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Research on Human-Computer Collaboration Paradigm in AIGC-Empowered High-Level Language Programming Courses

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Abstract: With the rapid development of artificial intelligence technology, AIGC (Artificial Intelligence-Generated Content) has triggered profound changes in the field of high-level language programming courses. This paper deeply explored the application principles, advantages, and limitations of AIGC in intelligent code generation, analyzed the new mode of human-computer collaboration in high-level language programming courses driven by AIGC, discussed the impact of human-computer collaboration on programming efficiency and code quality through practical case studies, and looks forward to future development trends. This research aims to provide theoretical and practical guidance for high-level language programming courses and promote innovative development of high-level language programming courses under the human-computer collaboration paradigm.

Keywords: Human-computer collaboration; AIGC; High-level language programming; Intelligence programming; Efficiency improvement

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1. Introduction

Under the wave of digital transformation, high-level language programming courses, as discipline requirement courses for students majoring in computer-related fields, have increasingly high requirements for efficiency and quality. In traditional courses, students have weak self-learning abilities and limited teacher resources, so traditional programming teaching is time-consuming and laborious, and is easily limited by students' programming experience and skills. Many researchers [1–3] have proposed reform methods and measures for their respective courses, but the course effectiveness still cannot meet the ideal requirements. As a result, AIGC (Artificial Intelligence-Generated Content) technology [4,5] has emerged, bringing new breakthroughs to support the development of university courses [6] and attracting widespread attention from the industry. For example, research [7,8] has provided methods for AI to assist university courses and improve teaching quality. Based on the above research inspiration, it holds great significance to study the AIGC-empowered intelligent code generation

and human-computer collaboration paradigm for high-level language programming courses, in order to improve programming efficiency, promote students' learning skills, and upgrade traditional courses.

2. Current status of high-level language programming courses

2.1. Course introduction

The high-level language programming course is a discipline requirement course for undergraduate students majoring in computer and information-related fields. This course relies on the C language for computer science initiation education, initially cultivates students' computational thinking ability, trains the basic methods and skills of program design, enables students to write programs to solve simple practical problems, and lays a solid foundation for solving complex engineering problems. While imparting knowledge, this course also trains students' hands-on ability, develops the ability to analyze and solve engineering problems, and emphasizes the cultivation of abilities and the development of individuality. The teaching contents are mainly covered by the following aspects: C language basic grammar, three basic program control structures, data organization structure, function, program organization structure, modular program design ideas and methods, first understanding of computer algorithms, and basic debugging skills of programs.

2.2. Existing problems

The summary of the current problems in high-level language programming courses is as follows:

(1) Single teaching mode: In the past, high-level language programming classes mainly relied on teachers teaching knowledge points and students passively receiving learning knowledge points, supplemented by computer practice. This approach can easily make students feel tired of learning, and ultimately only learn paper skills without improving their hands-on abilities, resulting in students with "high scores but low abilities."

(2) Weak self-learning ability of students: At present, most high-level language programming courses adopt a teaching mode of lecture-based and computer-based teaching, transmitting knowledge to students through classroom indoctrination, which results in a lack of improvement in students' self-learning ability. At the same time, in the specific process of computer programming, each student has various small problems and errors. Due to the large number of students and the limited time and energy of teachers, computer tutoring often cannot provide timely one-on-one answers to problems, leading to students easily feeling frustrated and losing interest in the course learning.

(3) Simplified assessment and evaluation: At present, high-level language programming courses mainly focus on programming in terms of question types, with a small number of questions and a high proportion of scores for each question. Therefore, one assessment is not sufficient to measure students' learning ability, algorithm ability, engineering ability, etc.

3. Overview of AIGC technology

3.1. Definition and principles of AIGC

AIGC refers to Artificial Intelligence-Generated Content, which is based on deep learning generation models such as GPT and Codex, etc. By learning large amounts of text, code, and other data, AIGC captures patterns and features and generates new content based on input prompts or requirements. In code generation, after learning the code structure, syntax, and algorithms, the model can output corresponding code according to user

needs.

3.2. AIGC's advantages in assisting courses

The high-level language programming intelligent course empowered by AIGC can integrate emerging technologies such as artificial intelligence and big data, explore deep hybrid learning modes and continuous optimization and iteration methods of intelligent courses empowered by artificial intelligence, explore the application of artificial intelligence technology in course teaching, explore the method of transforming teaching mode from "teacher-student interaction" to "teacher-student-computer deep interaction," and ultimately achieve efficient utilization of teaching resources, personalized learning experience for students, and high-quality teaching for teachers.

With the assistance of AIGC, it has the following advantages:

(1) AIGC can quickly generate a large amount of code, shorten the development cycle, produce high-quality code, follow standards and best practices, have good readability and maintainability, and can implement complex functions, helping students overcome skill limitations.

(2) On the basis of AIGC empowerment, a hybrid innovative teaching mode of "online self-learning + offline classroom interaction" can be easily formed. Teachers integrate and prepare materials through AI assistants, while students preview and learn independently from online resources through AI assistants. Based on each student's own situation, personalized AI learning support can be developed. At the same time, case analysis, group discussions, and programming practices can be combined with offline classroom to improve teaching effectiveness and learning efficiency.

3.3. Limitations of AIGC

Despite its obvious advantages, AIGC still has shortcomings, such as the possibility of logical errors in generated code that require manual inspection; Possible deviation in understanding complex requirements; Model training relies on a large amount of data, the quality and quantity of which affect the generation effect, and the model itself has high energy consumption and cost, etc.

4. Human-computer collaboration paradigm of high-level language programming courses empowered by AIGC

4.1. Construction of human-computer collaboration mode

The human-computer collaboration paradigm is based on AIGC tools as the machine foundation, combined with developer intelligence. Developers input requirements, AIGC generates a preliminary code draft, developers analyze and modify it, and use their creativity and domain knowledge to optimize the code. The collaborative process requires a good interaction mechanism, such as natural language processing for smooth communication between humans and computers, and version control systems for managing code iteration.

(1) The advantages of human-computer collaboration: Human-computer collaboration combines machine efficiency and human intelligence to improve programming efficiency, ensure code quality, promote knowledge sharing and innovation, and drive the development of programming.

(2) The challenge of human-computer collaboration: In collaboration, there are issues such as differences in understanding, vague definition of responsibilities, and excessive reliance on computers. It is necessary to balance the roles of humans and computers and optimize the collaboration mechanism.

4.2. Practical application of human-computer collaboration

Under the empowerment of AIGC, the high-level language programming course can achieve the following capacities:

(1) Intelligent lesson preparation: Using AI assistants such as KIMI, DeepSeek, ChatGPT, etc., automatically generate teaching plans, courseware, exercises, and other teaching resources based on teaching objectives, existing teaching materials, and student situations.

(2) Intelligent tutor: In programming education, AIGC can generate example code, explain knowledge points, correct homework, assist teachers in teaching, and enhance students' practical abilities. At the same time, teachers can train AI teaching assistants to provide real-time answers to students' questions, offer learning advice and guidance, perform automatic code evaluation and code correction functions, and reduce the burden on teachers.

(3) Intelligent code function: AIGC tools such as GitHub Copilot can complete code in real-time, improve input efficiency, and automatically fix syntax errors to ensure code standardization. At the same time, AIGC tools can automatically generate code frameworks and complete programs based on functional requirements, optimize existing code, and improve performance and readability.

(4) Intelligent learning path planning: Based on the different foundations and learning needs of each student, develop personalized learning paths, provide targeted learning resources and guidance, and help students learn more effectively.

(5) Intelligent homework system: Based on an intelligent homework system, it can monitor students' learning progress and situation at any time, automatically evaluate and assist in correcting homework codes in real time, provide personalized learning advice and guidance for students, and timely solve problems encountered by students in the learning process.

4.3. Impact of human-computer collaboration

Through preliminary practice of human-computer interaction, it has been proven that various impacts can be improved as follows:

(1) Teaching efficiency improvement: By optimizing teaching through AIGC technology, teaching efficiency has been significantly improved. For example, preliminary teaching data shows that students' mastery of knowledge points has increased by about 30% compared to traditional teaching, and classroom interaction and fun have also been enhanced.

(2) Learning outcomes improvement: With the assistance of AIGC, the average score of students' programming ability has been improved to a certain extent, and the conversion rate of high-risk warning students has also been improved, fully reflecting the advantages of AIGC in improving teaching quality.

(3) Programming efficiency improvement: Through preliminary practice, compare traditional manual programming, pure AIGC programming, and human-computer collaborative programming. The results show that the human-computer collaboration group has the highest efficiency and significantly reduces development time, which proves its advantage in improving programming efficiency.

(4) Code quality assurance: Preliminary practical results show that collaborative group code quality is also better, with lower error rates, good readability and maintainability, reflecting the effectiveness of human-computer collaboration in ensuring code quality.

5. Conclusion

The new paradigm of human-computer collaboration in AIGC-empowered high-level language programming, integrating machine efficiency and human intelligence, can improve programming efficiency and teaching quality, cultivate students' independent learning and thinking abilities, and has broad application prospects. In the future, we need to continue exploring collaborative mechanisms, overcome technical challenges, ensure the steady development of AIGC, and help steadily improve the effectiveness of curriculum education.

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Author contributions

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