

# Research on Collaborative Innovation Teaching Design of Teacher-AI-Student in Primary School Information Technology Curriculum

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## Abstract

The rapid development of artificial intelligence technology and its deep application in the field of education have promoted changes in educational concepts, teaching methods, and other aspects. The traditional binary relationship of “teacher-student” has been transformed into a dynamic ternary relationship of “teacher-artificial intelligence-student”. This article focuses on the core competencies and supporting courseware of the new curriculum for information technology in primary schools in China. In the context of artificial intelligence, based on the ADDIE teaching design model, AI is integrated into various aspects of teaching design, including analysis, design, development, implementation, and evaluation. Research has found that AI has become a new teaching element. Teachers can use AI to deepen their understanding of teaching content and the discipline core literacy in instructional design. They can redesign their knowledge and skills system based on knowledge graphs, use artificial intelligence to generate content and develop characteristic educational resources, optimize teaching and learning methods, and implement smart teaching and evaluation. The article explores the rationality of AI application and the adaptability of students, as well as issues related to information security and social ethics in the context of AI deep integration teaching, with the aim of improving the teaching quality of primary school information technology and promoting educational reform.

## Keywords

Information Science and Technology Course, Artificial Intelligence, Teacher-AI-Student Collaboration, Instructional Design, Innovative Teaching

## 1. Introduction

In April 2022, the Ministry of Education of the People's Republic of China issued the "Compulsory Education Curriculum Plan and Curriculum Standards (2022 Edition)", renaming the original "Information Technology" course to "Information Science and Technology" and upgrading it to an independent discipline. Information Science and Technology curriculum revolves around core literacy to elaborate on course objectives, shifting from the previous focus on technical operations in the "information technology" course to the current emphasis on scientific principles and practical applications of "Information Science and Technology". The aim is to help students understand basic concepts and principles (Fu & Xie, 2023), while guiding them to use information technology to solve practical problems, thereby cultivating students' core literacy in four aspects: information consciousness, computational thinking, digital learning and information social responsibility (Huang, 2024).

In order to implement the 2022 version of the new curriculum standards, the Ministry of Education has organized efforts to develop new textbooks for each grade and curriculum. In July 2024, the Ministry of Education issued the "2024 National Curriculum Teaching Book Catalog for Compulsory Education (revised according to the 2022 version of the curriculum standards)". The new textbooks will be gradually put into use in the autumn semester of 2024. The compulsory education information technology teaching guide and supporting courseware are free to use on the national primary and secondary school smart education platform, solving the problems of curriculum standards and teaching content.

How should teachers teach, students learn, and academic performance be evaluated in the face of the new curriculum standards and textbooks? How can teachers integrate artificial intelligence technology into the teaching and learning process in a smart environment, with different levels of smart campus construction and application, and different practical teaching environments, in order to implement smart teaching? During the 2024 Digital Learning Week, UNESCO released the "Teacher AI Competency Framework", which indicates that in the field of education, artificial intelligence will create new teaching models: transforming the traditional binary relationship between teachers and students into a dynamic ternary relationship between teachers, artificial intelligence, and students (Liu, 2024). According to the innovative requirements of educating and nurturing talents in the era of artificial intelligence, information science and technology should start from a young age. Therefore, this article explores the solutions to these problems from the perspective of teacher AI student collaborative innovation in the systematic teaching design of primary school information technology curriculum, in order to inspire the intelligent teaching of primary school information technology teachers.

## 2. Overview of AI Supported ADDIE Instructional Design

The current deep integration of artificial intelligence into primary school

information technology has been widely applied, such as the video open course “Entering the Robot World”, which introduces the practical application of robots through virtual digital human hosting and dialogue with AI intelligent robots to stimulate students’ curiosity and introduce topics, exploring what robots are, their composition and practical life applications. The entire course deeply integrates AI technology, forming a new teaching path and providing students with a more personalized and efficient learning experience.

### **2.1. Artificial Intelligence Generated Content**

In the vast field of artificial intelligence (AI), generative AI (GAI) and AI generated content (AIGC) are two core and closely related concepts that together drive innovation in the field of content creation, bringing unprecedented opportunities and challenges to various industries. GAI provides the ability to generate new content and is the core technology for AIGC to implement content generation. With the advancement of GAI technology, AIGC’s generation quality and application scope in fields such as painting and video continue to expand, enabling the generation of more realistic and higher quality content. AIGC is the embodiment of GAI in specific application fields. Through AIGC, GAI’s technical capabilities can be utilized in practical applications, such as text content creation, painting, video, data analysis, etc.

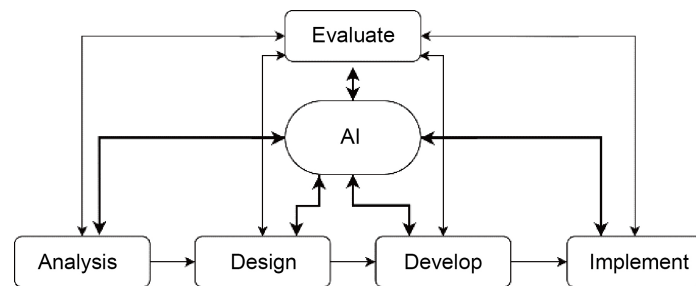
### **2.2. ADDIE Teaching Design**

Valuable teaching, effective teaching, efficient teaching, and charming teaching are the criteria for successful teaching. To achieve these standards, a systematic instructional design is necessary. The instructional design model decomposes instructional design theory into actionable implementation processes, facilitating flexible application by instructional implementers in teaching. The ADDIE instructional design model is widely used, including analysis, design, development, implementation, evaluation, and other stages (Yu, 2022).

### **2.3. AI Supported ADDIE Instructional Design**

ADDIE is a logical traditional teaching design model that focuses on imparting knowledge. With the development of AI technology, modern teaching design places more emphasis on cultivating students’ abilities, and the intelligent era also puts forward new requirements for new members of society. Therefore, in order to adapt to the needs of social development and the times, teachers can more effectively design and implement teaching activities through the application of AI technology, better achieve precise teaching, improve teaching innovation ability, enhance teaching quality, and promote professional development. By using AIGC technology to customize personalized and precise learning resources and paths, students can improve their learning outcomes, form a positive learning attitude, enhance their digital learning ability, digital social competence, and digital technology innovation, and become practitioners and innovators in the new era. The

ADDIE instructional design model supported by AIGC technology is shown in **Figure 1**.



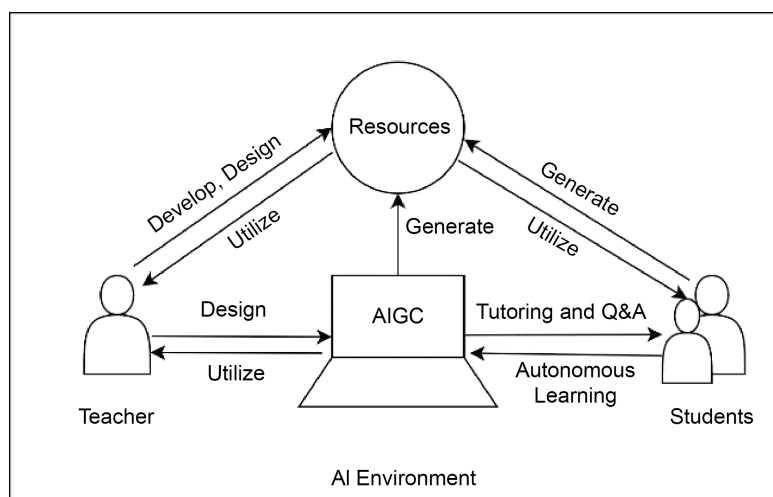
**Figure 1.** ADDIE teaching design model supported by AIGC.

### 3. AI as a New Element of Teaching Structure

In traditional teaching, teaching is a complex ecosystem composed of four elements: teachers, students, teaching environment, and teaching resources. The four elements are interrelated and influence each other. In the era of artificial intelligence, education, teaching environment, and teaching resources have all undergone changes. AI not only constitutes a smart teaching environment, but also becomes an indispensable smart teaching tool and smart resource generation platform in teaching. By utilizing artificial intelligence algorithms and deep learning through training models and large amounts of data, AI can not only replace teachers in teaching and answering questions, but also conduct intelligent teaching design, provide innovative teaching cases and methods for teachers, and achieve intelligent and personalized lesson preparation; It can intelligently generate teaching resources, such as generating static images or videos based on text descriptions, and can also intelligently generate teaching outlines and create courseware or animations based on themes, enriching the types of teaching resources and improving the efficiency of teaching resource development. AI provides accurate portraits for students' learning, realizing personalized intelligent push of learning resources, precise customization of learning processes and styles, and can also generate personalized resources to enrich the content of educational resources. In the AI smart environment, AI, as a new teaching element, must be deeply integrated with traditional elements. In teaching design, various elements and their interconnections in teaching must be scientifically, systematically, and comprehensively considered to achieve the optimization of education and teaching. As shown in **Figure 2**.

### 4. Teacher AI Student Collaborative Primary School Information Technology Innovation Teaching Design

The 2022 version of the information technology curriculum standards in China has the following characteristics: adhering to the goal oriented education and implementing the fundamental task of "cultivating morality and nurturing people"; Enlightenment and wisdom enhancement, fully implementing the requirements



**Figure 2.** New teaching elements of AI.

for cultivating new talents with ideals, abilities, and responsibilities in the era; Adhere to a problem oriented approach, enhance the scientific, systematic, cutting-edge, and operable nature of information technology; Adhere to the standards for academic quality in information technology, emphasizing thematic exploration and interdisciplinary learning activities; Adhere to innovation orientation, enhance the comprehensiveness, practicality, suitability, and timeliness of information technology; Adhere to the guidance of core literacy and promote the achievement of core literacy goals through the curriculum content form of broad concepts, themes, and tasks.

In order to achieve the new curriculum standards and take into account the uneven development of primary and secondary schools in China, the National Smart Education Platform for Primary and Secondary Schools provides a teaching guide and supporting courseware for compulsory education information technology. Starting from the third grade, each grade of three, four, five, and six is taught one class hour per week, and each grade has 30 class hours of teaching content. For content with higher learning difficulty, teachers can increase the class hours appropriately according to the situation. Integrating AI technology deeply into various aspects of information technology curriculum teaching design can trigger inspiration for teachers and students, expand learning resources, stimulate learning motivation, and achieve satisfactory teaching results with high quality and efficiency.

#### **4.1. AI Promotes Teachers to Analyze Subject Content and Deepen Their Understanding of the Discipline Core Literacy**

“Core literacy” is a conceptual tool for describing educational and curriculum objectives, referring to the unique, critical, and common educational value of a course, and is also the key to implementing the fundamental task of “cultivating morality and educating people “in the new era of education”. The “discipline core literacy” generally refer to the specific embodiment of the educational value

defined in each course, often described in 3 - 5 words or phrases. China's regulations stipulate that the core competencies of information technology disciplines include: information awareness, computational thinking, digital learning and innovation, and information social responsibility (Yu, 2022). Through the in-depth dialogue of AI technology, such as ERNIE Bot, iFLYTEK Spark and other big models, teachers can deeply understand the connotation of information awareness, computing thinking and other core qualities of information technology courses, obtain cases to improve students' core literacy, and establish the optimal path and evaluation methods to achieve core literacy. The core literacy of information technology in primary schools in China is divided into three stages: the first stage is grades 1 - 2, the second stage is grades 3 - 4, and the third stage is grades 5 - 6. The core literacy and content of each stage are shown in Figure 3.

### 4.2. Based on Knowledge Graph, AI Redesigns Knowledge and Skill System

Knowledge graph is a data model that stores entities and their interrelationships in graphical form. Through knowledge graph, information can be organized and retrieved more efficiently, complex relational networks can be understood, and advanced analysis and decision-making processes can be supported.

From the primary school information technology courseware provided by the National Smart Education Platform for Primary and Secondary Schools, it can be seen that they organize course content in a project-based manner based on the characteristics of students' age and cognitive patterns, reflecting the scientific, experiential, and cutting-edge nature of the information technology discipline. However, China has a vast territory and an uneven level of economic development, resulting in significant differences in the construction and use of smart

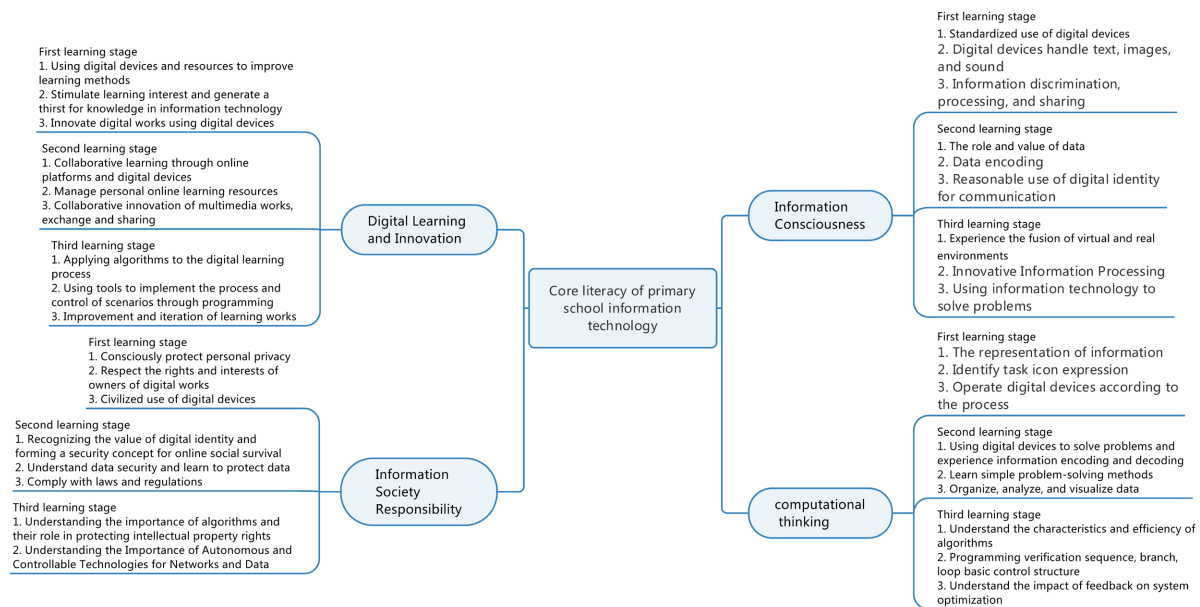


Figure 3. Core literacy and content of primary school information technology.

teaching environments among schools; At the same time, rural and urban students have different abilities to receive and recognize digital devices, and there should be differences in project settings and problem solving. However, the national universal courseware is difficult to meet the teaching needs and personalized learning needs of students in different places, and the local characteristics of the curriculum are not obvious.

The semantic association and reasoning ability of knowledge graphs can inspire AI to explore new directions of content creation. In addition to generating content with novel perspectives and in-depth analysis, it can also generate personalized cases with local characteristics and high credibility based on the provided rich background knowledge, propose multiple problem-solving solutions for teachers' reference, and reconstruct the information technology knowledge and skill system.

### **4.3. AI Generated Content, Innovative Development of Educational Resources**

By simulating the human creative process, AI is able to independently generate multimedia content that is rich in content and diverse in form, demonstrating enormous potential and a wide range of application scenarios. Like AIPPT (<https://www.aippt.cn/>), when teachers input the development of sensor teaching themes, AI can generate a lecture outline. After modifying and improving the lecture outline, the platform can automatically generate a PPT presentation. Teachers can modify the text, replace relevant images, insert videos, etc. as needed to obtain a teaching PPT with rich content, beautiful graphics, and unique style.

The intelligent creation function of Wancai Animation Master (<https://www.animiz.cn/>) can also intelligently generate teaching animations; The Tongyi APP can not only create text drawings and generate creative video animations, but also create exciting videos in the simplest language, unleashing people's imagination. These personalized and unique artificial intelligence generated content expand the types of teaching resources, increase the intuitiveness of teaching content, and use information technology to unveil the mysterious veil of information technology. Students can truly experience "learning through creation" and make knowledge applicable.

### **4.4. AI Optimized Teaching and Learning Methods, Implementing Smart Teaching**

AI technology has shown great innovative potential in primary school information technology curriculum teaching, bringing many novel teaching and learning methods to the field of education.

#### **4.4.1. Interactive Teaching and Situational Simulation Supported by AI**

Constructivist learning theory holds that knowledge is not simply acquired through teacher instruction, but rather through the process of meaning construction by learners in a certain socio-cultural context, through collaboration with

others (including teachers and learning partners), using necessary learning materials (Zhang & Chen, 2024). Therefore, instructional design needs to consider creating scenarios that are conducive to students constructing meaning. Primary school students have strong curiosity and are in the stage of knowledge accumulation, making it difficult for them to recognize and understand abstract conceptual knowledge. Therefore, it is even more necessary to promote students' cognition through intuitive learning scenarios. By utilizing AI technology, primary school information technology teachers can create various interactive teaching scenarios and virtual experiments, allowing students to conduct practical operations in a safe environment. For example, if the principle of Hanoi Tower and its animation demonstration are input in the dialogue of ERNIE Bot, AI will not only automatically generate the origin of the Hanoi Tower problem, but also decompose the problem, give recursive formulas and recursive applications, and provide relevant animation of the Hanoi Tower problem, so that students can more intuitively summarize laws in the problem situation, follow the basic process of the algorithm, and obtain problem solutions.

#### **4.4.2. Project Based Learning and Interdisciplinary Integration Supported by AI**

Project based learning is student-centered and promotes students' comprehensive learning and ability development through the process of solving practical problems. The seven part project-based learning method includes clarifying concepts, defining problems, brainstorming, constructing and hypothesizing, learning objectives, independent learning, and summarizing (Wu, 2023). AI can help teachers achieve interdisciplinary project mining based on teaching content, analyze the subject knowledge, skills, and difficulty level involved in the project; AI will perform intelligent analysis on class students, grouping them according to project characteristics, difficulty levels, and needs; During the project implementation process, AI teachers can monitor the progress of the project, use interdisciplinary knowledge to promptly answer students' questions, promote students' thinking and brainstorming, and conduct intelligent analysis of project results. In the teaching implementation of the course content of "Audio Recording Sound", projects can be designed according to different places such as classrooms, cinemas, and amusement parks. Projects can be designed according to different performance forms such as singing, poetry recitation, and skit performances. Projects can also be designed according to different digital recording devices such as mobile phones and computers, and different audio recording software. Students can conduct interdisciplinary research in music, science, information technology, etc. according to different needs, and comprehensively and deeply acquire relevant knowledge and skills in sound recording and processing.

#### **4.5. AI Intelligent Evaluation, Accurate Profiling of Teachers and Students**

AI is not only a new element in teaching structure, but also a comprehensive

evaluation and monitoring tool for analyzing, designing, developing, and implementing various aspects of teaching design. In the AI intelligent teaching environment, teachers can use AI technology and big data to comprehensively understand students' learning styles, cognitive characteristics, and knowledge structures, and accurately locate learning goals; By using AI to accurately depict the situation of each student, personalized teaching resources can be designed and developed, and different teaching methods can be selected to implement individualized and personalized teaching. During the teaching process, collect data on teachers' language, actions, expressions, etc., and accurately depict their teaching styles.

Students can use AI to expand their problem-solving ideas and methods; Using AI to correct program code and improve problem-solving efficiency; AI innovation can also be used to generate personalized works such as copywriting, painting, and videos, enhancing students' aesthetic abilities; Comprehensively collect data on students' moral, intellectual, physical, aesthetic, and labor aspects, use AI technology to create a comprehensive portrait of students, and promote the comprehensive development of students' overall quality.

## **5. Considerations and Application Suggestions for AI Empowered Teaching Design**

In the era of artificial intelligence, the deep integration of AI and subject teaching is the trend. Teachers fully utilize AI's functions such as content generation and data analysis to enable AI to participate in and even guide teaching throughout the entire process, which to some extent promotes teaching reform. However, things have two sides. While enjoying AI intelligence, efficiency, and convenience in teaching, attention should also be paid to the following aspects.

### **5.1. Considerations for AI Empowered Teaching Design**

#### **5.1.1. Rationality of Technology Application and Students' Adaptability Issues**

Due to differences in teachers' digital literacy, their ability to apply artificial intelligence in teaching varies. Skilled teachers can handle the application of artificial intelligence with ease, but often encounter the problem of excessive use of AI. In primary school information technology teaching, blindly catering to students' preferences and creating artificial intelligence works that go beyond the objective world and students' cognition can cause cognitive confusion among students. Therefore, the deep integration of AI technology into education and teaching must consider the rationality of technology application and the adaptability of students' AI technology, so that it can truly promote students' cognition and achieve the construction of knowledge meaning.

#### **5.1.2. Information Security and Social Ethical Issues in the Use of AI**

The development of AI technology highly relies on big data, and personal privacy is easily violated during the collection, storage, analysis, and use of this data. Especially for underage primary school students who are in a critical period of

physical and mental development, various information and viewpoints in the online environment affect the formation of students' worldviews, life philosophies, values, etc. Protecting their personal information data can effectively prevent harm such as online fraud and online violence, thereby ensuring their physical and mental health.

The decisions and behaviors of AI systems are often based on complex algorithms and large amounts of data, which cannot fully simulate human moral judgment and reasoning abilities, which may lead to some unfair or unethical decision outcomes. The widespread application of AI technology may also lead to a gradual transfer of power from human hands to AI systems, causing humans to lose their independent thinking and judgment abilities due to excessive reliance on AI systems, and also leading elementary school students to doubt the value of humanity itself; The content generated by AI may also involve issues such as intellectual property protection due to its value.

## **5.2. Application Suggestions for AI Empowered Teaching Design**

### **5.2.1. Suggestions for Optimizing the Generation of Teaching Resource Content**

In order to stimulate students' desire to learn and broaden their knowledge horizons, it is recommended that teachers optimize the design of AI teaching resource generation content, so that resources can go from knowledge representation to principle application, from scenario creation to knowledge construction, and enhance the accuracy and applicability of AI teaching resources.

### **5.2.2. Suggestions for Interdisciplinary Knowledge Application and Innovation**

The content generation of AI big models absorbs knowledge and updates from numerous disciplines in order to achieve content creation and innovation. Therefore, teachers need to fully utilize the interdisciplinary creative ability of AI, such as using language as beautiful as possible in the description of AI text generated images, painting styles and technical specifications, and reasonable scene descriptions, in order to generate digital works that are both aesthetically pleasing and literary.

## **6. Summary**

The collaborative teaching design between teachers, AI, and students in a smart education environment, where AI serves as the intellectual assistant for teachers, enables intelligent analysis of teaching content and learner characteristics, resulting in precise design of teaching objectives and visualization of student object analysis; The project design based on problem-solving is diverse in form; the multimedia resources generated by artificial intelligence are rich in content, have strong interactivity, are conducive to situation creation, and promote the meaningful construction of students' knowledge; AI assists teachers in completing tasks such as grading homework and answering questions, and accurately evaluates

students' learning outcomes. The innovative teaching design of teacher AI student collaboration requires teachers to have high digital literacy. While emphasizing information security and social ethics, teachers should also pay attention to the rationality of technology application, so that students can adapt to AI technology and improve their information literacy. Only in this way can we promote changes in teaching forms and methods, and cultivate high-quality talents with innovative spirit and ability for the era of artificial intelligence.

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### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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