Exploring the Construction and Implementation of Artificial Intelligence Curriculum in Primary and Secondary Schools--A Case Study Based on the Educational Practices of Primary and Secondary Schools in Guangzhou City

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Abstract. Artificial intelligence is one of the driving forces of social development, and the training of talents in its field is also very necessary. Under the strong impetus of the state, the promotion of artificial intelligence courses is carried out everywhere, and the design of primary and secondary school courses among them also appears to be very important. This paper explores the design and practice of AI curriculum in primary and secondary schools based on the Guangzhou AI curriculum project. The implementation of the project-based curriculum has a platform to rely on and the corresponding supporting resources. Still, in this process, due to the teacher's mastery of the learning situation and other practical issues, there will be the case of redesigning the teaching content, to cultivate students' artificial intelligence literacy, innovative thinking, and the ability to solve practical problems through the role of. Therefore, this thesis takes the Guangzhou primary and secondary school artificial intelligence education curriculum as an example, aiming to explore the design and practice of this curriculum in depth, and analyze its impact and effect on students, to provide useful reference for the development and implementation of primary and secondary school artificial intelligence curriculum in other regions.

Keywords: Artificial Intelligence, Curriculum Design, Teacher Instruction, Educational Programs

1 Introduction

Artificial Intelligence (AI), as a cutting-edge technology, is changing our lifestyles, work patterns, and social structures at an astonishing speed. With the wide application of AI in many fields, cultivating a new generation of talents with AI literacy has become an urgent need for the state and society. As the basic stage of talent cultivation, how to incorporate AI education into the curriculum system and cultivate students' innovative thinking, ability to solve practical problems, and awareness of the ethical and social impact of AI has become a focus of attention for the education sector and the community. UNESCO released the Beijing Consensus in 2019, which plans education in the era of artificial intelligence. In 2017, the State Council released the New Generation Artificial Intelligence Development Plan, which

EIMT 2024, March 29-31, Wuhan, People's Republic of China

DOI 10.4108/eai.29-3-2024.2347727

requires primary and secondary schools to offer courses related to artificial intelligence[1]. In 2020, the Ministry of Education pointed out in the Key Points of Education Informatization and Network Security Work 2020 that it is necessary to continue to push forward the construction of AI education courses in primary and secondary schools, application, and promotion work[2]. In terms of AI education, Guangzhou City actively responded to the national policy. It began to introduce AI education content in the curriculum system, which is committed to cultivating students who can adapt to the needs of the future society. The AI curriculum in Guangzhou City relies on the AI teaching platform for primary and secondary schools in Guangzhou to promote and practice. Much can be gleaned from the experience of implementing other new technologies into the classroom, and this will assist us in increasing the possibility that AI will aid students in flourishing and acquiring potent knowledge[3].By exploring the principles, application cases, and ethics of AI in the classroom, students gradually build up a basic understanding of AI and cultivate the spirit of innovation and cooperation in practical operation.

This paper will analyze the design ideas, teaching methods, and actual effects of the AI education curriculum in primary and secondary schools in Guangzhou, and explore the advantages and challenges of the AI education curriculum in primary and secondary schools in cultivating the comprehensive quality of students by comprehensively evaluating the students' knowledge level, ability enhancement, and attitude change. In addition, this dissertation will analyze the problems that may be encountered in the implementation of the curriculum and put forward suggestions for improvement, to provide useful references for the sustainable development of primary and secondary artificial intelligence education in the future.

2 Review of literature

In recent years, the development of artificial intelligence courses in primary and secondary schools in China has made remarkable progress. Since 2013, AI-related content has been added to the senior high school section, and then related policies have been introduced one after another, clarifying the important position of AI education in basic education. In 2022, the Compulsory Education Information Technology Curriculum Standards even included AI content in the teaching planning of junior high schools[4], reflecting the great importance China attaches to the cultivation of AI talents. However, due to the complexity of the AI subject and the cognitive differences between primary and secondary school students[5], as well as the lack of awareness of educational administrators and teachers[6], the AI curriculum in primary and secondary schools is still in the exploration stage and lacks a unified teaching standard[7].

Nevertheless, many cities have begun to actively explore the implementation path of AI education, laying the foundation for the comprehensive development of AI education in China. Globally, artificial intelligence education in primary and secondary schools has also attracted much attention. The United States[8], Canada, and European countries have incorporated AI into primary and secondary education curricula and cultivated students' innovative ability and logical thinking through programming teaching and robotics programs. These practices not only enhance students' scientific and technological literacy but also

stimulate their interest in the field of artificial intelligence. The successful experience of AI education in primary and secondary schools abroad provides a useful reference for China.

In general, the current AI education at the primary and secondary school level faces good development opportunities and has made great progress in curriculum development and resource construction[5]. Some scholars have shown that the current research on the implementation modes of AI courses in primary and secondary schools mainly includes lecture-based and inquiry-based approaches[9]. The introduction of Artificial Intelligence is going to change the scope and content of the moral education program by changing the teaching objectives, teaching content, teaching methods, and teaching tools[10].

However, curriculum design and implementation still face many challenges, in the artificial intelligence curriculum, the more commonly used teaching mode is "building + programming"[11]. "Build + Programming" instructs students to mimic the model construction by providing a building manual, and realizes the model functions in combination with programming tasks. Mechanized indoctrination and intensive training of students in the building method and programming process can not fundamentally improve students' artificial intelligence literacy[12]. At this time, we need to learn from foreign experience at the same time, in primary and secondary schools to carry out artificial intelligence education, must provide specialized, popular courses[13]. Combined with the domestic reality for in-depth exploration. The practice and research of Guangzhou City in the curriculum of AI education in primary and secondary schools will provide us with more valuable experience and inspiration to promote the further development of AI education in China's basic education.

3 Construction of Artificial Intelligence Curriculum Resources

This paper is based on the Guangzhou primary and secondary school artificial intelligence teaching platform, which is a platform developed by various relevant units in Guangzhou City in cooperation with enterprises, although the platform is still in the early stage of use but is rich in resources for each course, and there are still some parts that need to be improved. In addition, there is also the teacher's faculty level is also very important, the following will explain the content of these two parts.

3.1 Teaching platform

Teachers can teach on the platform, which is also equipped with curriculum resources for grades 1-8. Each grade is designed with a corresponding curriculum, as shown in **Table 1**, which summarizes the number of courses.

Table 1. Statistics on the number of courses on the platform.

Grades (both first and second half of the school year)	Number of courses	Resource (such as manpower or tourism)
first grade	8 lessons	Lesson plans, courseware, videos, etc.
second grade	8 lessons	
third grade	12 lessons	
fourth grade	12 lessons	
fifth grade	12 lessons	

sixth grade	12 lessons
seventh grade	12 lessons
eighth grade	12 lessons

Teachers can teach on it, teachers have accounts students have accounts, and they can submit assignments, etc. on the platform. Of course, essential AI programming, etc. can also be taught on the platform. There are also virtual labs that allow students to experience the fun of artificial intelligence. In addition, there are some competitions and activities on the platform that students can participate in, and students can also participate to increase their interest in learning.

3.2 Teachers' strength

The platform also has some teaching and research activities that teachers can participate in to improve their teaching skills. The platform will have some teaching competitions, in which teachers can participate and see other teachers' excellent cases for mutual learning. The platform and related organizations will set up some training activities to promote the improvement of teachers' teaching abilities. Teachers can also leave messages on the platform to interact with other peers or ask their questions.

4 Curricular exploration

In the process of promoting AI lessons, teachers need to first design activities based on the objectives of the lesson or teach based on the resources provided by the platform, and each lesson is adapted depending on the actual situation. Teachers need to polish their content before implementing it, adjusting it, and implementing it again to see if their instructional design is effective.

4.1 Course Design Practice

Here is an example of the teaching link design in the 5th lesson "My Intelligent Room" in the second book of the 5th grade of the Guangzhou Artificial Intelligence Curriculum. First of all, analyze the content of the textbook and the characteristics of the learners, define the teaching objectives and teaching points, design the teaching activities, prepare the learning task list needed in the classroom, and make good preparations before class. Here we emphasize that the teaching activities should be designed as "pre-course introduction - designing an intelligent room - imagining the future room design - self-evaluation".

4.2 Course Session Design

According to the teacher's teaching activity design, the link design is relatively strong and can emphasize the students' activities in the teaching link, and in the link of designing the room, the main purpose is to let the students design the room that can switch the light on and off by language, and know the function of voice recognition in artificial intelligence. So the design of the intelligent room can be divided into two sessions, that is, first experience and then design, so the session name is designed as "Intelligent Situation I appreciate - Intelligent Room I experience - Intelligent Room I design - Intelligent Room I think - Intelligent Learning I evaluation", and then the activity design is displayed in the form of a board book so that the

students can always remember what they are in. The "I" in the activity is the "I" in the activity. The "I" in the activity allows students to participate in the classroom from their point of view, and the specific link design is shown in **Figure 1**.

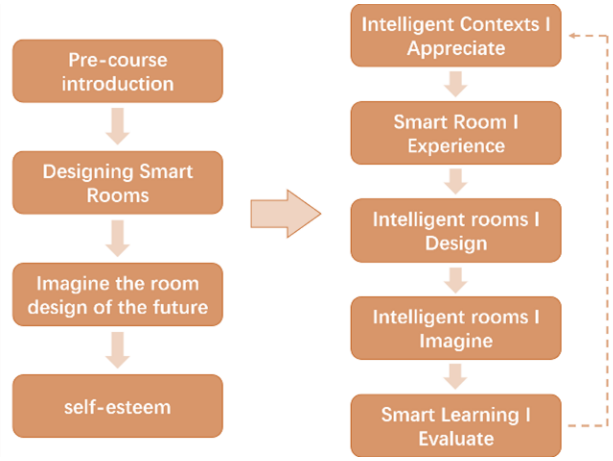

Figure 1. Reconstruction of the teaching and learning process

In addition, the design of the room stage was originally designed as a large group work, the efficiency of student cooperation is not high, so it will be changed to 3-4 people group cooperation, which is more able to improve the students' cooperation ability. And in the stage of imagination can be considered to guide students to the future of some scene design room, and then let the students show the group's imagination results, and its evaluation, and then at the end of the mutual evaluation and self-assessment is the complete evaluation process.

4.3 Course implementation and effectiveness

According to the above link design, we adjusted the classroom teaching program and conducted the lessons. Observing the teacher's control of the teaching link and the students' learning response in the classroom, and conducting a questionnaire survey on the students after the class found that such a teaching link design is effective and can enhance classroom efficiency, while the student's feelings about the classroom were also sorted out in the questionnaire data, which are detailed in Appendix 1, and the data were analyzed with confidence as shown in Figure 2 and the results of the validity analysis as shown in Figure 3:

KMO&Bartlett's Test

KMP Sample Suitability Quantity		.736
Bartlett's test of sphericity	rough chi-square (math.)	622.884
	(number of) degrees of freedom	91
	significance	.000

Figure 2. Reliability analysis

Reliability statistics		
Cronbach Alpha	Clonebach based on standardized terms Alpha	item count (of a consignment etc)
.711	.667	5

Figure 3. Reliability analysis

It is evident from the data that the data collected is valid and responds to the fact that the students recognize the teacher's instruction and that the purpose of the instruction has been achieved.

4.4 Segmental Design Patterns.

In the link design, from the student's point of view to design a good teaching link, from I appreciate, I experience, I design, I think about my evaluation, focusing on the cognition of the student's learning process, step by step, which can be used as a model to promote to the other artificial intelligence courses, and hands-on activities arranged in the experience can stimulate the student's interest in learning, and also to the knowledge to be learned to have an initial It is easier for students to be immersed in the learning environment.

5 Conclusion and Outlook

5.1 Conclusion

The practice of AI education in primary and secondary schools in Guangzhou has shown that sound curriculum design and practice can effectively facilitate teachers' teaching and significantly enhance students' innovative thinking, problem-solving skills, and interdisciplinary literacy. However, challenges such as teacher reserves, updating teaching materials, and curriculum integration remain. Therefore, concerted efforts are needed to provide training and support to promote the sustainable development of AI education. To this end, this paper explores some creative strategies.

At the level of education policy, appropriate policy measures are formulated to explicitly incorporate AI education into the teacher training system. Policies can be introduced to encourage and support schools and educational institutions to use online resources for AI teacher training. Second, the policy should also explicitly certify and evaluate teachers involved in online learning to ensure the quality and effectiveness of the training. In addition, the policy can promote cooperation between schools and the industry to provide more practice opportunities for teachers and students and promote the in-depth development of AI education.

In terms of resource allocation, investment in teacher training and teaching activities in the field of AI education can be increased. Special funds can be set up for developing specialized online courses, purchasing necessary teaching equipment and software, and providing high-quality educational resources. Secondly, more social capital can also be attracted to the field of AI education through a combination of government guidance and market mechanisms to promote the optimal allocation of educational resources. In addition, a resource-sharing mechanism can be established to promote cooperation and exchange between schools and realize the mutually beneficial sharing of educational resources.

In terms of teacher training, attention should be paid to improving teachers' professionalism and practical ability. First, special online training courses can be organized, and experts and scholars in the field can be invited to give lectures to help teachers systematically master the basic knowledge and teaching methods of artificial intelligence. Secondly, practical teaching activities can be carried out, such as organizing teachers to participate in the research and development of AI projects and guiding students to practice AI, to enhance teachers' practical ability and innovative spirit. In addition, a teacher-learning community can be established to encourage exchanges and cooperation among teachers to share teaching experience and results and promote their professional development.

The implementation of these strategies will help address challenges such as teacher training and resource constraints to support the development of AI education. We also expect that the efforts of all parties will contribute to the development of more AI-literate talents.

5.2 Outlook

In the future, AI education in primary and secondary schools will continue to grow globally. To gain a more comprehensive understanding of the long-term impact of AI education on students' academic performance and prospects, we plan to conduct a long-term tracking study. Through regular assessments of students participating in AI programs, we will collect data on their academic performance, skill acquisition, creativity, and future career plans. These data will help us more accurately assess the effectiveness of AI education and provide strong evidence to advocate for educational institutions to increase AI programs.

In addition, we have noticed that the demand for talent in AI is growing. Students with AI literacy will be more competitive in the future job market. Therefore, by promoting AI education, we are expected to lay a solid foundation for the future development of students and nurture more talents with innovative spirit and practical ability for society. Finally, we should view AI education in primary and secondary schools as a long-term endeavor and a continuous process. With the passage of time, primary and secondary AI education will be optimized under the dual impetus of theory and practice, contributing to the cultivation of capable and creative talents for the future society.

References

[1] Somov, A.: Wildfire safety with wireless sensor networks. EAI Endorsed Transactions on Ambient Systems. pp. 1-11 (2011)

[2] Ministry of Education Issues " Key Points of Education Informatization and Cybersecurity Work in 2020 https://www.edu.cn/info/focus/rd_xin_wen/202003/t20200303_1714814.s

[3] Kurni, M., Mohammed, M.S., Srinivasa, K.G., Ethics of Artificial Intelligence in Education. In: A Beginner's Guide to Introduce Artificial Intelligence in Teaching and Learning. Springer Cham, 2023, doi.org/10.1007/978-3-031-32653-0_12.

[4] Huang Xuan. Research on the Design and Practice of Artificial Intelligence Curriculum in Middle School [D]. Ningxia University, 2023.

[5] Ma Hao-xue, Zheng Su, Zhang Ling. Research on artificial intelligence curriculum design for primary and secondary schools oriented to core literacy[J]. China Information Technology Education,2023(02):83-87.

[6] Lu Yu, Tang Xiao-Lu, SONG Jia-Chen et al. Artificial intelligence education for primary and secondary schools in the age of intelligence: general orientation and core content areas[J]. China Distance Education,2021(05):22- 31+77.
[7] Liang Jie. A preliminary study on the teaching practice of artificial intelligence in junior middle school--Taking "making intelligent street light" as an example[J]. Primary and Middle School Information Technology Education,2023(Z1):130-132.
[8] Su Hong. How the U.S. Powerfully Lays Out Artificial Intelligence Education[N]. Guangming Daily, 2022.01.20. https://epaper.gmw.cn/gmrb/html/2022-01/20/nw.D110000gmrb_20220120_1-14.
[9] Zheng Yan, Zhou Qian, Wang Huixin. Exploration of effective teaching mode of artificial intelligence course in basic education stage[J]. China Education Informatization,2019(16):10-14.
[10] Hong, Hyunju "Application of Artificial Intelligence Ethics Education to Elementary School Moral Curriculum" Elementary Moral Education 75 pp.183-206 (2021): 183.
[11] Han X. Research on the design and practice of elementary school artificial intelligence curriculum based on project-based learning--Take the lesson of "intelligent drying rack" as an example[J]. Education and Equipment Research,2023,39(01):48-52.
[12] Ma Yanli, Chen Chen. The realization path of project-based artificial intelligence classroom teaching in primary schools--Taking the teaching of Speech Recognition Technology as an example[J]. Journal of Fujian Institute of Education,2021,22(02):107-109+117.
[13] Sang XM. Artificial Intelligence Education and Curriculum Teaching Innovation[J]. Curriculum. Teaching Materials. Teaching Methods,2022,42(08):69-77. DOI:10.19877/j.cnki.kcjcjf.2022.08.020.