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Research on the Construction of Smart Laboratory for Materials under the Background of New Engineering

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Abstract

In order to meet the needs of talent cultivation in the context of new engineering and respond to the innovative needs of experimental teaching models led by current information technology, the research on smart laboratory has become an inevitable choice for the construction of university laboratory. The article focuses on the materials laboratory as the main research object, and elaborates and analyzes the background, significance, objectives, and contents of the construction of smart laboratory for materials majors in universities, which is conducive to building a collaborative and efficient experimental teaching mechanism, and better leveraging the advantages of high-quality talent cultivation in new engineering.

Keywords

New Engineering, Smart Laboratory, Construction.

1. Introduction

With the continuous development of science and information technology, the innovation and application capabilities of Internet, big data, artificial intelligence and other technologies are constantly enhanced, making the digital intelligence integration era far beyond the digital era, with its application in various industries gradually deepening[1-3]. In the 14th Five-Year Plan, China proposed to accelerate digital development, create new advantages in the digital economy, advance the pace of digital society construction, and build a digital China, furthering becoming the development goals of various industries in the digital intelligence integration era, pointing out the direction for the development of the digital intelligence integration era, and surely promoting the leapfrog development of various industries in China. *The Outline of the 14th Five-Year Plan for National Economic and Social Development and Vision 2035 of the People's Republic of China* proposed to "accelerate digital development and build a digital China". With the promotion of digital technologies such as virtual reality, artificial intelligence, cloud computing, and the Internet of Things, especially the development of mobile applications, data is constantly growing and accumulating at an unprecedented speed, and the era of big data has arrived. Although the big data has a fast development speed, and has gradually matured in terms of practical application, technology, and development, the applications of virtual reality are still at a superficial level in the field of university education and teaching, especially in the teaching of materials majors in universities, and smart laboratory have not yet played its due role. Therefore, it is necessary to focus on the era of digital intelligence and explore strategies for the construction and teaching reform of smart laboratory in universities based on virtual reality technology support.

2. Research Significance

The core of the construction of new engineering majors is the innovation of engineering education talent cultivation methods, so as to improve the quality of engineering education

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talent cultivation, establish innovative, comprehensive, and cyclical new concepts of engineering education, construct a new discipline professional system combining new engineering and traditional engineering majors, and explore new model for implementing engineering education talent cultivation. The new engineering education model is in line with the trend of economic and social development. Taking materials majors as an example, there are some deviations between the talent cultivation model of traditional materials and that of new engineering, such as differences between the students trained by universities and the actual needs of enterprises, mainly manifested in the following aspects:

(1) The disconnect between professional theoretical teaching and engineering practice innovation. Traditional materials majors are mostly based on mature industry foundations, lacking the characteristics of new technologies and industries, resulting in a disconnect between professional theoretical teaching and engineering practice teaching. Meanwhile, traditional education models and talent cultivation programs usually focus on professional courses as the core, with outdated teaching content and single teaching methods in the knowledge system. Teachers only underline imparting and accumulating theoretical knowledge, emphasizing theory over practice, resulting in insufficient engineering practice and innovation capabilities of students. Even if participating in various internships, professional innovation practices, comprehensive experiments and other practical activities, students still face problems such as limited practical opportunities and short time, making it difficult to comprehensively apply theoretical courses to improve students' engineering literacy and solve practical engineering problems.

(2) The traditional teaching model lacks the universality of new engineering. The traditional teaching model for materials majors is dominated by teacher lectures, with students passively accepting, which makes it difficult to stimulate students' enthusiasm and initiative in learning. Meanwhile, most materials courses compress the number of hours, resulting in a wide range of knowledge points that are not connected, making it difficult for students to fully understand the taught content and leading to the phenomenon of "falling behind". In the teaching process of materials courses, various assessment methods have different impacts on students' learning of knowledge in materials courses. The difficulty lies in how to cultivate students' engineering innovation awareness, assess students' engineering innovation and practice capacities, and meet the requirements of the construction of new engineering majors and engineering education certification. In addition, for students in ethnic minority classes, due to their weak foundation in Chinese, they also need to face difficulties in receiving theoretical knowledge in materials majors， since they are relatively unfamiliar to relevant professional terms in materials courses as required courses in engineering majors, making it more difficult for them to receive theoretical teaching and knowledge learning.

(3) The teaching ability level and engineering practice capacity of teachers need to be improved. Under the background of the construction of new engineering majors, emerging technology industries such as intelligent manufacturing, 3D printing, artificial intelligence, and virtual technology have emerged rapidly. Therefore, the reform of talent training programs and curriculum systems is urgent. If teachers continue to use relatively outdated content, fail to innovate, and cannot keep up with the development of new engineering, students will not be able to access cutting-edge knowledge, which will limit their horizons. The quality and level of students they cultivate will be difficult to match with the development of new engineering and students' career choices. Meanwhile, professional teachers not only need to learn the latest theoretical knowledge, but also constantly improve their engineering practice capacity. However, most teachers lack practical experience in engineering, and there are shortcomings in guiding students to engage in innovative engineering practices, which objectively affects the output of new engineering talents. In addition, due to factors such as professional title evaluation, emphasis on scientific research, and neglect of teaching, university teachers have

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invested less energy in theoretical teaching and talent cultivation, resulting in difficulty in improving the quality of new engineering talents they cultivate. Furthermore, some materials teachers have shortcomings such as insufficient lesson preparation, single classroom teaching methods, and inability to simplify complex problems within limited classroom teaching time. Faced with the significant personalized situation of contemporary college students, it is difficult for teachers to provide targeted teaching for each student. The imparting of professional knowledge is a teaching method aimed at the general public, which makes it difficult for some students to accept and even leads to a sense of disinterest in learning. As a result, teachers find it difficult to develop their creativity during the teaching process. The course evaluation methods developed by some materials teachers are not conducive to cultivating students' innovation capability. In their courses, students' course evaluation methods are generally based on exam scores, supplemented by homework and attendance. This evaluation system that focuses too much on exam scores can lead to students being confined to rote memorization and excessive assignments tactic, greatly limiting the cultivation of students' creative thinking.

Given the teaching status and existing problems in the materials majors in universities, the construction of teaching practice bases for materials majors based on virtual reality technology can put forward new requirements for talent cultivation in materials majors, and reasonably plan and construct teaching experimental bases for materials majors in universities, providing support for improving the quality of talent cultivation.

3. Research Objectives

The construction of smart laboratory can enhance the cultivation of practice capacity of talents. We plan to establish a practice base, utilizing research-based learning models, relying on virtual practice platforms for materials majors and enterprise practices, and combining with the teaching of materials majors, and focusing on student-centered and teacher-assisted practice capacity cultivation, so as to truly engage in theoretical practice, stimulate students' learning initiative, gradually form a systematic and coherent practical experience process, cultivate students' innovative thinking, and provide reliable talent motivation for enterprises. The construction of the base is conducive to breaking away from the theoretical research of the "vacuum" in universities, combining with the society, calmly dealing with various problems in practical management services, improving students' administrative processing skills, integrating theoretical knowledge with practice, testing truth, and proposing new ideas based on the actual situation of enterprises, ultimately promoting the effective improvement of modern management level of enterprises.

The construction of smart laboratory can enrich management systems and flexibilize management mechanisms. We plan to, through the construction of the base, integrate the interests and requirements of universities, government, and enterprises, gradually enrich the management system through operation, adaptation, and adjustment, increase communication and contact between the government, universities, and enterprises, stimulate the teaching enthusiasm of the teachers, customize reasonable reward mechanisms, standardize teaching management norms and processes, improve teaching practice plans, processes, and analysis and evaluation, clarify the achievement of internship goals, and achieve zero alignment between the training of materials majors in universities and the demand for social talents.

4. Construction Content of Smart Laboratory

(1) We plan to conduct systematic research on regional enterprises, guide local enterprises to fully participate in project construction, explore win-win cooperation between universities and enterprises, and hire experts from the base to provide guidance and personnel training for the project team;

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(2) We utilize the venues and basic equipment such as PC devices, printers, scanners, projectors provided by universities, as well as big data technology and software and hardware platform support provided by enterprises, to create favorable conditions and environment for the construction of teaching practice base for materials majors;

(3) We construct a virtual practice platform for teaching materials majors in universities based on virtual reality technology according to the needs of practical teaching and talent cultivation, and plan to build a teaching practice base for materials majors, accepting teachers and students to participate in practical teaching and training activities, and improving the quality of talent cultivation;

(4) We establish a project assurance team, clarifying project objectives, providing assurance for the effective operation of the project, and assigning a project leader to undertake various tasks of management and coordination; establish a project reporting system, coordinating with various faculties and relevant departments, and promoting project implementation and execution; and build a teaching practice base for materials majors in universities based on virtual reality technology in the era of digital intelligence.

5. Conclusion

The construction of smart laboratory in universities under the background of new engineering has good theoretical and practical significance. In the era of digital intelligence, cultivating new engineering talents with strong engineering capacities and high comprehensive qualities has become an important direction for the education goals of universities. Building a high-level online intelligent laboratory in the context of new engineering is an inevitable choice, which can better construct a collaborative and efficient experimental teaching mechanism, and better leverage the advantages of high-quality talent cultivation in new engineering.

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