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Research on the Cross-School Study Model of Computer Programming Empowered by Digital Intelligence

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Abstract: With the rapid development of artificial intelligence (AI) technology and the popularization of generative AI represented by Large Language Models (LLMs), teaching of computer programming including cross-school study is facing large challenges and opportunities. The limitations of traditional teaching model are becoming increasingly apparent under the influence of the powerful capabilities of AI code generation tools. The teaching focus of computer programming is transferring from code implementation to high-level thinking development on problem definition, system design, review, and optimization. In response to the problems of current cross-school joint learning, we propose a demonstration cultivating model for cross-school study of computer programming empowered by digital intelligence, which provides a complete set of teaching reform plan including the curriculum system, teaching methods, teaching practice, evaluation standards, and the cross-school joint cultivation. It is not only applicable to computer programming courses but also has important reference for the teaching reforms of disciplines such as mathematics, physics, and engineering, which require the stronger logical thinking and problem-solving abilities.

1. Introduction

Cross-school credit study is one of the educational models of “Internet + Education”. It relies on a third-party online teaching management platform, where the high-quality courses are launched by various schools and universities. Students can break through the limitations of schools and regions to pursue their course studies online and obtain their certified credits [1-3]. This teaching method has achieved remarkable results over more than ten years since its implementation. However, with the rapid development of artificial intelligence technology in recent years, especially the widespread application of generative AI such as LLMs, traditional teaching models, under the strong impact of AI code generation tools, have gradually revealed their limitations.

Under this background, it will bring about broad application prospects to research a cross-school study model for computer programming courses empowered by digital intelligent, which holds the practical theoretical significance and the value for promotion in colleges and universities.

Firstly, this research is an inevitable requirement for educational transformation. Currently,

various AI programming assistants can generate, interpret, and debug codes in real time, and students can directly generate programming codes through AI tools, which makes it necessary to shift the teaching focus of computer programming from code implementation to the cultivation of higher-order thinking abilities, such as problem definition, algorithm design, system architecture, code review and optimization. This paper aims to explore how to redefine and evaluate students' programming abilities under the assistance of AI, and construct a new teaching theoretical framework that is compatible with it, applied for the current cross-school study.

Secondly, this research provides an innovative approach to address the imbalance of high-quality educational resources. The essence of cross-school study is to disseminate the teaching philosophy, practical resources, and evaluation systems of excellent university courses to more ordinary universities. Through digital intelligence empowerment, using big data technology to build a replicable and standardized teaching platform can effectively promote the cross-school study model.

Finally, this research focuses on strategic measure to enhance students' future competitiveness. Future software engineers will no longer be "code typists", but "AI-enhanced engineers" capable of mastering AI and solving complex problems. The study model empowered by digital intelligent not only upgrades students' programming skills, but also shapes their core competitiveness in the era of AI, and helps to cultivate innovative and multi-skilled talents who can adapt to the development of the digital economy.

2. Analysis of Research Actuality

Research on AI-empowered educational applications and cross-school study teaching models has achieved significant progress and important results [4, 5]. Early studies focused on intelligent teaching systems (ITS) and adaptive learning [6, 7], such as Cognitive Tutor [8] at Carnegie Mellon University. In recent years, the research focus has rapidly been shifted to generative AI. Top universities like Harvard, Stanford, and MIT have begun systematic exploration of integrating tools like ChatGPT and GitHub Copilot in programming teaching [9-11]. Preliminary research indicates that AI can effectively help students overcome initial learning obstacles, but it also brings new challenges such as excessive reliance, weakened critical thinking, and academic misconduct. Companies like Microsoft and Google are vigorously promoting the trial of their AI programming tools in educational area. Relevant research is beginning to design new programming tasks that must be completed through effective human-machine collaboration, thereby cultivating students' system thinking and AI tool mastery. AI-assisted MOOC platforms (like edX and Coursera) have proven the feasibility of large-scale cross-school online learning, where virtual online communication and cooperation provide students with cross-cultural and cross-regional team work experiences. All these offer mature technical and model references for cross-school education.

Although there are some advanced efforts, the targeted research that deeply integrates the two dimensions of "AI empowerment" and "cross-school cultivation" is still rare. Most of the existing research concentrates tool application, lacking systematic teaching model construction aimed at ability reshaping. At present, most of the practices in Chinese colleges remain at the level of "whether to allow the use of AI" or "how to prevent AI cheating", rather than deeply integrating AI into the entire teaching process to achieve a leap from assistance to empowerment. Therefore, there is a lack of redefinition of the connotation of programming ability in the AI environment. In addition, the existing cross-school cooperation mainly focus on resource sharing, lacking in-depth process fusion based on common projects and real-time collaboration. Moreover, the existing research is mostly in the form of scattered practical reports or theoretical discussions, lacking a complete model construction and empirical study that integrates AI empowerment and cross-school cultivation.

In short, through a systematic analysis of the current research status, and in response to the gaps in “deep empowerment” and “deep integration” in the existing research, this paper aims to construct an innovative and implementable cross-school cultivation model. This model not only has the major theoretical innovation, but also has urgent practical significance and broad application prospects for improving the overall quality of programming talent cultivation in colleges and universities and promoting educational equity.

3. The Reform Model Empowered by Digital Intelligence

Computer programming teaching emphasize the cultivation of abilities and thinking, which objective is to master programming languages and basic programming skills, including fundamental operations, logical representation, set processing, function definition and call, memory, and external storage management, and so on. For cross-school study, it is an important issue that how to use the online and offline hybrid teaching empowered by digital intelligence in programming courses to cultivate students’ programming capacity and innovative thinking.

3.1. Reform Content

Focusing on cross-school study empowered by digital intelligence, a specialized cultivation system will be established to develop students’ programming skills and computational thinking. The system explores the application scenarios using generative AI technology to assess programming abilities and thinking by constructing a shared intelligent learning space, where the theoretical and practical teaching activities are restructured, and the relevant teaching resources are developed.

3.2. Reform Objectives

The teaching reform of computer programming in cross-school study aims to utilize generative AI technology to enhance the cultivation quality and level of programming skills and computational thinking. A new hybrid teaching model will be proposed based on intelligent learning spaces to improve the quality of the curriculum system, innovate the teaching mode, consummate the standard for credit recognition and evaluation; and enhance students’ comprehensive abilities.

3.3. Key Problems to Be Addressed

This paper addresses the main problems existing in the current cross-school study of computer programming in colleges and universities, and proposes innovative solutions empowered by digital intelligence, mainly including:

- **Course design for cultivating programming skills and thinking.** Based on the principle of leading with ideas, a novel course framework will be constructed for programming ability and thinking cultivation, which carries out the corresponding reforms in teaching contents and methods, and completes a brand-new design of teaching activities and resource development.
- **Assessment system for students’ ability and thinking based on generative AI.** Making full use of the excellent achievements of generative AI in code generation and code analysis, an assessment system will be established for students’ programming abilities and thinking. It specifically includes the normalization of evaluation indicators and assessment strategies using LLMs, as well as the design of relevant AI prompts.
- **Construction of a cross-school smart learning space.** Leveraging AI agentic tools, an interactive personalized learning space will be built to realize resource co-creation and mutual learning for teachers and students from different schools and universities.

4. The Implementation of the Cross-school Study Modal

The current curriculum system of programming course has been established based on constructivist thinking, which core resources and practical units are built on the online open platform around knowledge points. Therefore, the curriculum reform led by the concept of digital intelligence need to be systematically reshaped from concept to action, from content to model. The reform focuses on the cultivation of students' abilities and thinking, which requires reconstructing the corresponding teaching contents, teaching practices, assessment system and cross-school smart learning space.

(1) In course content, a transformation is realized from accumulation of knowledge modules to reverse task driven teaching. Programming skills are reflected in the ability to design programs to solve problems, and the level of thinking determines the height of the ability. We break away from the traditional course organization method based on algorithm categories and creatively adopt the content construction logic of reverse task-driven teaching. Through systematic analysis on typical programming tasks, we reversely comb and organically integrate the required programming algorithms, collating isolated knowledge points into a knowledge chain that serves a unified task. Thus, a course content system is established at the source of teaching that aligns with the "thinking-action" closed loop of artificial intelligence, and achieve students' cultivation for innovative thinking and abilities centred on tasks.

(2) In teaching practice, an experimental framework should be constructed following "question → discussion → reflection → generalization". A teacher sets practices that go beyond the existing knowledge points in the manner of a "question" and encourages students to explore independently. Then, through joint "discussion" with the teacher, students learn from previous achievements and discover new solution ideas for experiments. Finally, by introducing "reflection" and "generalization", the teacher guides students to deepen their understanding of concepts such as algorithm robustness and system model in the process of solving real engineering problems, to achieve the advancement of practical teaching from experimental verification to exploration and innovation.

(3) In ability evaluation, generative AI technology is introduced to assess students' abilities and thinking. The code generation and code analysis capabilities of current mainstream generative AI products, such as DouBao, DeepSeek, and Qianwen, are already sufficient to meet the basic demands of programming courses. In this instance, generative AI technology is applied into the student ability and thinking assessment system to establish a unified evaluation standard for course teaching. In order to convert the code analysis results into the quantitative standards for ability evaluation, we use prompt engineering to build a prompt word lexicon for programming ability assessment, guiding generative AI products to output reasonable ability and thinking assessment results.

(4) In teaching collaboration, a cross-school intelligent learning space is established to realize resource cocreation and mutual learning. The existing cross-school study platforms provide a simple shared space for teaching and learning. Teachers can manage their courses and related resources, while students can independently complete tasks such as watching teaching videos, completing after-class assignments, and taking online tests assigned by the teachers. However, there is short of resource collaboration among teachers and effective interaction among students, especially among cross-school teachers and students. Therefore, we are going to build an interactive personalized teaching environment based on big data, using the intelligent agent technology in generative AI to construct a human-computer interactive platform, a real cross-school intelligent learning space that integrates co-creation of learning resource, sharing of learning activities, and standardization of ability evaluation.

Table 1 summarizes the differences in the methods implemented in various aspects before and after the reform of the cross-school study teaching model.

Table 1: The differences in the implementation methods before and after the teaching reform

Aspects	Before the reform	After the reform
Course content	Knowledge module accumulation	Reverse task-driven teaching
Teaching practice	Code implementation	Question → discussion → reflection → generalization
Evaluation system	Evaluate students' coding outcomes by teachers	Assess students' abilities and thinking using generative AI
Teaching collaboration	A simple shared space for teaching and learning	A shared intelligent learning space for resource co-creation and mutual learning

5. Conclusions

In the construction of the cross-school computer programming courses, we have accumulated rich experience in teaching methods and practice through constant exploration. This paper analyzes the application of AI-powered education in the cross-school study model and researches the teaching model of computer programming courses empowered by digital intelligence. It establishes a students' ability cultivation system, reforms the teaching model, reconstructs teaching activities and teaching resources base on generative AI technology. At the same time, an intelligent learning space is built as a novel teaching collaborative platform to improve teaching quality and level in the cross-school study.

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