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Leveraging LLM in Blended Learning: An AI+HI Teaching Approach for Procedural Programming

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Abstract

As a professional core course of computer science majors in universities, the main content of procedural programming mainly involves data representation methods, data input and output interaction methods, process control methods, data structure representation, modular design thinking, etc., revealing the basic ideas and general principles of program design. In the teaching process of the course, there are generally problems such as monotonous teaching resources, lack of engineering application scenario design, and insufficient application of modern artificial intelligence tools. In response to these problems, this course proposes an AI+HI teaching path based on online and offline blending and LLM: enriching online and offline hybrid teaching resources, strengthening the creation of common engineering application scenarios, enhancing the application of artificial intelligence tools to achieve AI+HI integration which use LLM, and creating a three-dimensional classroom of theory, practice, ideology and politics. Through reform, the course has won the provincial quality engineering project and the school-level high-quality course project, and the course group teachers have won various course honors, led students to participate in subject competitions and won many provincial awards.

Keywords

Online and offline blending teaching; AI+HI; LLM.

1. Introduction

The procedural programming course is an important professional course for computer students. The basic concepts, basic theories, and basic methods taught in this course are an important part of students' scientific literacy in programming. This course systematically lays the necessary foundation for students' programming, cultivates students to establish a scientific world view, enhances students' ability to analyze and solve problems, and cultivates students' spirit of exploration and awareness of reform. Through this course, students can master the methods and basic knowledge of process programming, improve students' practical ability, and lay a good foundation for their future study and work in related fields. For procedural programming courses, using C language as the programming language, different reform paths are proposed for course researchers: the design of the "backgammon mini-game" project is used to improve the teaching effect [1], the teaching design is carried out with flipped classrooms [2], and the teaching design is integrated with OBE and PBL [3]. As the code generation capabilities of LLM also affect the teaching of programming courses, scholars have proposed different approaches in this context: a three-stage teaching model [4], empowering all aspects of courses with LLM [5], a new teaching paradigm for natural language-oriented development under the background of LLM [6], and Doubao-assisted lesson plan design [7]. In addition, in the context of AI development, scholars have also introduced teaching with the help of knowledge graphs: knowledge graph + AI teaching design [8], Graph database visualization

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scheme of the knowledge graph of course knowledge points [9]. Scholars in non-computer-related programming courses have also been exploring, such as the teaching of non-computer programming courses based on the concept of OBE has achieved good results [10]. In terms of curriculum ideological and political design, scholars have also explored such as the OBE-BOPPS hybrid curriculum ideological and political teaching model [11]. This study is based on the procedural programming course, since the course has been taught, Cheng has continuously improved and established various online and offline course resources, gradually deepened the use of AI artificial intelligence tools, continuously strengthened the creation of curriculum engineering application scenarios, continued to enrich the construction of curriculum ideological and political resource library, successively applied for various course projects at all levels, and successively participated in various course competitions at all levels, and achieved certain results, and the overall feedback from students was good.

2. Problems in Curriculum Teaching

In the traditional teaching process of procedural programming courses, there are generally the following pain points.

(1) Teaching resources are relatively monotonous. Teaching resources are relatively monotonous, the courses are mainly taught by offline teachers, and there is a lack of corresponding online resources, so students cannot cross the limitations of time and space, and can only obtain knowledge through classroom time.

(2) Lack of engineering application scenario design. The course mainly focuses on some example questions designed around the knowledge point itself, and students can only forcibly memorize a lot of knowledge and do not know what real applications of knowledge are in practice.

(3) The application of modern artificial intelligence tools is insufficient. The course teaches only traditional development tools, such as CodeBlocks, Dev-C++, etc., and it is difficult to integrate more auxiliary programming tools into the integrated development environment IDE, such as Coplilot.

3. Curriculum Teaching Reform Path

In view of several pain points in course teaching, this course reform proposes a hybrid online and offline AI+HI three-dimensional classroom teaching path: enriching online and offline hybrid teaching resources, strengthening the creation of common engineering application scenarios, enhancing the application of artificial intelligence tools to realize AI+HI integration, and creating a three-dimensional classroom of theory, practice, ideology and politics. The overall idea of the curriculum teaching reform path is shown in Figure 1.

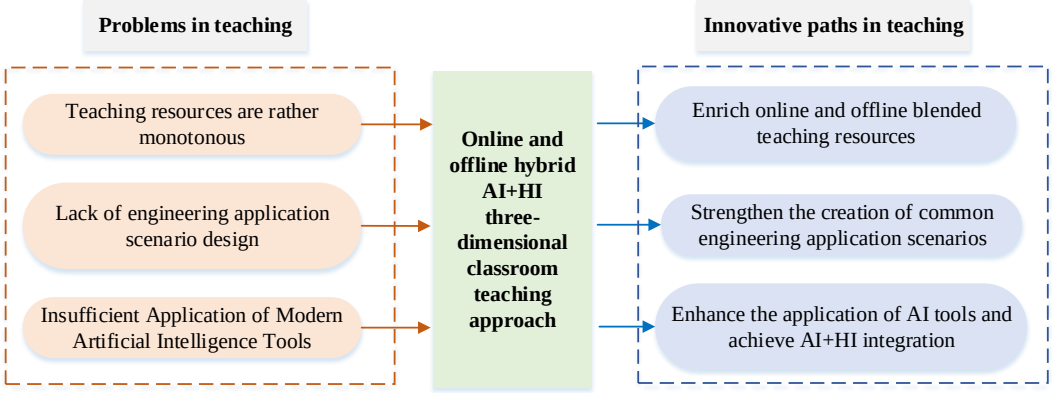

Figure 1. The overall idea of the curriculum teaching reform path

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3.1. Enrich Online and Offline Hybrid Teaching Resources

This course is designed with a mix of online and offline teaching resources around the student-center. Online mainly focuses on the chapter knowledge points of the course, and builds resources such as course videos, PPT, homework databases, experiment data bases, ideological and political databases, and summary brain databases. In the process of offline teaching, combined with the help of online resources, mainly focusing on the main content of the course for procedural programming, classroom teaching, designing relevant code cases of the course, analyzing the knowledge points, and allowing students to discuss and communicate with actual application occasions, raise questions, and discuss and solve problems together. Through online and offline hybrid teaching, the teaching objectives of the course are achieved, and the resources are shown in Figure 2.

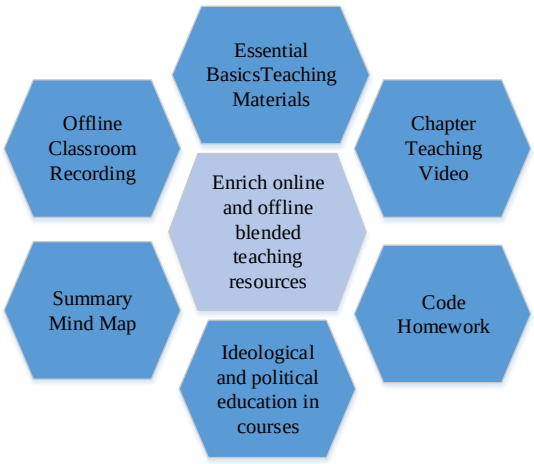

Figure 2. Enrich online and offline blended teaching resources

3.1.1. List of Online and Offline Teaching Resources for Courses

The course adopts online and offline hybrid teaching, and a wealth of resources are prepared for students to learn, and the list of resource reserves is shown in Table 1.

Table 1. Online and offline teaching resources of the course

Classifications	Contents
Basic essential teaching materials	Course outline, course lesson plan, course teaching schedule, course assessment form, teaching courseware PPT, chapter exercises
Chapter instructional videos, assignments, code, and other resources	Chapter knowledge point teaching videos, homework library, experimental question bank, test paper library, software teaching tutorials, textbook supporting theoretical lesson example code resources, extracurricular supplementary example code resources, course activity library
Classroom records, course ideology and politics, and summary brain map resources	Classroom recording video resources, course ideological and political resource library, summary brain map

3.1.2. Curriculum Ideological And Political Implementation Plan

The all-round content of the curriculum ideological and political is always developed and penetrated around the course theme and important and difficult content, which allows students to feel the invisible power of ideology and politics at the same time, and can also closely focus on the core content of the course to expand their knowledge and cognition. In a silent way, guide students to form an overall knowledge system, establish national self-confidence, improve their own ability, apply knowledge reasonably and correctly, and contribute to the great

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rejuvenation of the Chinese nation. The correspondence between curriculum ideological and political design and chapters is shown in Figure 3.

Implementation Plan for Ideological and Political Education in Courses	
Chapter 1 Introduction to Programming Fundamentals	The binary system in the 'Zhou Yi' is initially explained through the classic books of our traditional culture, cultivating students' national spirit of confidence and self-reliance, and enhancing national pride and self-confidence.
Chapter 2: Variables, Operators, and Expressions	Create a spinning TaiJi diagram to cultivate students' self-confidence and resilient national spirit, enhancing their sense of national pride and confidence.
Chapter 3 Keyboard Input and Screen Output	Yang Hui, a mathematician of the Southern Song Dynasty, cultivated students' national spirit of confidence and self-reliance, enhancing their national pride and self-confidence. Throughout subsequent chapters, multiple solutions to a single problem are explored, promoting dialectical thinking and deepening the depth of problem-solving.
Chapter 4 Control Structures of Programs	The 'Individual Income Tax Law of the People's Republic of China' stipulates the importance of seven special additional deductions: reducing the tax burden, reflecting social fairness and reasonableness, and promoting harmonious social development.
Chapter 5 Functions	Using the coding environment setup mechanism of VSCode Copilot to guide students in understanding the teamwork spirit of integrating different functions in a program.
Chapter 6 Arrays	The array implementation of Pascal's Triangle cultivates students' spirit of self-confidence and self-reliance, enhancing national pride and self-assurance.
Chapter 7 Pointers	Chinese character rain, through the animation and color transitions of Chinese characters, cultivates students' confident and resilient national spirit, enhances national pride and self-confidence, and allows them to appreciate the beauty of Chinese character art.
Chapter 8 Structures	Drawing the periodic table to strengthen interdisciplinary integration can help understand the ways computers are applied in the field of chemistry and appreciate the charm of programming.

Figure 3. Correspondence between curriculum ideological and political design and chapters

3.2. Strengthen the Creation of Common Engineering Application Scenarios

The course strengthens the creation of common engineering application scenarios, introduces real-life engineering technology into the classroom, and introduces the core implementation methods. Integrate and explain the classroom discussion in the teaching of the corresponding chapter. The corresponding table of engineering application scenario creation and chapter is shown in Figure 4.

The creation of common engineering application scenarios mainly includes the color block sorting of industrial robots; shift operation in marquees; The browser input box accepts the application of user input and corresponding input and output functions; DNA molecular double helix structure, creating dialogue scenarios, introducing selection structures; the call of functions in the electronic music box program; Function calls in cryptographic encoding programs for Confidential Computing micro-diploma; one-dimensional array application in electronic music box program; Application of pointer in lane line detection; User information in WeChat can be implemented through struct code, etc. In the teaching process, through the creation of scenarios, the method of asking questions is proposed, and students are guided to think, ask questions and solve problems based on existing knowledge. In the future, it will continue to be enriched and improved to guide students to start from practical application and think positively.

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Strengthen the creation of common engineering application scenarios	
Chapter 1 Introduction to Programming Fundamentals	Color block sorting by industrial robots
Chapter 2: Variables, Operators, and Expressions	Shift operations in the marquee, where software and hardware are integrated
Chapter 3 Keyboard Input and Screen Output	The browser input box accepts user input and the application of corresponding input and output functions
Chapter 4 Control Structures of Programs	The double helix structure of DNA molecules, creating a dialogue scenario to introduce the selected structure.
Chapter 5 Functions	Function calls in electronic music box programs; cryptographic program function calls in confidential computing
Chapter 6 Arrays	Application of One-Dimensional Arrays in Electronic Music Box Programs
Chapter 7 Pointers	The Application of Pointers in Lane Line Detection
Chapter 8 Structures	User information in WeChat can be implemented through struct code.

Figure 4. Corresponding table of engineering application scenario creation and chapter

3.3. Enhance the Application of Artificial Intelligence Tools and Realize the Integration of AI+HI

Influenced by AI technology, the teaching method of AI + HI integration, artificial intelligence + human intelligence, is proposed. As a programming language course, since the development of ChatGPT in 2020, it has been impacted by various LLM frameworks and tools that can be converted into programming language(PL) according to human natural language (NL), that is, NL2PL technology. This poses a great challenge to traditional programming language teaching. In the context of the rapid development of AI technology, peers have conducted extensive discussions and in-depth thinking on programming courses, and have opened a series of online and offline teaching and research activities. The overall creation idea of enhancing the application of artificial intelligence tools and realizing AI+HI integration is shown in Figure 5.

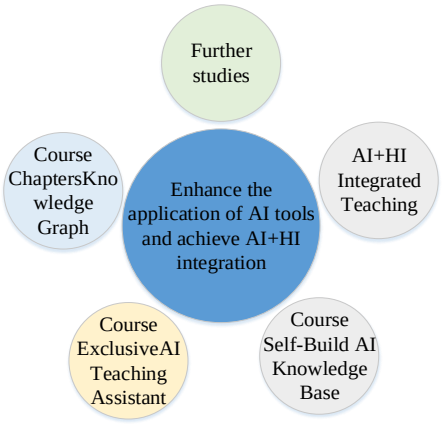

Figure 5. Ideas for enhancing the application of artificial intelligence tools and realizing AI+HI integration

3.3.1. Further Studies

Continuing education provides a theoretical basis for the curriculum design method of AI and HI integration, and also learns from other teachers the teaching design method of computer programming courses in the AI era. In order to adapt to the teaching of programming courses in the AI era, he participated in various seminars: during the continuing education project, he participated in the seminar on "digital intelligent teaching", intelligent learning companions in

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the whole process of intelligent teaching empowered by artificial intelligence, one-on-one tutoring, digital virtual teachers and other personalized learning experiences, and a new hybrid teaching model based on IMOOC virtual and real integration and cross-domain collaboration.

3.3.2. AI+HI Integrated Teaching

With the rapid development of LLM, their functions can realize the conversion of NL to PL, just like language translation between different countries, and the resulting programs are operable. In the course teaching process, students are taught how to use modern AI tools in a variety of ways to assist students in learning and do a good job of ideological guidance. In addition, HI is realized through offline teacher teaching, online and offline homework tutoring, and student communication and discussion. Thus, the integration of AI+HI is realized and the teaching effect of the course is improved. The following is an example of VSCode+Copilot.

VSCode is an integrated development environment that adapts to multiple programming languages, and can add a variety of dependencies to extend the development functions of the platform, and Copilot is one of the extension functions to achieve auxiliary programming. In view of this, this course uses the VSCode+Copilot solution to teach, practice and complete course experiments. After implementing the code of basic program functions with VSCode, the program is checked, optimized, and replaced again through Copilot. Colpilot supports LLM bases generated by multiple programming languages, such as Claude Sonnet, Gemini, GPT-4o, o3-mini, etc., which can be selected by yourself, and the generated code is different, but it has the required code checking, code troubleshooting, code optimization, code generation and other functions. For students, it is equivalent to having a silent professional companion teacher, who can learn anytime and anywhere.

Although the rapid development of AI technology has had an impact on the teaching of programming courses, the role of human teachers is still irreplaceable by AI. In the different teaching environments of offline teaching and online platforms, teachers and students are still the main participants in the curriculum, and the mutual communication and communication between human beings can promote the learning of knowledge. The HI described in the reform of this course is human intelligence, which is mainly in the traditional teaching process, on the basis of offline teaching by teachers, offline tutoring and Q&A, and students' offline learning and exchange, and adding online Q&A and online discussion of students on the learning platform. Teachers and students maintain communication and solve problems in learning together.

3.3.3. The Course Builds Its Own AI Knowledge Base

With the advantages of the Learning Pass platform, combined with the file resources of different formats such as word, pdf and txt in the course resources, an exclusive knowledge base for the course has been created. Based on this knowledge base, it can provide rich course expertise to subsequent course-specific AI teaching assistants, which is highly compatible with the course and can help students better absorb the knowledge of the course in the process of using AI teaching assistants. The knowledge of the knowledge base is the core knowledge point and expansion knowledge point of the course, and the correctness and professionalism are higher than that of the general LLM, which is conducive to the cultivation of students' professional quality.

3.3.4. Exclusive AI Teaching Assistant for the Course

The content of the AI teaching assistant's answers mainly comes from the content of the course resources set in the early stage to ensure the accuracy of the content, avoid the hallucination problem of LLM to a certain extent, and improve the correctness and professionalism of the AI teaching assistant's answers. During use, if students ask questions that are not content in the knowledge base, the AI assistant will answer accordingly based on their own LLM base.

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3.3.5. Knowledge Graph of Course Chapters

Combined with the creation, production and accumulation of all chapter resources of the previous course, with the help of the Learning Pass platform function. The knowledge graph lists the core knowledge points in each chapter in detail, which helps students form a stronger memory of the entire course. At the same time, it can also allow students to better grasp the practice between knowledge points. The knowledge graph image is specific, which is more convenient for students to learn.

4. The Effectiveness of Curriculum Teaching Reform

At present, for the procedural programming course, a wealth of curriculum resources have been built for students to use, and the results of teaching reform related to various courses at all levels have been achieved, which has been well received by teachers and students, and has been promoted to a certain extent in the school.

Relying on the curriculum construction, a number of projects at all levels and types have been declared, and phased results have been achieved. Including provincial quality engineering projects, online and offline hybrid courses, procedural programming; school-level quality engineering projects, computational science and AI teaching teams, etc. Relying on the course content, the teachers of the course group led the students to participate in the "Blue Bridge Cup" competition and won the provincial award in the C/C++ Programming University Group B subject competition.

The procedural programming course strengthens students' programming ability and scientific thinking ability, and combines theory and practice. Through teaching exploration, a relatively complete set of curriculum resources has been formed and a relatively complete curriculum system has been built. In the teaching process, it is constantly integrated into practical scenarios of social and engineering applications, and students are guided to actively explore the application of relevant knowledge in real life. In addition, the curriculum also continues to explore the ideological and political elements of the curriculum, and guides students to form a sense of self-reliance and self-improvement, the spirit of courage to explore the world, and establish a firm ideal of serving the motherland in a silent way. Overall, the curriculum was unanimously recognized by students and peers.

5. Conclusion

The teaching reform of this course mainly responds to the three common pain points in the traditional teaching process of procedural programming courses: the monotony of teaching resources, the lack of engineering application scenario design, and the insufficient application of modern artificial intelligence tools , ideological and political three-dimensional classroom, and has achieved certain results and results. The course uses LLM to improve teaching process.

In the future, through the creation of curriculum resources, the declaration and development of projects, and the interaction and communication between students and teachers, the reform path of the curriculum will be continuously improved, the program design of engineering application scenarios will be further enriched, and the curriculum design and summary and refinement will be done well, so that the curriculum can play a better role in promotion and demonstration.

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