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Application and Practice of Intelligent Learning Assistant in Python Programming Course

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Abstract: Artificial Intelligence enhanced teaching has become an important content of teaching reform and innovation with the wide application of AI in the field of education and enabling digital education. This paper takes the application and practice of intelligent learning assistant in Python Programming Course in Higher Vocational Colleges as an example, and discusses the core functions of intelligent learning assistant and the teaching mode of Python Programming Course Based on intelligent learning assistant, aim to effectively improve students' learning efficiency and interest. At the same time, it provides teachers with more flexible teaching tools and resource management methods, and provides new ideas for the development of Higher Vocational Education in the era of artificial intelligence technology.

Keywords: Artificial Intelligence; Intelligent learning assistant; Python programming course

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1. Introduction

As the core driving force of new-generation technology, Artificial Intelligence (AI) plays a pivotal role in catalyzing industrial transformation. Not only recognized as a critical engine for fostering new-quality productive forces, AI applications have expanded across diverse domains: intelligent healthcare, digital education, smart cities, intelligent security, and smart living— demonstrating vast developmental prospects and significant market potential. The Third Plenary Session of the 20th Central Committee of the Communist Party of China emphasized deepening the integration of the real economy with digital technologies and refining policy support systems and regulatory frameworks for emerging industries represented by AI. The 2024 Government Work Report introduced the concept of "AI+" for the first time, stressing the need to deepen AI applications through an AI+ Action Plan [1]. Additionally, the 2024 World Digital Education Conference highlighted AI's transformative role in shaping, expanding, and redefining cognitive paradigms—profoundly influencing education by reshaping knowledge production/distribution methods, significantly enhancing knowledge acquisition tools/techniques/efficiency/quality, and enabling seamless virtual interpersonal interactions [2]. In future education and teaching contexts, AI will profoundly impact both instructors and learners through innovative pedagogical approaches and content design. Students will engage in real-time interaction and collaborative exchange with virtual tutors to achieve personalized learning experiences.

The Python programming language course in vocational colleges serves as a core subject for computer-related majors,

vital for cultivating students' computational thinking, algorithmic thinking, and systematic reasoning. Its curriculum integrates theoretical knowledge with practical application, emphasizing hands-on problem-solving. Through this course, students gain deep mastery of Python fundamentals and core programming concepts, significantly improving coding proficiency and software development competencies. While learners typically use Integrated Development Environments (IDEs) to practice coding and meet learning objectives, they frequently encounter challenges—most notably syntax errors causing program failures. Due to resource/time constraints, instructors often struggle to address every student query promptly [3], which can stall progress and dampen enthusiasm. Moreover, some students merely copy teacher-provided code during exercises, lacking independent analysis and creativity [4].

The rapid evolution of AI technology has shifted the focus of education beyond mere knowledge acquisition. AI systems analyze vast datasets to identify and extract highly relevant information tailored to user needs—radically transforming traditional learning models. This technological leap compels educators to pivot from knowledge transmission toward nurturing critical thinking and innovation capabilities [5]. This paper explores an AI-enhanced teaching framework for vocational Python programming courses, exemplified through the implementation of an intelligent learning assistant. By leveraging such tools, we aim to improve student learning efficiency and engagement while providing instructors with more flexible pedagogical resources and management solutions.

2. Intelligent learning assistant

Intelligent assistants have brought revolutionary changes to the field of education by leveraging advanced large-model language technology. The core principle of the generative AI technology they use is that through the learning of massive amounts of data and model training, machines can understand the input contextual information and generate reasonable outputs [6]. Based on advanced artificial intelligence language models, intelligent assistants are driving profound innovations in education. The generative AI technology they employ, through the learning of massive data and the training of deep models, endows machines with the ability to understand contextual environments and generate high-quality responses. Various domestically independently developed artificial intelligence auxiliary tools cover multiple functions, including text summarization, information extraction, text classification, logical reasoning, and image generation, and are widely applied in many aspects of daily life and work environments. The intelligent learning assistant is an intelligent question-and-answer platform specifically designed for educational scenarios, aiming to improve teaching efficiency and interactive experience. The platform has two roles: teacher end and student end, each with functional permissions matching their responsibilities. Users need to complete registration and log in to the system before using various functions. Both teachers and students can create new questions and answers through human-computer interaction. In this process, based on the user's prompt input, the platform will automatically generate corresponding feedback results.

In the teaching reform of Python programming courses, the application of AI technology has significantly improved teaching effectiveness. Deng Hua's [7] research points out that AI technology can help teachers customize personalized learning materials, enhance students' enthusiasm and independent learning ability, and deeply discusses the educational practice of Python and artificial intelligence. Zhang Aihua [8] emphasizes that through artificial intelligence technology, Python programming teaching can realize an adaptive teaching model and improve students' practical ability and intelligent evaluation skills. Lu Jun [9] takes the Python programming course as an example to explore the specific application and practice of artificial intelligence technology in computer programming course teaching in higher vocational colleges. Ma Xiaona [10] has studied the key applications of AI teaching assistants in Python course teaching. The experimental results show that the intelligent learning assistant has a significant effect in cultivating students' problem-solving ability and provides intelligent tutoring services. By using this learning assistant, teachers can conduct learning situation analysis more efficiently, thereby being able to adjust and optimize teaching progress and strategies more targeted.

Through the introduction of intelligent learning assistants, the teaching of Python programming courses has achieved optimization and improvement in multiple aspects. It not only significantly optimizes the allocation of teaching resources

but also effectively improves teaching quality, and provides students with a richer and more efficient learning experience. With the continuous progress and in-depth application of artificial intelligence technology, higher vocational education will pay more attention to the in-depth integration of it with subject content, committed to cultivating more high-quality talents with innovative ability and practical skills to meet the needs of social development.

3. Design of core functions of intelligent learning assistant

By analyzing the problems encountered in the teaching of Python programming courses, the core functions of the intelligent learning assistant are designed as follows: learning guidance, programming guidance, programming inspection, and question answering.

3.1. Learning guidance

Learning guidance is a system function that formulates personalized learning plans and paths for students based on their learning interests, abilities, and needs. By in-depth analysis of students' learning data, it generates scientific and reasonable suggestions to help students optimize their learning plans. Its main functions include:

Knowledge Point Decomposition: According to the content that students want to learn, decompose it into a series of detailed knowledge points. These knowledge points will cover Python programming concepts from basic to advanced.

Interactive Teaching: For each knowledge point, provide detailed explanations, including concept explanations, syntax explanations, descriptions of characteristics and requirements, explanations of execution processes, etc. At the same time, provide links to explanatory videos corresponding to each knowledge point, so that students can deepen their understanding by watching the videos.

Quizzes and Feedback: After students learn each knowledge point, provide a series of quiz questions to test their learning effect. Students need to submit their answers, and immediate feedback will be given based on their answers. If the answer is correct, explain why it is correct; if the answer is wrong, analyze the reasons for the error and provide the correct answer. Repeat this process until the student fully understands and masters the knowledge point.

Personalized Learning Path: Adjust the difficulty of learning content and quiz questions according to students' learning progress and understanding level to ensure that students can improve step by step.

Learning Effect Evaluation: After students complete the study and quizzes of all knowledge points, give evaluations based on their performance and provide suggestions for subsequent learning.

3.2. Programming guidance

Programming guidance provides personalized learning suggestions and resource recommendations based on students' programming foundation, learning goals, and interest preferences. It not only helps students master programming knowledge but also improves their practical application ability through practical projects and code feedback. Its main functions include:

Demand Analysis: Understand students' programming needs, including the functions they want to implement, expected effects, and any specific requirements.

Plan Formulation: According to students' needs, formulate a detailed learning plan, including the knowledge points to be learned, the learning goals of each knowledge point, and the estimated learning time.

Knowledge Point Explanation: For each knowledge point, provide detailed explanations, including concept explanations, syntax explanations, descriptions of characteristics and requirements, explanations of execution processes, etc. At the same time, provide links to explanatory videos corresponding to each knowledge point, so that students can deepen their understanding by watching the videos.

Programming Practice: After students understand each knowledge point, guide them to carry out programming practice. Provide some programming exercises to help students consolidate the knowledge they have learned and solve

problems encountered in actual programming.

Code Review: After students complete the programming exercises, review their code, point out errors and areas for improvement, and provide improvement suggestions.

Feedback and Adjustment: Adjust the difficulty of learning content and exercises according to students' learning progress and understanding level to ensure that students can improve step by step.

Continuous Support: Provide continuous support throughout the learning process, answer students' questions, and help them solve programming problems.

Learning Effect Evaluation: After students complete the study and programming practice of all knowledge points, give evaluations based on their performance and provide suggestions for subsequent learning.

3.3. Programming inspection

Programming inspection aims to help students find syntax errors, logical problems, and optimization suggestions when writing code. By analyzing students' code, the intelligent learning assistant can provide immediate feedback, thereby improving coding efficiency and code quality. Its main functions include:

Code Submission: Students need to submit their written Python programs to the intelligent learning assistant. Students can provide code in text form or upload code files.

Code Review: The intelligent learning assistant conducts a detailed review of students' code.

Error Feedback: If errors or areas for improvement are found, provide specific error information and modification suggestions.

Code Optimization: According to the situation of students' code, provide some optimization suggestions to help students improve the performance and readability of the code.

Learning Suggestions: Based on the learning situation reflected in students' code, provide some learning suggestions to help students better master Python programming knowledge.

Continuous Support: Provide continuous support throughout the code inspection process, answer students' questions, and help them solve programming problems.

3.4. Question answering

The question answering function is an artificial intelligence-based technology that can understand and answer questions raised by users. It can not only provide factual information but also provide personalized explanations, guidance, or suggestions according to the context and user needs. Its main functions include:

User Questioning: Students need to ask questions about Python programming or related fields.

Question Analysis: The intelligent learning assistant will analyze students' questions to determine the core of the questions and the involved knowledge points.

Providing Answers: According to the nature of the question, provide detailed answers. If the question involves specific knowledge points, quote relevant content from Python Programming to answer.

Answer Verification: After providing the answer, verify it to ensure the accuracy and scientificity of the answer.

Feedback and Adjustment: If students have any questions about the answer or need further explanation, adjust according to their feedback and provide additional information or explanations.

Learning Suggestions: Based on students' questions and answers, provide some learning suggestions to help them better understand and master Python programming knowledge.

Continuous Support: Provide continuous support throughout the question answering process, answer students' questions, and help them solve programming problems.

4. Application of intelligent learning assistants in Python programming courses

The teaching content of the vocational college Python programming language course mainly consists of two modules: theoretical knowledge and practical operations. The theoretical knowledge part covers core knowledge points such as basic syntax of Python programming, data types and operators, flow control statements, functions and modular programming, common data structures (such as lists, tuples, dictionaries), exception handling mechanisms, and file operations. The practical operation part focuses on cultivating students' programming design ability, problem analysis and solving ability, and code debugging and maintenance skills through well-designed programming exercises, comprehensive project development, and training in the use of tool software. The teaching mode that combines theory and practice helps students fully grasp the characteristics of the Python language and its application methods.

In the teaching process of the "Python Programming" course, teachers systematically implement the task-driven teaching method and combine typical case analysis to guide students to complete various learning tasks. This method effectively stimulates students' initiative and innovative thinking, helping them master programming skills and improve problem-solving abilities in practice. In the classroom, teachers first create real learning situations and explain task requirements, then organize students to carry out practical operation training. During this process, teachers conduct demonstration and key explanations on the common error-prone problems of students, and guide students to summarize the learning process at the end of the teaching to deepen understanding and consolidate the knowledge learned. In the entire teaching process, teachers can make full use of the intelligent learning assistant as an auxiliary tool to carry out teaching activities. The intelligent learning assistant can provide a variety of support services for teachers and students according to actual needs, and can play an important role in pre-class preview, in-class teaching, practical operations, and after-class review. In the teaching process of "Python Programming", students first participate in classroom interactions and clarify learning goals, conduct logical analysis and independent thinking after deeply understanding the task requirements. Then, they complete code writing through practical operation, further debug and run the program, and finally obtain the expected output results.

With the help of the intelligent learning assistant, teachers can design questioning tasks related to the classroom theme and guide students to carry out human-computer interaction in the preset teaching scenarios. This teaching method aims to stimulate students' desire to explore and prompt them to achieve the expected learning goals through active thinking and problem inquiry. In the process of classroom learning, when students encounter learning difficulties, the intelligent learning assistant will provide professional guidance and rich learning resources in real time. These supports are intended to guide students to deeply understand the core of the problem and present them with diversified solutions to ensure that students can efficiently complete learning tasks and improve their overall learning efficiency.

By using the comprehensive learning situation analysis data and real-time feedback information provided by the intelligent programming assistant, teachers can gain an in-depth understanding of each student's learning progress, knowledge mastery, and potential problems.

Teachers can more accurately answer students' questions in the classroom by using the real-time feedback information from the intelligent learning assistant. Through in-depth analysis of the collected data, teachers can formulate more scientific and reasonable teaching suggestions, and adjust teaching strategies according to students' personalized needs, so as to achieve precise teaching according to students' aptitude.

5. Reflection on the application of intelligent learning assistants

Intelligent learning assistants have demonstrated significant advantages in programming teaching. They not only effectively improve teaching efficiency but also create a more personalized and flexible learning environment for students. Such assistants not only enhance classroom interactivity but also provide students with more challenging learning opportunities. With the help of intelligent learning assistants, students' autonomous learning ability has been significantly improved, and their innovative ability has also been obviously enhanced and developed. Students can independently complete complex

programming tasks and cultivate unique critical thinking and problem-solving skills. This progress enables them to achieve better results in the learning process. By using intelligent learning assistants, teachers can effectively manage classrooms and students, conduct precise teaching, thereby significantly improving teaching quality and overall learning effects.

The use of intelligent learning assistants has made the Python programming course more flexible and efficient in the teaching process. This innovation allows students not only to better grasp the core concepts of Python programming but also to significantly improve their practical operation ability, thus achieving higher learning outcomes and skill level improvement. At the same time, through in-depth analysis of the collected data, teachers can formulate more scientific and reasonable teaching suggestions and adjust teaching strategies according to students' personalized needs, so as to realize precise teaching tailored to individual students. Although artificial intelligence technology can significantly enhance teaching interactivity and personalized learning experience, it has a certain negative impact on students' ability of independent thinking and problem-solving. Some students tend to over-rely on intelligent learning assistants when using them, lacking active exploration of programming challenges, and only relying on their instant answers and code examples to complete tasks. Therefore, in future education and teaching, it is necessary to pay special attention to achieving a reasonable balance between the application of intelligent learning tools and the cultivation of students' autonomous learning ability. This balance lies not only in ensuring that artificial intelligence technology is not just a tool for solving problems but also regarded as a key driving force for promoting students' comprehensive development.

6. Conclusion

The application of intelligent learning assistants in teaching has effectively improved the quality of education, enhanced the interactivity between teachers and students, and significantly improved students' learning outcomes. However, it is worth noting that the relationship between intelligent learning assistants and teachers' teaching is not a simple substitution, but a complementary one. Therefore, while using intelligent tools to assist teaching, teachers should also pay special attention to cultivating students' independent learning ability to ensure the harmonious development of technology and humanistic education.

Disclosure statement

The author declares no conflict of interest.

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