

# Artificial Intelligence Education in Primary and Secondary Schools from the Perspective of Thinking Quality

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**Abstract:** With the vigorous development of social economy in China, various advanced technologies and equipment have emerged, among which artificial intelligence (AI) has rapidly developed and achieved remarkable results when applied to many fields. Therefore, leaders and teachers in primary and secondary schools should pay more attention to AI education and explore effective measures to optimize the effectiveness of this education. Among them, carrying out artificial intelligence education and teaching from the perspective of thinking quality, with an aim to improve students' technical ability and effectively cultivate their thinking skills, may improve students' learning efficiency and teachers' teaching efficiency. How to carry out AI education from the perspective of thinking quality is an important issue that teachers need to address urgently. Through in-depth research, we focus on this issue, in hope to benefit primary and secondary school teachers.

**Keywords:** Thinking quality; Primary and secondary schools; Artificial intelligence; Teaching path

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## 1. Introduction

The leaders and teachers of primary and secondary schools should update the teaching concepts, innovate their teaching methods, and extend the scope of teaching with reference to the times. In order to further enhance the competitiveness of students and enable them to adapt to high-level learning, it is necessary for teachers to introduce artificial intelligence (AI) education in primary and secondary schools, so as to promote the long-term development of students<sup>[1]</sup>. With the innovation and development of AI technology as well as the development and reform of AI education, teachers need to explore new and effective measures to ensure the effectiveness of AI education in order to improve students' comprehensive thinking. Many primary and secondary schools are involved in AI education, with a certain popularity foundation. AI education can be carried out to enliven the classroom environment, mobilize students' emotions, attract them in such a way that they devote themselves to the learning of AI, enable them to successfully acquire basic knowledge and operating skills, and ultimately promote all-round development in students. In view of this, our teaching experiences are assumed as the starting point to analyze the problems in AI education in primary and secondary schools and the importance of carrying out AI education in primary and secondary schools from the perspective of thinking quality as well as to propose specific education paths based on this<sup>[2]</sup>.

## **2. Problems in artificial intelligence education in primary and secondary schools**

Nowadays, the forms of AI education in primary and secondary schools are quite diverse, and they are integrated into the whole teaching process in the form of curriculum or community. Some schools have even written relevant knowledge related to AI education into the curriculum system, so that students can keep pace with the development of the times. However, based on our research, there are still some places that do not carry out AI teaching in the form of courses, which hinders students from learning more comprehensive and detailed theoretical knowledge and practical skills. Consequently, this suppresses students' internal demand and motivation for AI learning and interferes with the quality of AI education <sup>[3]</sup>.

### **2.1. Exclusion of artificial intelligence education from the curriculum system**

After course explanation, schools need to test students' mastery of knowledge and skills. The development of AI education over a short period of time has attracted the attention of teachers and students. However, due to various practical reasons, AI education cannot be introduced into classrooms to carry out teaching activities like the content of textbooks. As far as the current situation of AI education is concerned, there is no authoritative publishing house to develop relevant teaching materials, and local education is still the main method, thus making the content of teaching materials similar and students unable to master more advanced theories and foundations. In addition, due to the lack of rigid education, a large gap exists in AI education among different regions, leading to differences in subsequent learning. Therefore, it is crucial to popularize AI education in primary and secondary schools to promote students' all-round development.

### **2.2. Uneven artificial intelligence education teachers**

In different regions, one of the problems of AI education is uneven teachers, which results in different educational outcomes. Generally speaking, this problem is mainly reflected in the number of teachers, professional quality, scientific research ability, and other aspects. AI is a new field, and many teachers have a relatively simple understanding of it. In addition, AI technology has outstanding professionalism <sup>[4]</sup>. Therefore, it is difficult for teachers to comprehensively and skillfully master it over a short period of time. When information technology teachers and those of other disciplines carry out AI teaching, a huge gap is observed in the teaching quality. Although some schools have recruited professional teachers to carry out AI teaching, they have not addressed the problem from the root – the lack of teachers – which ultimately leads to difficulties in AI teaching.

## **3. Importance of artificial intelligence education in primary and secondary schools from the perspective of thinking quality**

Nowadays, open-source hardware and graphical programming have garnered widespread attention from both teachers and students in primary and secondary schools and achieved a certain foundation in terms of popularity. Therefore, we can take this as a basis to carry out AI education and teaching. According to our understanding of AI education, there is a big difference between AI and information technology education. The former focuses on tool learning, while the latter focuses on skill mastery. AI integrates knowledge of many fields, such as science, computer, automation, electronic technology, data science, and system science; thus, it is practical and comprehensive. AI education in primary and secondary schools reflects the popularization of AI education and can effectively cultivate students' comprehensive thinking quality <sup>[5]</sup>.

Teachers must not mechanically imitate the teaching method of subject knowledge when carrying out AI education; rather, they need to regard important knowledge and skill points as the main goal of teaching. In order to effectively cultivate students' thinking quality, teachers need to focus on training students' ability to explore problems, conceive concepts, explore plans, innovate, and express their thinking based on this perspective, which includes computational thinking, creative thinking, and design thinking. In terms

of cultivating students' creative thinking, teachers can incorporate this content into the teaching objectives and carry out AI teaching under the guidance of these objectives. It is difficult to determine which solution is the best one. For instance, although contact fingerprint is accurate, it is not convenient; on the other hand, face recognition may not unlock the device. Therefore, students must deeply explore, analyze, and design different solutions to make the mechanical equipment more intelligent and convenient. The design of AI teaching content and teaching scheme should be different from that of basic education. We should consider the integrity of thinking quality; integrate the explanation of basic knowledge, the enlightenment of case explanation, the expansion of practice, and practice innovation; provide high-quality teaching services for students; and promote the development of students' thinking.

#### **4. The path of artificial intelligence education in primary and secondary schools from the perspective of thinking quality**

At present, AI education in primary and secondary schools is still in the exploratory stage. Therefore, teachers need not stick to a specific form in the teaching process but rather ensure good level division and goal refinement. For regions with relatively good conditions, schools can officially introduce courses and practical activities, while teachers can introduce practical cases and carry out case explanations; for regions with relatively poor conditions, schools should expose the students to AI technology or related products in information technology courses with an aim to promote the long-term development of AI education.

##### **4.1. Science popularization and experience**

AI is a characteristic technology. If primary and secondary school teachers actively carry out AI education, they can stimulate students' curiosity and desire for exploration. By exposing students to trending news, such as the AlphaGo man-machine war and Xinhua News Agency's AI news announcer, students would be inspired to carry out in-depth exploration and think about AI and other related technologies. At the same time, it is possible to achieve science popularization. For practical teaching purposes, teachers should choose materials and cases that spark the interest of students and those that are related to the life of students. For example, the following topics concerning AI doctors can be introduced: "Do hospitals need robot doctors, and which one is more competent?" What are the similarities and differences between robot doctors and human doctors in the diagnosis process? Will robot doctors replace human doctors in the future? What should we do if there is a misdiagnosis by a robot doctor? By setting questions related to the life of students, it is possible to improve the effectiveness of science popularization. The use of intelligent devices or applications is characterized by a younger age, which reduces the learning threshold of AI to a certain extent. In addition, AI has certain characteristics, including rich content and diverse forms. For example, primary and secondary school students tend to use voice interaction, beauty filters, and other software. With that in mind, we can design AI teaching links that meet students' interests and learning needs. The maturity of intelligent products and application software is an important prerequisite for the popularization of AI education, such as small AI speakers, Microsoft's Xiaoice chat robot, *etc.* The aforementioned interesting and novel products and programs can be used as effective auxiliary tools in basic AI education and ultimately achieve the widespread popularization of basic AI education.

##### **4.2. Curriculum design**

When designing the AI curriculum system, we must choose appropriate teaching content. The teaching content should be simple and based on the cognitive laws and development needs of students in primary and secondary schools to ensure that students do not lose interest in learning when faced with difficulties and to stimulate their curiosity in learning. For example, when explaining about knowledge representation and reasoning to students, teachers should integrate binary, human-computer interface, machine reasoning,

knowledge representation, artificial life, and other content into the curriculum, as well as ensure that the teaching content of the designed curriculum conforms to the cognitive rules of learning and also their specialty. When designing AI courses, the course content must be from the perspective of both teachers and students, that is, the feasibility to carry out comprehensive analysis and reasonable practice. In addition, there is a need to select appropriate teaching materials according to the teaching needs and explore appropriate integration opportunities. When designing the teaching plan, teachers need to consider the students' learning situation, cognitive level, receptive ability, and basic understanding. At the same time, they should also consider whether they have mastered AI operating skills. In order to give full play to the abilities and professionalism of teachers, primary and secondary schools can consider expanding the AI teaching content on the basis of information technology courses. Secondly, teachers should also grasp the differences between basic AI education and professional AI training. In order to reflect the knowledge and skills of AI, many basic AI courses involve various professional terms, such as in-depth learning, knowledge maps, expert systems, *etc.* Hence, teachers should take effective measures to simplify and visualize obscure and professional concepts to lower students' learning threshold and enable students to understand the meaning of those professional terms. There is also a need for teachers to deduce knowledge for students, so that they can understand the connotation of concepts. Thirdly, teachers should try to integrate theoretical teaching with practical operation to improve students' comprehensive ability. Teachers should also be fully aware that interest is the impetus for students to actively participate in the learning of AI. Therefore, teachers should design classroom activities with rich content and various forms to enliven the classroom environment, mobilize students' emotions, and encourage them to actively participate in it. For example, teachers can integrate theoretical knowledge with actual life situations and topics of interest and hobbies. At the end of the explanation, there should be a corresponding practical teaching link for students to consolidate basic knowledge and exercise their practical skills. For key and difficult knowledge, teachers can break it down into smaller problems and guide students to think and explore, so as to complete the teaching task. Fourth, teachers should take AI as the main factor when designing the curriculum system. The focus of AI education is still the learning and practice of AI-related knowledge; otherwise, AI education will lose its value of independent learning. Although AI and open-source hardware, programming, robotics, and other contents are intertwined, with mutual references existing in teaching models, there are great differences between AI education goals and contents. Therefore, it is necessary to emphasize the opportunity and path of AI knowledge teaching in teaching activities.

### **4.3. Practical activities**

The "Guiding Outline of Comprehensive Practical Activity Curriculum for Primary and Secondary Schools" issued by the national education department clearly proposes that students' scientific and technological abilities should be exercised in the teaching process and explains in detail from various aspects, including activity content design, activity project determination, and activity project implementation. Based on this, primary and secondary school teachers generally have two ideas when carrying out practical activities related to AI: first, consider the requirements of the outline, expand and extend to different curriculum activities, and integrate research learning, science course perspective, and application orientation into existing information technology courses; second, redesign the curriculum content and meet the requirements of ability training proposed in the outline. Different needs must be taken into account in the design of the curriculum content, and it is important to draw inferences from one instance on this basis. The characteristics of AI education and its related practical teaching activities are more in line with the second point. Through in-depth analysis of the specific requirements of the ability dimension proposed, the content of AI can better meet the requirements of various dimensions. For example, taking natural language processing as an example, the grammatical rules following the collective understanding of human language

are closely related to semantics, logic, psychology, and research, but the corresponding scientific methods can be represented by different teaching models, such as statistical models. Other than that, an experiment and trial and error dimension can be used as an example to improve the rate of accuracy through training and correction with the help of models. In the dimension of thinking and innovation, different applications can be explored when dealing with natural language, such as chat robots, voice control, and so on. In summary, carrying out AI education from the perspective of thinking quality does not suppress basic knowledge learning or skills teaching, but rather promotes students' learning of knowledge and skills by highlighting their thinking quality. Based on this, in the process of AI teaching, thinking quality plays an important role, which is not only determined by the characteristics of AI teaching content, but also related to AI practical teaching.

## 5. Conclusion

In the context of modern education and teaching, AI education and teaching should be actively carried out in primary and secondary schools where students' technical ability can be improved through science popularization and experience, curriculum design, and practical activities, and their thinking quality can also be effectively cultivated.

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## Disclosure statement

The authors declare no conflict of interest.

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