

The Exploration of the “Four-Fold Nature and One Price” Intelligent Learning Environment for Digital Circuit Courses

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Abstract—AI-based educational models are gradually receiving widespread attention and application with the rapid development of information technology. In the course of digital circuits, by combining modern technology with educational theories, constructing an intelligent learning environment can provide students with more efficient and personalized learning experiences. This article explores the significance and challenges of building an intelligent learning environment in the digital circuits course. It combines the characteristics of intelligent education that differentiate it from traditional education and constructs methods and strategies for creating a "four attributes, one value" intelligent learning environment from the perspectives of diversity, adaptability, autonomy, contribution, and optimized instructional assessment.

1. INTRODUCTION

The "Action Plan for Education Informatization 2.0" issued by the Ministry of Education on April 13, 2018 clearly pointed out that the construction of a smart learning environment is one of the important contents of the innovative development actions in smart education. It emphasizes the strengthening of theoretical research and top-level design for smart learning, the advancement of technological development and practical applications, and the improvement of talent training quality^[1]. A smart learning environment refers to the use of modern information technology to construct an intelligent and personalized learning environment that provides comprehensive learning support and services for students. This type of learning environment extends education and teaching from traditional classroom forms to virtual learning spaces through integrated educational resources, intelligent learning platforms, and personalized learning systems^[2]. Classroom teaching is the specific process of curriculum implementation, and the learning environment is an important component of classroom teaching. With the development of modern technology and the increasing demand for high-level talents, traditional teaching environments such as classrooms, laboratories, and libraries are far from satisfying the requirements for learning environments at the present stage. There needs to be a breakthrough in both form and content to support teaching content and course activities that are more innovative in nature. This paper takes the example of a digital circuit course to discuss the problems encountered in constructing a smart learning environment, and explores a solution for constructing a smart learning environment, providing a perspective and

method for problem-solving from the "four characteristics and one value" standpoint.

2. QUESTIONS

Traditional teaching activities often rely on specific spatial environments and certain hardware and software equipment. They are both open and somewhat closed. Taking the laboratory for digital circuit courses as an example, as one of the most important places for students' discipline and scientific research, the laboratory plays a vital role in activities such as graduation design, practical skill cultivation, and operation training. However, the learning environment design of traditional laboratories is too closed. It simply lists various software and hardware devices required for experiments or scientific research without adequately considering the needs of students. Therefore, the user experience is poor. With the impact of the wave of intelligent technology, whether the existing learning environment can meet the needs of students' learning, scientific research, and practice is crucial to the quality of education^[3]. Based on specific realities, there may be the following issues when constructing an intelligent learning environment.

2.1. The imbalance between individuals and the whole

The learning environment is the external condition for the formation of learners' cognition and the development of their abilities, including learning materials, learning and cognitive tools, learning spaces, and interpersonal relationships, etc^[4]. Smart education aims at personalized and precise education, while traditional school education, based on school infrastructure conditions, teaching methods, experience, attitudes, and energy, tends to

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downplay the individual differences of learners in most traditional classrooms and implement a "one-size-fits-all" approach, making the construction of personalized learning environments mere empty talk. Teachers, as the coordinators of the classroom, often overlook the individual differences of students, ignore the importance of cultivating students' active learning awareness and thinking abilities, and gradually turn students into passive knowledge receivers. In a smart classroom, teachers and students are both executors of teaching activities, builders of teaching resources, and participants in teaching evaluation, and the teacher-student relationship tends to become a two-way "equality". An intelligent learning environment needs to find a balance between individual and collective needs, not only to adapt to the needs of the majority of students, teachers, and schools, but also to conform to personalized education and highlight the quality of individual cultivation^[5-6].

2.2.Imbalance between subjective and objective needs

The designer of the learning environment should not blindly follow the social benefit orientation and directly introduce traditional and ready-made solutions for the learning environment. In the early stage of design, there should be as much communication as possible with students to understand their ideas about learning environment design and the demands they have for the learning environment based on their own learning support conditions. Due to the neglect of the subjective needs of the subjects, the design of traditional learning environments, represented by school classrooms and other architectural designs, has long neglected the integration of educational visions, educational philosophies, curriculum, activities, and the design of learning environments^[7]. It fails to take the perspective of learners into consideration, thus unable to effectively transform between educational goals and physical environments^[8]. In addition to sustainability requirements, schools should also have attributes such as healthiness, embodying modern technology, meeting the needs and personalized demands of users, and also be flexible and adaptable to changes. One of the most important tasks for designers is to balance students' subjective needs with objective quality indicators. It should be pointed out that students' physiological needs and psychological needs are equally important and cannot be ignored. The subjective psychological needs have important influence and value on environmental design.

2.3.Imbalance between teaching forms and the construction of intelligent environments

The traditional form of 'teachers lecturing and students listening' was the dominant method in classroom teaching in the past. However, this form is not conducive to simulating teacher scenarios and constructing student knowledge. Intelligent education requires talents who not only possess solid professional knowledge but also have certain comprehensive abilities and humanistic qualities,

which are mainly acquired through real-life situations^[9]. Due to the fixed desks and chairs in traditional classrooms, it hinders students' mobility and communication, resulting in a significant difference from real work environments. This is not conducive to organizing teacher-led instruction, such as inquiry-based teaching, and does not facilitate the full development of student teamwork. Therefore, group learning conducted under such conditions often becomes superficial and fails to stimulate true brainstorming. The development of artificial intelligence technology has been rapid, especially in areas such as deep learning, which has greatly expanded the application scope of AI. However, the development of intelligent learning environments may require more time and resources to keep up with the pace of these technologies in order to maintain compatibility with the latest advancements^[10]. When building smart learning environments, it is necessary to incorporate advanced technological methods. This implies the need for new teaching forms that not only match the existing technological aspects of intelligent environments but also balance the healthy interaction between students and teachers.

2.4.The problem of single evaluation methods

Smart education emphasizes the cultivation of abilities and the cultivation of higher-order thinking levels. However, the existing talent evaluation methods are single, relying on final assessments such as grades, credits, and GPA, thus neglecting the improvement of abilities and the enhancement of humanistic qualities. The course of digital circuits has strong engineering practicality, emphasizing the cultivation of students' practical abilities, focusing on cultivating their "doing" abilities. This practical hands-on ability is a kind of quasi-skill that can be quickly transformed into work ability after students enter the workplace^[11]. The development of such practical hands-on ability mainly relies on practice and sometimes even requires one-on-one guidance. However, the traditional classroom teaching method makes it difficult for teachers to have real-time grasp of students' learning process, and it is difficult for teachers to give timely guidance. The teaching method focused on lecturing can only be evaluated through written exams in the end. This runs counter to the emphasis of smart education on practical abilities, because fundamentally, this is an ability to "write" rather than "do", which does not meet the requirements of the current job market for talents. In the context of the information age, students should not be evaluated solely based on exam scores. Multiple links and levels should be used to evaluate the improvement of students' abilities and learning outcomes^[12].

3.MEASURES

The establishment and improvement of an intelligent learning environment is an inherent requirement and concrete manifestation of the informatization, digitization, and modernization of education ^[13]. Constructing an

intelligent learning environment in digital circuits can not only meet the requirements of educational reform and development in the digital age but also improve the quality of educational services in the new situation. Based on the connotation and challenges of intelligent learning environments, improvements can be made from the following perspectives.

3.1.Diversity

Building an intelligent learning environment can be considered from multiple angles, levels, and aspects to meet the needs and individual differences of different learners. The word "more" here encompasses many aspects, such as introducing diverse learning resources for students with different learning backgrounds, making it convenient for students from different fields, cultural backgrounds, and difficulty levels to learn. For example, providing diverse learning modalities including text reading, image recognition, audio playback, video watching, etc., to accommodate different learners' preferences and perceptual modes. In a digital circuit course, many principles and methods are often difficult to understand. If they are solely taught through classroom lectures, students may have difficulty grasping their meanings. By utilizing situational awareness technologies and timely introducing animation design, scenario simulation, dynamic perception, etc., the teaching format can be enriched, allowing students to have a better learning experience. For instance, designing personalized learning paths according to learners' learning goals, interests, and ability levels. The learning paths can be linear or non-linear, flexibly adapting to learners' needs. By employing the aforementioned methods, a diversified intelligent learning environment can be built, providing personalized, flexible, and interactive learning experiences for different learners, promoting their learning outcomes and development.

3.2.Adaptability

The informatization is a slow transformation from an environment driven by technology in the cultivation of students, which is reflected in various aspects of environmental design, such as architecture, software and hardware facilities, light management, humidity management, etc. For example, collecting personalized data through wearable devices and other smart devices to continuously improve the heterogeneous adaptability of the learning environment is an important perspective for the future intelligent technology to enter the design of the learning environment ^[14]. For example, through the supervision and feedback of the smart learning environment, timely feedback is provided to learners and educators, guiding their learning progress and methods. The digital circuit course emphasizes engineering practice by introducing virtual laboratories, guiding students to perform practical operations and application practices during the learning process, and solving the dilemma of the need for experimental cases to be taught and implemented in a laboratory, improving the

transferability and adaptability of students' practical learning. Constructing an intelligent learning environment requires comprehensive consideration of learning goals, learner needs, diversity and personalization in the learning process, as well as continuous improvement and optimization, to provide learners with an adaptive and effective learning environment.

3.3.Autonomy

The subjective experience of students, the physical environment, and the social context form a continuous unity, together serving as important indicators for the design of learning environments. Intelligent interaction is the key to constructing intelligent learning environments. The "physical" elements ultimately serve the "human" elements, and good interaction between teachers and students is crucial for a successful class. For example, with the introduction of behavior sensing technology, teachers can analyze students' behavior on devices through data analysis in the background, in order to identify their interests and learning difficulties. Additionally, with the use of mobile internet technology, teachers and students can engage in comprehensive communication through devices like tablets, including practicing key content, showcasing student work, and real-time questioning. This allows for greater information exchange compared to traditional language-based communication, and is easier for students to absorb. Smart education emphasizes students' autonomy in learning, independent thinking abilities, and the capacity to independently solve problems and showcase achievements. When constructing intelligent learning environments, it is important to give learners sufficient autonomy and decision-making power, while at the same time providing personalized support and timely feedback through technological means. Encouraging collaboration and communication among learners helps cultivate their habits and skills for independent learning.

3.4.Contribution

When building an intelligent learning environment, it is not advisable to only consider social benefits and build the learning environment based on social needs, school needs, and employer needs^[15]. Instead, it should consider the needs of students and match the development of new technologies, talents, and the new era. The design of the learning environment needs to constantly balance between the interests of students and others, and between tradition and innovation. For example, establishing a knowledge map between different scenarios of learners' learning, scientific research, and industrial production, assisting learners in achieving seamless transitions between different contexts, and enhancing their abilities in knowledge acquisition and generation, collaborative sharing, knowledge map construction, and learning, etc. For example, using social media, online discussion platforms, and other tools to encourage discussions and sharing among students, solving societal issues and

national issues beyond laboratory experience. For example, in addition to the digital circuit course, discussing issues such as the difficulty of developing domestic "chips" and the problems that bottleneck the integrated circuit industry. Smart education should not only cultivate students' high-order abilities but also pay attention to shaping their emotions and spirits^[16].

3.5.Assessment

In terms of evaluation concepts, teachers need to consider more factors that reflect personalized growth and better showcase students' efforts and learning outcomes. In terms of evaluation subjects, teachers need to break the boundaries of classroom teaching and integrate in-class and out-of-class, formal and informal learning, and pay more attention to learning contexts. In terms of evaluation indicators, teachers need to deeply explore students' personalized characteristics through big data analysis and efficiently implement multiple classification evaluations. In terms of evaluation results, teachers should emphasize a "people-oriented" approach, where the development of students' intellectual abilities is taken into account as the evaluation content, and the entire learning process is included in the evaluation scope. The intelligent teaching evaluation mechanism relies on teaching big data that spans the entire learning process to assess students' learning situations, intelligently diagnose their learning status and effectiveness, and provide them with the most suitable personalized learning resources, thereby implementing precise teaching interventions and guidance. The digital circuit course adopts a multi-link, formative assessment and grading system, using an intelligent evaluation system to monitor and assess students' learning situations in real-time. By analyzing students' learning data, teachers can promptly understand students' learning statuses and provide targeted guidance and feedback. At the same time, students can actively evaluate their own learning situations through assessment tools in the system, and make timely adjustments and improvements.

5. Conclusions

The intelligent learning environment is of great significance for educational reform and innovation. It can promote the innovation of teaching methods, break the traditional teaching mode, and encourage students' active learning and spirit of inquiry. By introducing intelligent technology and data analysis, it can help educational institutions and decision-makers better understand students' learning situations and needs, providing scientific basis for education policies and teaching reforms. This article describes the meaning of intelligent learning environment, discusses the challenges of building an intelligent learning environment in the digital circuit course, and proposes a "four qualities and one value" intelligent environment construction plan. By properly utilizing artificial intelligence technology and modern educational methods, it provides students with a

more personalized and efficient learning experience, and improves the quality of teaching.

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