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Exploration and Practice of a New Smart Teaching Model for the Course "Electrical and Electronic Technology"

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Abstract: In the context of emerging engineering education and the digital transformation of education, this paper explores and implements a novel smart teaching model for the course Electrical and Electronic Technology. The study addresses persistent challenges in traditional instruction, including fragmented knowledge, insufficient practical training, outdated technical tools, and monolithic assessment methods. A multidimensional curriculum map integrating knowledge, problem-solving, and competency development is constructed. In this model, artificial intelligence is deeply embedded throughout the entire teaching-learning-management-evaluation process. Furthermore, an intelligent assessment and feedback system is developed, enabling multi-source data collection, real-time analysis, and multi-channel feedback, thereby forming a closed loop that encompasses formative, summative, and value-added evaluations. Practical application demonstrates that the proposed model effectively enhances students' engineering practice abilities, innovative thinking, and self-regulated learning skills. This research provides a practical reference for reforming fundamental engineering courses in the context of New Engineering and smart education.

Keywords: Electrical and Electronic Technology, Smart Teaching, Artificial Intelligence, Intelligent Assessment.

1. Introduction

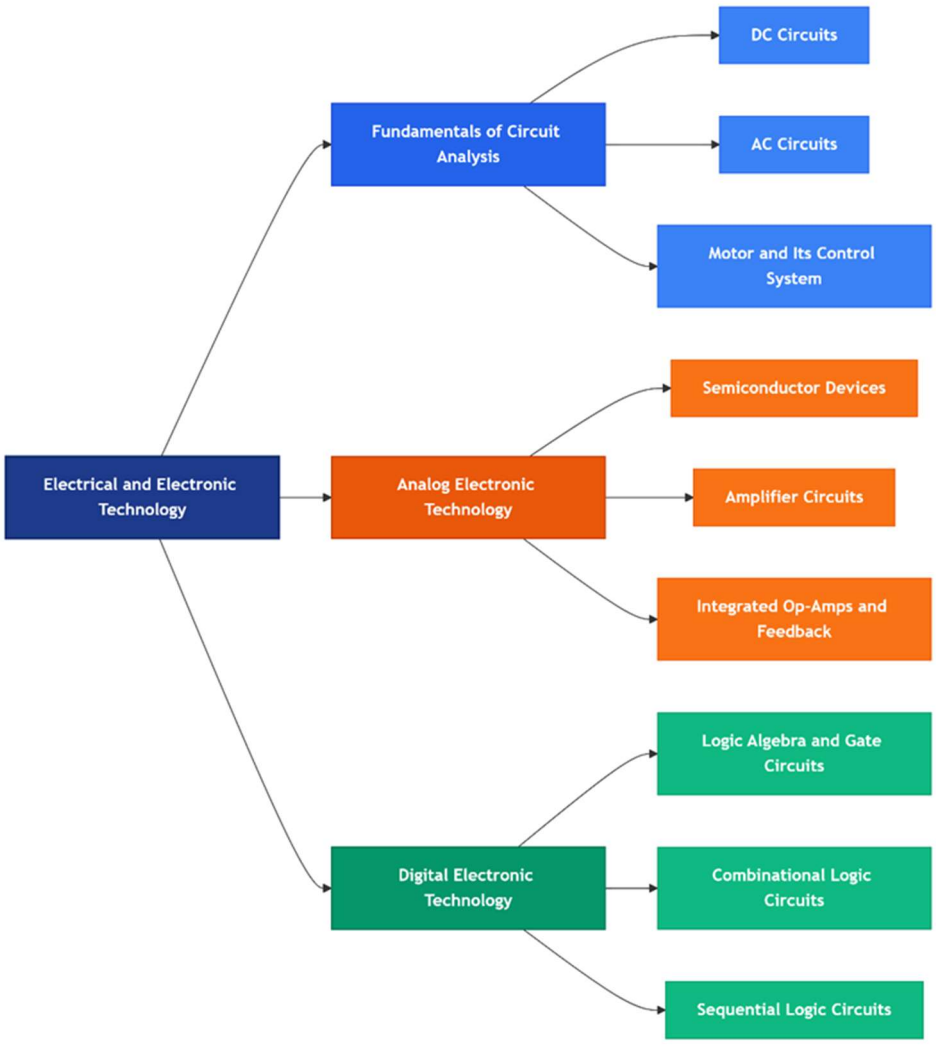


Fig. 1 Curriculum map

With the maturity of new-generation information technologies such as big data, artificial intelligence, and virtual reality, educational informatization has entered a new stage of digital transformation. To actively respond to this change, the Ministry of Education has actively promoted the construction of "New Engineering", emphasizing a shift from discipline-oriented to industry-demand-oriented, from professional segmentation to cross-disciplinary integration, and from adaptation and service to support and leadership[1][2]. The core essence of New Engineering lies in cultivating outstanding engineering talents with strong engineering practice abilities, interdisciplinary integration abilities, innovative thinking, and the ability to solve complex engineering problems.

"Electrical and Electronic Technology" serves as a crucial technical foundation course for non-electrical engineering majors, providing students with an introductory bridge to engineering concepts such as circuit analysis, electronic devices, and system integration. However, in the context of the new engineering paradigm, the traditional positioning of this course has become outdated. On one hand, modern engineering technologies (such as smart sensing, power electronics conversion, and embedded systems) require a deep integration of electrical and electronic fundamentals with digital control, signal processing, and other related knowledge. On the other hand, enterprises generally reflect that graduates have weak practical abilities and insufficient innovative consciousness, making it difficult for them to quickly adapt to real engineering environments[3][4]. Therefore, this course must shift from "knowledge impartation-oriented" to "ability cultivation-oriented", strengthening students' practical operation abilities, circuit design and debugging skills, fault diagnosis capabilities, and preliminary system innovation consciousness, laying a solid foundation for subsequent professional courses and engineering practice in the new engineering paradigm. Although some universities have begun to experiment with blended teaching or introduce simulation software, overall, the "Electrical and Electronic Technology" course still faces issues such as "too much theoretical teaching, weak practical components, outdated technical methods, and single evaluation methods", which significantly differ from the new engineering capability goals and the concept of smart education. Students generally reflect that "they learn but cannot apply, follow instructions in experiments, and forget everything after exams". Therefore, exploring and constructing a new smart teaching model that deeply integrates information technology, embodies engineering practice orientation, and supports whole-process evaluation is not only an inherent demand for improving the quality of course teaching but also an inevitable choice for implementing the new engineering construction and digital transformation strategy of education.

2. New Model of Intelligent Teaching

2.1. Construction of a Multi-dimensional Curriculum Map

The knowledge map serves as the "skeleton" of the curriculum knowledge system, structuring hundreds of knowledge points in the curriculum according to hierarchical relationships and associative logic[5]. Taking "Electrical and Electronic Technology" as an example, the course content spans two major modules: "Electrical Technology" and "Electronic Technology". The former includes circuit analysis, electric motors, and their control systems, while the latter encompasses analog electronic technology and digital electronic technology. In traditional teaching, students often experience low learning efficiency due to scattered knowledge points. The construction of the knowledge map follows a progressive logic of "global - module - knowledge point". Firstly, the overall knowledge structure of the course is sorted out, and the boundaries and connections between each knowledge module are clarified. Secondly, each module is refined into knowledge points. Finally, associative relationships between knowledge points are established, including various types such as "predecessor - successor", "analogy - contrast" and "theory - application". During the learning process, students can either progress linearly according to the order of chapters or understand the interconnectedness of knowledge points from a global perspective through the map mode. For example, when learning "three-phase circuit", the map can automatically associate related knowledge points such as "motor drive" and "power system", helping students establish systematic cognition. Fig.1 presents the curriculum map.

2.2. The Integration of Artificial Intelligence into Various Aspects of the Curriculum

The introduction of artificial intelligence (AI) is reshaping the underlying logic of education, transitioning from being "experience-driven" to being "data-driven"[6][7]. This study systematically integrates AI technology into the four core aspects of teaching, constructing a collaborative smart teaching ecosystem.

2.2.1. Intelligent Lesson Preparation Process

Utilizing the intelligent lesson preparation assistant, teachers can generate a preliminary lesson plan that includes teaching objectives, key and difficult points, and teaching activity design with a single click based on the curriculum map. AI will intelligently recommend classic cases, cutting-edge literature, multimedia resources, and interactive strategies according to knowledge points, supporting teachers in making personalized adjustments and improvements, greatly enhancing the efficiency and quality of lesson preparation.

2.2.2. Smart Classroom Session

Deploy AI teaching assistants in the classroom and use the "Rain Classroom" client on the classroom terminal. By integrating speech recognition and natural language processing technology, the system can record the teaching process in real time, assist teachers in random roll-calling, intelligently answer common questions raised by students, and automatically generate a visually rich classroom summary based on the content of classroom discussions, creating a highly interactive and immersive learning atmosphere.

2.2.3. Personalized Learning Session

Based on the curriculum map and learning data, a personalized learning path is planned for students. The platform intelligently pushes explanation videos, exercises, and extended materials that match students' weak spots in knowledge, achieving precise learning support.

2.3. Intelligent Evaluation and Feedback System

The intelligent evaluation and feedback system, designed with the core concepts of "data-driven, closed-loop feedback, and multi-dimensional evaluation," has achieved deep tracking of the entire learning process, encompassing pre-class preview, in-class interaction, and post-class homework. This system realizes the three-dimensional and precise evaluation dimensions. Traditional teaching evaluations are often limited to final exam scores, making it difficult to comprehensively reflect students' learning processes and ability development. This study constructs a multi-source collection layer of "online learning data, offline classroom data, and virtual simulation data," abandoning the single evaluation mode. It simultaneously outputs process evaluation (tracking learning behavior and ability growth trajectory), summative evaluation (assessing project outcomes and comprehensive literacy), and value-added evaluation (focusing on individual progress and development potential). The organic integration of the three makes the evaluation results more scientific, fair, and development-oriented. Fig.2 presents the flowchart of intelligent evaluation and feedback, showing the complete path from learning activities, through data collection, intelligent evaluation, multi-terminal feedback, and ultimately feedback to teaching improvement. Students adjust their learning strategies based on feedback, teachers optimize their teaching methods, and administrators promote course iteration. The improvement results of the three are integrated into the next learning cycle, forming an upward virtuous cycle. This design breaks through the limitation of separating evaluation and improvement, making evaluation truly a driving force for promoting learning and improving teaching, and achieving the transformation from summative evaluation to developmental evaluation.



Fig. 2 Flowchart of the intelligent evaluation and feedback system

2.4. The Integration of Artificial Intelligence into Various Aspects of the Curriculum

Integrate high-quality teaching resources both inside and outside the school, including national-level quality course videos, virtual simulation experiment projects, engineering case libraries, and other materials, to build a dynamically updated and shared exclusive resource library. Leverage AI recommendation algorithms to achieve precise retrieval and intelligent push of teaching resources based on teachers'

lesson preparation needs and students' learning behaviors, maximizing resource utilization efficiency[8].

3. Conclusion

This study integrates fragmented knowledge systems from three major modules: circuit analysis, analog electronics, and digital electronics by constructing a "knowledge-question-ability" curriculum map, providing students with a clear learning path. In this process, artificial intelligence is deeply integrated into the entire "teaching-learning-management-evaluation" cycle. Relying on AI teaching assistants, intelligent lesson preparation, data-driven classroom management, and academic warning mechanisms, a collaborative teaching ecosystem is established, effectively addressing the long-standing pain points of difficulty in individualized instruction and weak process evaluation in traditional classrooms. Simultaneously, the intelligent evaluation and feedback system forms a closed loop between learning outcomes and teaching improvement through multi-dimensional data collection and immediate feedback, stimulating the development of students' higher-order thinking and practical abilities. On this basis, an integrated and intelligent teaching resource ecosystem relies on multi-party collaborative construction, learner portrait-driven precise recommendations, and a dynamic update mechanism, providing a solid foundation for the sustainable operation of smart teaching. However, with the continuous evolution of generative artificial intelligence, knowledge graphs, and large model technologies, smart teaching will develop to a deeper level. On the one hand, "intelligent learning companions" based on large language models can provide more natural and in-depth question-and-answer sessions and tutoring, realizing a truly personalized mentor. On the other hand, data mining and learning analysis technologies will more accurately depict students' cognitive states, providing a more nuanced basis for teaching interventions.

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