. However, human vision is based on visible light, but computer vision can utilize much more other information that is invisible for human eyes. For example, human eyes can see nothing in the deep night, but the computer imaging system can see everything clearly even in the deep night. Furthermore, computer vision is able to provide the temperature field of human body or an object based on the reflected infrared information.

When applied to preschool children's education, the key visible features of children should be extracted, such as children's face expressions and body movements or languages. Figure 1 shows an example of a child's various expressions when eating cheese. It can be seen that a child has very rich expressions. As a first step of artificial intelligence, computer vision should visualize and extract these expressions. Learning and reorganization of these features belongs to data analysis. It should be noted that the meaning of some features may be different for different children, and then the learning and reorganization should be performed for each child. Beside these, much other information about pre-school children can also be captured and recognized with the help of computer vision.



Figure 1. Example of a child's various expressions when eating cheese [5].

2.3. Big Data Analysis

Big data analysis is a very important technology for artificial intelligence. Big data analysis refers to the analysis of big data. Big data was associated with five key concepts: volume, variety, velocity, veracity and value. Big data processing refer to the use of predictive analytics, user behavior analytics, or certain other advanced data analytics methods that extract value from data, and seldom to a particular size of data set. There is a lot of valuable information hidden in big data, but it is not easy to mine useful information from it. One basicical method for big data analysis is machine learning, which extracts useful information from the data and makes decision through repeated learning.

3. Requirement Analysis of Artificial Intelligence in Preschool Children's Education

The basic characteristic of preschool children's education is children-centered, respecting children and providing appropriate education according to children's development level [6]. This section analyses the current demand for artificial intelligence from these three aspects in children's education.

3.1. Children-Centered

In preschool children's education, students are the main body of learning. All teaching activities should be carried out with the purpose to promote the development of children. Children-centered learning emphasizes the transformation of children's passive learning into active learning in the learning process. That is to say, children are the main body of learning activities, including children's thinking activities, and children's cognitive process, rather than "students as the main body, teachers as the secondary part". Children-centered education required that teachers not to be writers and directors, but to be instructors, helpers and participants. The core characteristic of student-centered is independence, and the core of independence is the independence of thinking activities, that is, independent thinking. The core characteristic of teachers' guidance is enlightenment.

Children-centered education makes the learning activities not be designed in advance. The unpredictability of learning activities puts forward high requirements for teachers. The application of artificial intelligence can provide a large amount of learning resources to all learners, and the learning activities can be design in real time depending on the children's reaction in the learning activities.

3.2. Respecting Children

Children's feeling of respect first comes from their parents. The sense of respect is gradually established through repeated training and education. First, respecting children means respecting their basic rights. Second, to respect children, we must respect the natural law of their growth and development. The children's development is a natural process. Both children's physical or psychological development has their own internal law of development. Finally, respecting children means respecting their independent personality and self-consciousness. Although children are young, they have independent personality and self-awareness, and have their own ideas and views.

In kindergarten teaching activities, the limitation of kindergarten teachers' energy and ability makes it difficult to pay attention to every aspect of children and to fully respect every child. The introduction of artificial intelligence makes it possible to collect all aspects of information for each child, use big data processing technology to accurately grasp the physical and mental status of children in real time, and take appropriate measures to ensure that the children are fully respected.

3.3. Learning in Accordance with Children's Development Level

Due to the influence of congenital factors, family education and growth process, there are great differences among children. Teaching according to each child's requirement, that is to say, according to individual differences, appropriate teaching activities are very important for individual's good development. At present, due to the limitation of teachers' capabilities and efforts, preschool teaching activities can only meet the common needs, but can not meet the special needs.

The introduction of artificial intelligence technology can analyze process and evaluate the information for each child, provide specific teaching activities according to the development level or special requirement of each child, and promote the best development of each individual.

4. Potential Application of Artificial Intelligence in Preschool Children's Education

The following potential applications [7, 8] of preschool children's education should be addressed during the integration of artificial intelligence and preschool children's education.

4.1. Artificial Intelligent Evaluation of Children

Artificial intelligent assessment of children includes children's homework correction, children's language development level test, and children's physical exercise test, children's intelligence level test, and so on. Compared with traditional assessment, the advantage of artificial intelligence is that it can consider more aspects, point out the shortcomings of children and provide proper measures.

Take children's language development level test as an example, with the development of big data, speech recognition and semantic analysis technologies, assessment of language development and personalized instant feedback have gradually become reality. Artificial intelligence can provide efficient, consistent and accurate assessment results in a short time, so as to accurately grasp the development of children's language and vocabulary. More importantly, artificial intelligence has the capability to provide targeted teaching activities to promote the coordinated development of each child's language ability, and therefore overcomes the children's shortcomings in language development (such as pronunciation, vocabulary, grammar, communicative competence, etc.).

4.2. Artificial Intelligent Teaching System

Artificial intelligent teaching system is an adaptive teaching and learning system, which changes the traditional one-way transmission of knowledge between teachers and children. The smart classroom is a preliminary case of the application of artificial intelligence in the field of education. Compared with the traditional one-to-many classroom teaching and one-to-one teacher counselling, the teaching results of artificial intelligent teaching are significantly improved.

Artificial intelligent teaching system provides individualized learning mode, learning resources and learning companions to help children achieve specific goals according to each child's status (mastery of learning content, learning speed and learning process). In the process of interaction with children, the artificial intelligent teaching system uses big data analysis according to the observable information such as children's facial expression response, speech expression and knowledge feedback, so as to realize emotional perception, prediction and regulation, and then make active intervention and adjustment to children's emotional state. However, artificial intelligent teaching system is still in the initial stage of development, focusing on children's after-school self-study and answering questions, rather than classroom teaching activities. The future of artificial intelligent teaching system depends on the development of some key technologies and the support of hardware facilities.

4.3. Artificial Intelligent Educational Robot

Artificial intelligent education robot integrates multi-disciplinary human knowledge through machine learning, and integrates a variety of advanced technologies at the same time. The independent teaching, assistant teaching and teaching management of artificial intelligent educational robots will add new intelligence and interest to children's learning activities and become an excellent platform for training children's innovative ability and comprehensive knowledge. In the process of teaching, artificial intelligent educational robots can act as intelligent teaching aids, independent or assistant kindergarten teachers to carry out teaching activities. During the communication and interaction with children, the artificial intelligent educational robot searches answers on the internet and self-learns. The more they communicate with children, the clearer and more comprehensive the artificial intelligent education



Figure 2. Example of an artificial intelligent educational robot [9].

robot understands the children's emotions and characteristics. It can teach children in accordance with children's aptitude and teach children with special knowledge according to the big data analysis for each child, and thus brings a brand-new learning experience in the age of intelligence.

In addition to the robot itself, the artificial intelligent education robot also needs some supporting hardware facilities. Artificial intelligent education robot has played an active role in the cultivation and improvement of children's scientific literacy. It has been tested in some schools and is popular with teenagers because of its feature of "learning during playing". Figure 2 shows an example of intelligent education robots in kindergartens. In the future, artificial intelligent educational robots will appear more and more in kindergartens, just as computers have become very popular in school.

4.4. Artificial Intelligent Virtual Reality Teaching

Artificial intelligence in combination with virtual reality technology can provide children with more intuitive and visual multi-sensory stimulation, which is of great help to children's learning. Combining virtual reality with education, the classroom is no longer confined to small classrooms, whiteboards and PPT. Through the virtual scene, children can deeply understand the previously unimaginable knowledge, provide students with a vivid and lifelike learning environment, enable students to explore freely and learn independently, stimulate children's learning enthusiasm, and help children construct knowledge system. The value of virtual reality education lies in improving children's learning experience and efficiency, and assisting teachers to teach efficiently and effectively.

The Ministry of Education of China has explicitly listed virtual reality technology as the key work of education informatization, which means that the promotion and application of virtual reality education in the Chinese education system is imperative. Virtual reality has been widely used in the field of education. Some kindergartens have introduced virtual reality education.

5. Conclusion

The potential application of artificial intelligence in preschool children's education is investigated in this paper. This paper briefly introduces the critical technologies of artificial intelligence and their relationship to preschool children's education, analyses the demand of preschool children's education for artificial intelligence, and preliminarily discusses the possible application of artificial intelligence in preschool children's education. With the development of computer science, sensor recognition, memory storage, and machine learning algorithms, artificial intelligence will become a revolutionary technology to change human life style and production efficiency. The deep integration of artificial intelligence and preschool children's education is a long-term, complex and arduous task.

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