The Exploration of the Path of Promoting the Reform of Embedded Software Practice Teaching by Generative Artificial Intelligence

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Abstract: With the rapid advancement of generative artificial intelligence (AI) technology, its applications in education have been expanding significantly, demonstrating tremendous potential in embedded software practical teaching. Traditional embedded teaching models face challenges such as slow content updates, insufficient hands-on practice, and low student engagement, which fail to meet the demands of information technology development. Generative AI can provide personalized learning experiences, intelligent programming assistance, and virtual experimental environments, thereby enhancing students practical skills and innovative capabilities. This paper explores methods for integrating generative AI into embedded software practical teaching, analyzes reform approaches in curriculum design, instructional methods, and evaluation systems, offering references for optimizing teaching model innovation.

***Keywords*:** generative artificial intelligence, embedded software, practical teaching, teaching reform

1. Introduction

With the rapid advancement of artificial intelligence technology, generative AI has seen increasingly widespread applications in education. As a crucial branch of computer science and technology, embedded software education faces challenges such as rapidly evolving content and practical demands. Traditional teaching methods struggle to meet students 'needs for real-world engineering skills. Generative AI can provide personalized learning resources, intelligent programming assistance, and virtual experimental environments, offering innovative approaches for reforming embedded software education. This paper explores application pathways of generative AI in practical teaching of embedded software, aiming to enhance instructional effectiveness and students' hands-on capabilities while driving innovation in educational models.

2. Overview of generative artificial intelligence technology

2.1 Basic principles of generative artificial intelligence

Generative artificial intelligence (AI) is an intelligent technology that learns from existing data to create new content. Its core lies in training models to understand data distribution patterns, enabling them to generate results that are both similar to and innovative compared to the original data. This process relies on deep learning frameworks, particularly neural network architectures, which learn from massive datasets to develop the ability to comprehend and reconstruct input information[1] Generative AI not only replicates data patterns but also demonstrates creative capabilities, producing outputs such as text, images, and audio. This technology has found extensive applications across natural language processing, computer vision, speech recognition, and related fields. With advancements in algorithms and computing power, generative AI is increasingly becoming a vital driver of innovation across industries.

2.2 Main algorithms of generative AI

Generative artificial intelligence relies on various algorithms for data generation and learning. Classic models like Generative Adversarial Networks (GANs) consist of generators and discriminators, where the interaction between these components enhances generative quality. Variational autoencoders (VAEs) employ probabilistic modeling to compress data into latent space before reconstruction for generation. Transformer-based models such as GPT and BERT excel in text generation, producing coherent and semantically rich content[2]These algorithms have their own characteristics and are suitable for different scenarios. In practical application, the appropriate algorithm should be selected according to specific tasks to achieve the best effect. With the deepening of research, new algorithms are emerging constantly, which expands the application boundary[3].

3. Exploring the path of promoting embedded software practice teaching by generative artificial intelligence

3.1 Exploring the path of generating artificial intelligence to promote embedded software practice teaching

A report from Tsinghua Universitys Embedded Systems course for the 2023-2024 academic year shows that the implementation of Codex-based generative AI has boosted students first-time experiment success rate from 68% to 91%, while reducing average iteration attempts from 4.8 to 2.2. Concurrently, a Ministry of Education industry-academia collaboration platform survey covering 36 universities (N=1, 124) revealed that teachers preparation time decreased by an average of 39%, with course satisfaction rates rising by 24 percentage points.Tracking the graduation project data of 427 students across two cohorts revealed that teams utilizing generative AI achieved a 34% reduction in code defect density and a 28% increase in functional completeness. These classroom-derived statistics and official metrics demonstrate how generative AI is transforming traditional "teacher-led, student-following" one-way instruction into a collaborative model of "AI co-coding and teacher-student co-research" through its closed-loop process of "instant feedback → iterative optimization → personalized coaching". This evolution has yielded verifiable and replicable improvements in teaching effectiveness[4].

3.2 The role of generative AI in the optimization of teaching resources

A 2024 October study by Hans Publishers on the "Data Analysis and Mining" course demonstrated that using three types of generative AI — Wenxin Yiyang, Gamma, and GitHub Copilot — could reduce teachers time spent preparing lesson plans, PPT, and demonstration code from an average of 12 hours to just 4.3 hours within 48 class hours. The accuracy rate of resource selection improved from 73% to 94%, while the first-time pass rate for student experiments increased by 19 percentage points.According to a June 2025 supplement by the WeChat public account "China Education Informatization", after using generative AI for real-time error correction and personalized exercise push, the median score of the class rose from 72 to 81, and the satisfaction of students with case code rose from 65% to 89%.

3.3 Application of Generative AI in personalized learning

A 2024 study in Educational Technology Research tracking 247 embedded systems students revealed that the experimental group using generative AI teaching assistants saw their average question count jump from 1.8 to 7.4 questions within two weeks, significantly higher than the control groups 2.1 questions. The platform uses conversational text and learning path data to build cognitive profiles, dynamically adjusting task difficulty: When students fail to compile a two consecutive times in RTOS tasks, the system immediately switches to bare-metal GPIO experiments with step-by-step visual guidance. If scores exceed 85, it automatically pushes STM32Cube.AI-based neural network deployment case studies .According to the questionnaire feedback, 89% of students believe that "the pace of learning is no longer kidnapped by the class average", the average extracurricular time increased from 3.2 hours to 5.7 hours per week, and the excellent rate of final projects increased by 18 percentage points[5].

3.4 Application of Generative AI in teaching evaluation and feedback

According to the formative evaluation report of Northwest Normal University in November 2024, after using generative AI to correct embedded experimental reports, the average time for teachers to review the papers was reduced from 38 minutes to 11 minutes, and the consistency K value of two scores for the same assignment was increased from 0.63 to 0.91. The system delivers three-tiered feedback through multimodal intelligence: The grammar-level analysis uses the Turnitin engine to flag errors, while the structure-level analysis employs ChatGPT to generate flowcharts with risk alerts. For strategic guidance, historical data provides links to exemplary code samples. Students can request a second round of explanations within 48 hours, with all interactions recorded in their personal profiles for personalized task recommendations. Notably, the experimental classs course failure rate dropped from 12.4% to 4.7% this semester, while 92% of students rated the feedback as "specific and actionable."

4. Conclusions

Generative AI provides innovative approaches and tools for reforming embedded software education. By offering intelligent teaching assistance, designing personalized learning paths, and creating virtual lab environments, it enhances both instructional efficiency and students practical skills. Leveraging its strengths in knowledge generation, code assistance, and problem-solving capabilities, this technology stimulates creative thinking while driving educational models toward smarter, more efficient development, laying a solid foundation for cultivating future talent.

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