The Construction of Vocational Education Training System Based on Virtual Simulation Technology

Xingshu Liu, Lei Duan*, Zhiqing Zhu, Mengmei Jiang

Hunan Automotive Engineering Vocational College, Zhuzhou, 412001, China

*Corresponding author: Lei Duan, 1263493303@qq.com

Abstract. Virtual simulation technology has brought revolutionary changes to the practical training and teaching of vocational education. In response to the high investment, high loss, high risk, and difficulty in implementation, observation, and reproduction of vocational education professional course training projects, based on virtual simulation technology, a VR smart education teaching platform is created to integrate high-quality teaching resources; Taking "virtual simulation training platform" as the core, breaking the boundaries of practical training teaching; Customized intelligent training equipment, equipped with a virtual operation platform. Thus, the construction and reform of professional courses, as well as the comprehensive innovation and improvement of teaching methods, have been achieved.

Keywords: Virtual simulation technology; Vocational education and practical training system; Smart education.

1 Introduction

With the widespread application of new generation information technologies such as artificial intelligence, virtual simulation, and big data in the field of education, the use of information technology to build high simulation and immersive virtual simulation training teaching environments, connect real job skills and operational processes to develop on-site and systematic training resources, innovate and promote virtual simulation training teaching, systematically solve the learning and application gap between single point learning of knowledge and skills cases and comprehensive application in real work scenarios, efficiently solve the problems of high investment, high loss, high risk, difficult implementation, difficult observation, and difficult reproduction of some training projects, and have become a research hotspot in the field of vocational education and teaching. In 2020, the Ministry of Education and nine other departments issued the "Action Plan for Improving the Quality and Excellence of Vocational Education (2020-2023)", proposing the "Implementation of Vocational Education Informatization 2.0 Construction Action"; In 2022, the Ministry of Education and five other departments released the Action Plan for the Integration and Development of Virtual Reality

© The Author(s) 2024
Y. Feng et al. (eds.), *Proceedings of the 4th International Conference on Internet, Education and Information Technology (IEIT 2024)*, Atlantis Highlights in Social Sciences, Education and Humanities 26,
https://doi.org/10.2991/978-94-6463-574-4_62

and Industry Applications (2022-2026), proposing the construction of a number of virtual reality classrooms, teaching and research rooms, laboratories, and virtual simulation training bases. The integration of information technology and education and teaching continues.

2 Research Status

In China, research on virtual simulation technology and teaching often involves analyzing the concept, characteristics, classification, and other aspects of virtual reality technology, and then discussing its integration with education and teaching. The main focus is on typical applications and advantages in education and teaching. A few studies have provided examples based on virtual simulation technology, which have certain practical value and reference significance. Pan Haisheng elaborated on the problem of "three lows" in traditional practical teaching, and believed that combining virtual simulation training with teaching can improve the effectiveness of vocational practical teaching[1]. Jiang Yong theoretically explained the advantages of using information technology teaching resources, and finally established a competency based assessment and evaluation system, providing support for deepening vocational education and teaching reform[2]. Zhou Heting and Wu Zheng described the characteristics and main teaching applications of virtual simulation teaching resources, and then rationally analyzed the current situation and existing problems of the construction and application of virtual simulation teaching resources. Finally, she provided suggestions for solving the problems[3].

It is very common to build virtual laboratories in developed countries. Among them, the earliest to establish a virtual laboratory was the Web Lab remote laboratory established by the Massachusetts Institute of Technology[4]. This laboratory provides students with experimental conditions for microelectronics and an experimental environment for circuit design. Based on this laboratory, students can design and modify circuits on their personal PCs, and then remotely operate through the previously connected personal computer to test the modified experimental data and verify the feasibility of their design; The VRCEL Laboratory, established by the Department of Chemical Engineering at the University of Michigan, focuses on the application of virtual reality technology in the field of chemical engineering and is committed to contributing to the development of the chemical field[5]; There is also a virtual laboratory focused on biomedical engineering, established by the Howard Hughes Medical Research Institute (HHMI) in the United States; The University of Pavado in Italy has established a remote virtual education laboratory[6].

3 Existing Problems

Firstly, constructing a curriculum system based on disciplinary logic overlooks the requirement for knowledge integration in the professional process. The existing professional curriculum system is still built on the basis of subject knowledge system, and the integration of professional ability standards and levels in the curriculum system is not sufficient. The professional core competency courses set up are relatively scattered, and the content of each core course is repetitive. The courses planned to cultivate students' professional core competencies have become a pile of theoretical explanations and content detached from job requirements, without forming a curriculum system based on professional core competencies. This requires the reconstruction of a modular curriculum system for professional groups based on job processes and core competencies.

Secondly, the integration of information technology and vocational education is insufficient, and the construction of digital resources for practical training projects lags behind.

Vocational colleges, in pursuit of educational informatization, have invested efforts in teaching reforms such as "MOOCs", "micro courses", and "flipped classrooms", only achieving classroom transfer. Information technology and practical skills training have not been integrated and practical teaching has been carried out, resulting in a lack of vocational skills training for students[7]. The lag in the construction of digital teaching resources has led to low teaching efficiency and inability to meet the needs of the new era of "making learning happen proactively and in the entire time domain".

Thirdly, the subject of teaching evaluation is single, and the evaluation results cannot truly reflect the level of student skill mastery. A tripartite evaluation mechanism has not yet been established among schools, enterprises, and students. The evaluation subject of practical training teaching is single, and there are too many human and subjective factors in the evaluation process, lacking quantitative analysis, and the evaluation is not accurate enough. And the combination of formative evaluation and summative evaluation has not been used, resulting in a more scientific, objective, and comprehensive assessment of student professional competence.

Fourthly, the application level of virtual simulation technology in practical teaching is not high. Due to the lack of specific and detailed standards for the construction of virtual simulation bases, vocational education professional training teaching has not achieved the aggregation of simulation resources. There is a tendency towards generalization in virtual simulation resources, with a focus on reconstruction rather than application, while neglecting the cultivation and improvement of students' information literacy, teachers' information technology application, and managers' information technology leadership, resulting in a lack of overall improvement in the informationization level of vocational education.

4 Measures

4.1 Building a VR Smart Education and Teaching Platform, Integrating High-Quality Teaching Resources

The VR smart education teaching platform, as an intelligent teaching platform that integrates technologies such as VR virtual reality, 3D simulation, and artificial intelligence, provides learners with a comprehensive and multi-dimensional learning experience through online access, immersive experience, and human-computer interaction, improving learning effectiveness and educational quality. The VR smart education teaching platform integrates five core sections(Figure 1), including virtual simulation training sub platform, 1+X assessment training sub platform, rich media electronic textbook sub platform, ASE skill evaluation sub platform, and learning behavior data center, to create a comprehensive teaching platform that integrates teaching resources (theory), practical training resources (virtual), and teaching management (real). Teachers and students can quickly find teaching and practical resources for their professional courses through mobile apps, tablets, PCs, and other platforms. Through digital technology and innovative teaching methods, it meets the teaching, learning, and training needs of teachers and students in information technology teaching, online learning, simulation operations, online assessment, and comprehensive evaluation. By integrating the platform, we can improve the compatibility between resources and content, enhance the value, learning, interactivity, and fun of the practical training classroom[8].

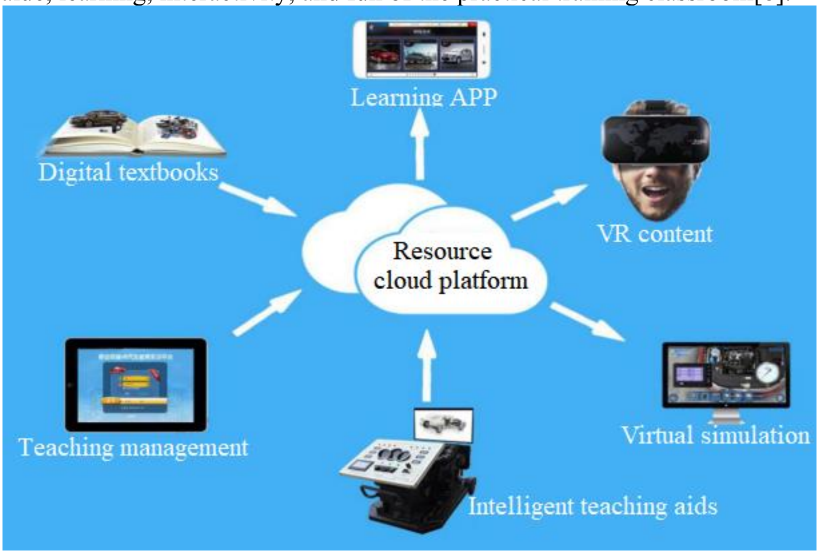

Fig. 1. Functional diagram of "VR Smart Education Teaching Platform"

4.2 Taking the "Virtual Simulation Training Platform" As the Core, Breaking the Boundaries of Practical Training Teaching

The VR smart education teaching platform takes the "virtual simulation training platform" as the core, adopts a combination of "teaching, learning, practice, and examination", and combines computer technology, network technology, 3D technology, and video animation operation. Taking the automotive inspection and repair technology major in vocational colleges as an example, it has developed modules for automotive construction and disassembly, automotive maintenance and upkeep, automotive fault and repair, and new energy vehicle construction and repair, and achieved AR scanning augmented reality function. Before the training, students can learn independently or group virtual exercises through the platform, and then carry out practical operations, breaking the boundaries of training time and venue.

Taking automobile construction and disassembly modules as an example. This module includes the construction and disassembly of the engine and transmission[9]. Each learning task includes task flow guidance, tool guidance, part description, training manual, virtual training, voice prompts, intelligent prompts, etc. Through virtual simulation technology, the tools, instruments, and disassembly process are introduced, allowing students to intuitively experience the process and details of car disassembly and installation, understand the structure and working principle of learning cars.

4.3 Customized Intelligent Training Equipment, Equipped with a Virtual Operation Platform

In offline training teaching, intelligent training equipment is mainly used to complete the system, which includes a training platform, supporting intelligent touch devices, and simulation software resources. The intelligent test bench realizes virtual practice, disassembly and assembly process guidance, tool combination, component description, and theoretical knowledge of engine system training courses. The intelligent training equipment combines the integration of theory and reality, virtual and real teaching, and intelligent design. It combines theory and practice to comprehensively integrate principles, structures, skills, and standards in information technology. The intelligent training equipment, together with the virtual operation platform, has completed a teaching loop of "centralized teaching" → "group practice" → "virtual exercise" → "enhanced training", improving the current situation of the lack of training teachers, enhancing student interest and practical ability, reducing equipment wear and tear, and maximizing the teaching efficiency of the platform equipment.

4.4 Typical Case

Taking Hunan Automotive Engineering Vocational College as an example. To meet the requirements of the new professional catalog, implement professional digital transformation and upgrading, promote digital course construction, and explore the integration of technologies such as artificial intelligence, big data, and virtual reality into the teaching process. Adhere to student-centered approach, utilize modern information technology, deepen curriculum education, and create distinctive, effective, and highly evaluated demonstration courses. In the on-site display activities of the digital campus, 43 smart teaching scenes were built, and 43 information-based teaching classrooms were solidified, playing the leading role of excellent teachers in teaching demonstration and improving classroom effectiveness.

Firstly, student satisfaction has increased. A questionnaire survey showed that after introducing the VR teaching platform into the teaching process, 91.7% of students reported an increase in their learning motivation, 93.5% of students reported an improvement in their self-learning ability, 94.3% of students reported a more reasonable allocation of learning time, and 96.7% of students reported that VR teaching is very helpful in improving their theoretical and practical abilities.

Secondly, the improvement of students' professional abilities. As a provincial-level office of the national "1+X" certificate, the school has undertaken the task of testing automotive application and maintenance technology and new energy vehicle level certification questions. Relying on the 1+X information training and assessment function in the automotive VR smart education teaching platform, the passing rate of the 1+X certificate for students majoring in automotive repair and inspection in 2018 reached 100%.

Thirdly, improving teaching efficiency. Based on the automotive VR intelligent education teaching platform, a hybrid online and offline teaching approach is carried out, which uses information means to visually display and solve the abstract and implicit problems of some knowledge points in teaching. Integrated digital textbooks, intelligent teaching apps, and intelligent training platforms are used to enhance students' interest, enhance understanding, and guide practical operations. Through information technology, students develop a discovery based and autonomous learning style and habit, shorten practical teaching time, and improve practical teaching efficiency. Students can better and faster complete practical tasks when operating offline, and the average completion time of tasks is significantly reduced. Personal practical completion is effectively improved.

5 Conclusions

By promoting the comprehensive application of textbooks, teaching resources, and practical training resources through the automotive VR intelligent education and teaching platform, the requirements of integrated theoretical and practical training teaching have been met, and the construction and reform of professional courses, as well as the comprehensive innovation and improvement of teaching methods, have been achieved. Although the application of virtual simulation technology in education has brought many advantages, it also faces some challenges. Firstly, the issue of equipment cost. The high price of related hardware equipment may be an economic burden for schools and students. The solution to this problem is to strengthen cooperation between the education and technology sectors, reduce costs, and promote the further popularization and application of virtual simulation technology in education. Secondly, the challenge of content development. The educational application of virtual simulation technology requires a large amount of content support, including high-quality virtual scenes, teaching resources, and course content. One solution to this problem is to strengthen the research and sharing of diverse content, and promote the enrichment and popularization of educational content. Thirdly, correct use and management. Virtual simulation technology can provide an immersive learning experience, but it may also have an impact on the physical and mental health of students. Therefore, it is necessary to develop relevant education policies and student protection measures to ensure the healthy and safe use of virtual reality technology in education.

References

1. Pan Haisheng, Hu Juan. The Construction Mechanism of Public Training Bases under the Participation of Multiple Social Subjects Research on System [J]. China's Electronic Education, 2022 (3): 54-61.
2. Jiang Yong. The construction path and practice of virtual simulation laboratories for economics and management [J]. Laboratory Research and Exploration, 2024, 43 (01): 238-245.
3. Zhou Heting, Wu Zheng. The Value Connotation, Realistic Dilemma, and Practical Path of the Construction of Virtual Simulation Training Base for Higher Vocational Finance and Economics Majors [J]. China Vocational and Technical Education, 2024, (02): 19-25.
4. Enrique G N,Hugo I M C, Yan X T, et al. Haptic-enabled Virtual Planning and Assessment of Product Assembly[J].Assembly Automation,2020,40(4):641-654.
5. Jin W K, Hun L, Taeho Y, et al. V irtual Simulation for Entertainment using Genetic Information[J].International Journal of Advanced Computer Science and Applications (JACSA), 2020(10):23-28.
6. Beltran Sierra LM, Martin Llamas Nistal M, Fernandez Sanchez J. Second Life: A new platform for distance learning in Electrical Engineering[J]. IEEE Transactions on Education, 2022, 52(2):225-229.
7. Chen, Li-Wei. Investigating the learning performances between sequence and context based teaching designs for virtual reality (VR)-based machine tool operation training[J].Computer Applications in Engineering Education. 2019.27(5):43-63.
8. Safadel Parviz. Effectiveness of Computer-Generated Virtual Reality (VR) in Learning and Teaching Environments with Spatial Frameworks[J].Applied Sciences-basel.2023.10(1):16-17.
9. Klingenberg Sara. Investigating the effect of teaching as a generative learning strategy when learning through desktop and immersive VR: A media and methods experiment[J].British Journal of Educational Technology. 2023.51(6):115-138.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.