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Analysis and Enlightenment of Virtual Simulation Practice Teaching in Civil Aviation Vocational Colleges

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Abstract: *This paper analyzes the significance of virtual simulation technology in practical teaching in civil aviation higher vocational colleges. It is the need to implement national and civil aviation bureau-level vocational education reforms and development plans, an important means to construct a teaching model of "combining virtual with real, virtual assisting reality, and virtual and real integration, and innovative practical training", an important carrier to establish a practice teaching system with characteristic integration of "work, course, competition, and certification", a practical means to align with job competency and curriculum reform to enhance the quality of talent development. It points out the problems existing in virtual simulation practical teaching in civil aviation higher vocational colleges, and finally puts forward the enlightenment of domestic virtual simulation practical training construction for virtual simulation practical teaching in civil aviation higher vocational education.*

Keywords: *virtual simulation; practical teaching; technology; model*

1. The significance of virtual simulation practical teaching in civil aviation higher vocational colleges

In September 2021, the Science and Technology Development Center of the Ministry of Education issued the notice of the "Guidelines for the Construction of Vocational Education Demonstration Virtual Simulation Training Base" ([2021] No.17). The guidelines point out that vocational education demonstration virtual simulation training bases should be built as comprehensive training bases integrating teaching, practical training, training, scientific research, competition, and popular science, serving the cultivation of versatile technical talents in the new era and promoting technological innovation in the industry. It should play a role of demonstration, leading, radiation, and driving force, empowering the high-quality development of modern vocational education. The construction of high-quality demonstration virtual simulation training bases is not only a deepening, transformation, and solidification of the achievements of vocational education colleges, but also a strategic measure in the new era to comprehensively improve the level of vocational college management, focus on connotation development, and establish a virtual simulation training system that combines reality with virtual, virtual assisting reality, and virtual and real integration. It aims to solve the pain points and difficulties in practical training and enhance the social service capabilities, serve enterprise personnel employment training, and promote technological innovation in the industry.

Firstly, it meets the needs of national-level and civil aviation-level vocational education reforms and development plans. The virtual simulation practical teaching in civil aviation higher vocational colleges is a concrete manifestation of implementing the "Implementation Plan for the Reform of Vocational Education at the National Level" and the "Action Plan for Enhancing the Quality and Excellence of Vocational Education (2020-2023)". It is a response to the new concepts and requirements of vocational education in the new era, fully implementing the Party's educational policies, implementing the fundamental task of moral education and cultivating people, and greatly improving the modernization level of vocational education in the new era in higher vocational colleges and promoting the reform of talent training models using modern information technology. It is a specific embodiment of implementing the spirit of documents and plans such as the "Action Outline for Building a Strong Civil Aviation Country in the New Era" and the "Roadmap for Building Smart Civil Aviation". It actively promotes the upgrade of talent training from "skill-oriented" to "innovation-oriented", cultivating students' independent learning awareness, lifelong learning ability, and project-based engineering practice and innovation ability.

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Secondly, it is an important means to construct the teaching model of "combining reality with virtual, virtual assisting reality, and innovative practical training". In the implementation of virtual simulation practical teaching in civil aviation higher vocational colleges, the integration of civil aviation-related professional knowledge and related disciplines is continued, expanding the knowledge dimension of professional talents, promoting the mutual penetration of basic vocational skills, professional knowledge abilities, and self-development innovation abilities. The focus is on cultivating learning abilities, innovation abilities, practical abilities, and social adaptability, centering on the new requirements for talent training brought about by the intelligent construction of civil aviation, relying on new-generation information technologies such as virtual reality and artificial intelligence, deeply integrating information technology and practical teaching, fully utilizing the characteristics of interdisciplinary practical training, and ensuring the professionalism and compatibility of practical training subject design. It establishes training and teaching course settings that are compatible with three-dimensional simulation, clarifies training and teaching content effectively and scientifically, and conducts research and development training and teaching resources.

Thirdly, it is an important carrier for establishing a practical teaching system with a distinct integration of "occupation, course, competition, and certification." Virtual simulation practical teaching helps civil aviation higher vocational colleges to design an integrated talent training model that revolves around "occupation, course, competition, and certification." "Occupation" relies on civil aviation job demand analysis, taking vocational standards and vocational competence development as course learning objectives, absorbing new industry knowledge, technologies, and processes in a timely manner and transforming them into course content. "Course" utilizes the characteristics of modularized, flexible, and reconfigurable modular courses to rapidly build a learner-centered professional course teaching system that focuses on vocational competence development. "Competition" is integrated into the teaching and evaluation processes, transforming competition results into corresponding courseware, showcasing high-end skills and assessing teaching quality through platform-based skill exchange. "Certification" integrates vocational training into the teaching process, strengthening the connection between teaching and production, and facilitating talent development channels.

Lastly, it is a practical means to align curriculum reform with occupational competency and enhance the quality of talent development. With the development of new generation information technology, the aviation industry has a growing demand for versatile talents with knowledge and skills in this field. The industry also has increasingly higher requirements for talent qualifications and skills. Currently, most aviation-related institutions have relatively singular teaching models in terms of practical skills development for students. The technical skills mastered by students are limited, resulting in limited professional abilities that fail to meet the industry's demands for vocational skills. The establishment of virtual simulation training platforms based on competency-oriented modular curriculum systems aims to provide targeted skill teaching that aligns with the knowledge, technology, and skills required by specific professions or industries. By designing courses aligned with the actual job requirements, students can acquire the necessary professional skills while studying at school[1-2].

2. The status of virtual simulation practical teaching in aviation vocational colleges.

With the deepening of smart aviation construction and the application of new technologies and concepts, the criteria for selecting personnel for various professional technical positions in the aviation industry are gradually increasing. This calls for higher requirements for the talent development capabilities of aviation colleges, requiring more and more applied talents with a "craftsman spirit." Cultivating the "craftsman spirit" and highlighting practical training abilities have become urgent priorities. It represents the organic integration of innovative consciousness and hands-on abilities and is an essential support for enhancing students' practical training capabilities. Virtual simulation experimental teaching is the deep integration of information technology and professional training, and it is an important part of the informationization construction of higher vocational education. By integrating virtual simulation training equipment and facilities with virtual simulation experimental projects, it plays a crucial role in improving students' professional and innovative abilities.

Although aviation colleges have made active explorations in the construction of virtual simulation experiments in recent years, there are still issues such as redundant resource procurement, low quality of virtual simulation experimental construction, poor compatibility and scalability, and the need for further exploration and improvement of specific teaching methods. With the deepening of virtual simulation experimental teaching, it is important to explore how it can truly improve students' practical skills, contribute to the development of talent cultivation, explore substantial explorations to improve the

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effectiveness of educational administration in the digital age, and how to construct the experimental teaching center in the era of new technology. Therefore, there are still issues to be addressed in terms of construction concepts, methods, and means. Through literature review and on-site interviews, it is found that there are certain issues still present in virtual simulation practical teaching in aviation vocational colleges, manifested in the following aspects:

First, there is a lack of top-level design and overall planning in the construction of virtual simulation teaching systems in aviation vocational colleges. Although a number of virtual simulation resources have been established around the field of aviation operations support, the lack of a comprehensive application advancement mechanism prevents the production of unified educational management, teaching evaluation, and teaching decision-making. As a result, the virtual simulation practical teaching hardware platform built around aviation operations support has not fully covered the core job positions in this field, and students' thinking, understanding, application, and creativity of the learned theories have not been fully triggered during the actual teaching application process.

Second, there is insufficient construction of virtual simulation experimental teaching resources in the field of aviation operations support. Given the national emphasis on virtual simulation experimental teaching, research in this field in aviation vocational colleges started relatively late. It lags behind in terms of enterprise data accumulation, typical cases, collaborative development, software integration, and platform construction, leading to a relative shortage of materials that can be transformed into virtual simulation teaching scenarios. The construction of teaching resource systems, construction goals, construction contents, funding guarantees, and institutional mechanisms are not yet perfect, resulting in inadequate virtual simulation experimental teaching resources.

Third, an effective hybrid virtual simulation experimental teaching model combining online and offline applications has not been formed in the field of aviation virtual simulation practical teaching. Currently, most teachers in aviation vocational education still use a model where the teacher guides students to complete experimental content. There is a lack of clear thinking and implementation methods on how to use virtual simulation technology and platforms for experiential, immersive teaching, focusing on students' experience, thinking, application, and innovation in virtual environments. The shift from a teacher-centered approach to a student-centered teaching model and the transformation of traditional offline classroom teaching into a combination of online and offline teaching models have not been clearly outlined.

Lastly, the concept of “smart aviation” has not truly become the guiding principle for the construction of virtual simulation public training centers in aviation vocational colleges. With the advancement of smart aviation construction, the development of aviation industry also undergoes new changes, such as the change in active safety business models, the change in collaborative operational control systems, and the change in end-to-end passenger service models. However, the currently constructed virtual simulation platforms and resources have not kept up with the times in terms of developing corresponding functions, leaving a significant room for improvement[3-4].

3. Enlightenment of domestic virtual simulation training construction on virtual simulation practice teaching of civil aviation higher vocational education

Virtual simulation training is widely applied in China, including in experimental teaching in general undergraduate institutions, engineering practical training, professional internships, vocational college practical training, competition teaching, 1+X skill level certificates, safety education, ideological and political education, innovation, and entrepreneurship education in schools, as well as remote skills training in continuing education and adult education for enterprise employees. At the end of 2022, the General Office of the Communist Party of China Central Committee and the General Office of the State Council issued the “Opinions on Deepening the Reform of Modern Vocational Education System Construction,” emphasizing the development and strengthening of the national vocational education smart education platform, and the establishment of vocational education virtual simulation training bases and other key projects, in order to expand the sharing of high-quality resources and promote changes in education teaching and evaluation methods. At the macro level, domestic virtual simulation training resources mainly include online simulation resources of the national smart education platform and virtual simulation training bases (centers) of local colleges.

On March 28, 2022, the “National Smart Education Platform” was officially launched, providing rich virtual simulation training resources, including the “Virtual Experiment” (N = 297) of the national higher education smart education platform and the “Virtual Simulation Training Center” (N = 1557) of the national vocational education smart education platform. The virtual simulation experiment resources

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offered by "Virtual Experiment" mainly focus on engineering and science majors, where students use computers to complete virtual simulation experiments to master the principles and operational skills of the experiments. As of October 2023, the "Virtual Experiment" service has covered 2,687 universities nationwide, with more than 16 million experimental participants. The virtual simulation resources of the "Virtual Simulation Training Center" include 778 training software and 779 3D models, serving three levels of vocational undergraduate, higher vocational, and secondary vocational education, covering 17 major categories including equipment manufacturing, civil construction, electronic information, transportation, resource environment, and safety. Students familiarize themselves with operational procedures through digital simulation training to deepen their understanding of knowledge and strengthen their acquired skills[5-6].

On the front of universities and colleges, vocational colleges have widely and effectively implemented virtual simulation training. The Ministry of Education issued the "Guiding Opinions on Further Promoting the Informationization of Vocational Education", which requires orderly guidance for vocational colleges to develop virtual simulation training resources based on workplace environments and work processes, and to select and promote exemplary virtual simulation training bases nationwide. By the end of 2022, the average number of virtual simulation training rooms per major in vocational colleges was 13.69, and the average number of virtual simulation training bases (centers) per major was 9.59. China has successfully established one national vocational education virtual simulation training demonstrative base and launched 215 vocational education demonstrative virtual simulation training base cultivation projects. The national vocational education virtual simulation training demonstrative base in Jiangxi consists of 28 virtual simulation teaching and experimental centers for professional groups, which can accommodate 10,000 students for internships and training at the same time. The 215 national demonstrative cultivation projects are spread across 31 provinces, with Guangdong, Sichuan, Tianjin, Jiangsu, Zhejiang, and Shandong provinces having more than 10 projects. From the distribution of demonstrative bases, Guangdong Province, economically developed provinces along the eastern coast, as well as Sichuan Province and Henan Province, which are developed inland provinces for vocational education, have more bases. However, the number of bases is relatively less in western and some central provinces, which also reflects the differences in the investment intensity of virtual simulation training funds in different regions of China. The schools participating in the construction of these 215 demonstrative bases include higher vocational colleges (N=193), secondary vocational schools (N=16), undergraduate vocational colleges (N=5), and municipal public training centers (N=1), among which higher vocational colleges play an important role in the construction of virtual simulation training bases.

4. Conclusions

From the above analysis, virtual simulation teaching has been widely applied in the field of education. Based on the problems existing in virtual simulation practical teaching in civil aviation higher vocational education mentioned above, we can draw on the mature cases and experiences of virtual simulation practical teaching in China. Civil aviation higher vocational education virtual simulation practical teaching should carry out systematic work and reforms from the following aspects, in order to better adapt to the impact brought by the development of "smart civil aviation" on professional skills, professional knowledge, and professional abilities.

Firstly, in the process of constructing virtual simulation teaching resources in civil aviation higher vocational colleges, it is necessary to shift from offline construction to online construction and emphasize the openness and sharing of resources. In recent years, due to budget limitations, civil aviation higher vocational colleges have not received sufficient financial support for virtual simulation practical teaching. If more attention is focused on the construction of offline virtual simulation resources, a large amount of hardware equipment such as computers need to be purchased, and corresponding training rooms and venues need to be built. The funding needed for the above work is relatively large, which poses a significant financial challenge for civil aviation higher vocational colleges. At the same time, it is explicitly stated in the evaluation criteria for the identification and review of virtual simulation practical teaching bases that the construction of online shared virtual simulation resources should be realized. Although this requirement is not a deal-breaker, the ability to achieve online resource sharing has been implicitly considered as a necessary condition in various evaluations. In summary, in the process of constructing virtual simulation practical teaching resources, civil aviation higher vocational colleges should focus on the construction of online resources, realize resource sharing and ubiquitous learning. In the future, a hybrid model that supports the multi-platform and shared use of virtual simulation practical training resources will become the trend of development in civil aviation higher vocational colleges.

Secondly, in the process of constructing the virtual simulation teaching system, civil aviation higher vocational colleges need to change their mindset, focusing not only on system construction but also on the development of content and substance. Civil aviation higher vocational education is different from

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undergraduate education. Undergraduate education is based on the discipline system, while civil aviation higher vocational education is based on job positions. This requires civil aviation higher vocational colleges to pay attention to the content and integration of the developed training resources with the professional courses in the construction of virtual simulation practical teaching system. Information technology should effectively support the teaching content and play a role in innovating teaching methods, content, and modes. The system should be oriented towards the practical needs of training teaching, emphasizing the integration of virtual simulation practical training resource content with traditional practical training and practical job skills, and aligning with student conditions, school conditions, and social demands. A multi-level practical teaching system should be constructed, including "professional basic knowledge, virtual simulation experiments and practical training, real simulation and practical training, and scientific and technological innovation practice," thus avoiding the situation of "heavy infrastructure construction and light substance development".

Thirdly, in the process of introducing virtual simulation equipment and resources into the talent development system, civil aviation higher vocational colleges should plan ahead and reduce the difficulties faced by teaching staff in the application of virtual simulation teaching. The "Opinions on Deepening the Reform of the Modern Vocational Education System" and the "Notice of the Ministry of Education on Accelerating the Key Tasks of Reforming and Advancing the Construction of the Modern Vocational Education System" (Education Reform Office Letter [2023] No. 20) clearly propose to build around 200 national exemplary virtual simulation bases and promote the construction of about 1,000 regional exemplary virtual simulation bases by 2025. This would facilitate the innovation of vocational college technical skills training and teaching models, with virtual simulation teaching becoming an important initiative at the national level to promote talent reform and enhance the quality of talent development. Integrating virtual simulation practical training into traditional training classrooms will become a trend. However, due to uneven teacher capacity development, some teachers have relatively low acceptance levels of new things, inadequate ability to optimize, innovate, and transform teaching activities using digital technology, and may have some resistance. This requires civil aviation higher vocational colleges to plan ahead and systematically train teachers in the mastery and use of virtual simulation practical training resources to ensure smooth progress in promoting the application of virtual simulation technology in information teaching in the future.

Fourthly, in the process of constructing a virtual simulation system, civil aviation higher vocational colleges need to focus on solving the difficulties and pain points of meeting actual needs and achieving consensus with enterprise recognition. In the construction of the virtual simulation practical teaching system, the teaching team of civil aviation higher vocational colleges lacks experience in terms of concepts and practices related to higher vocational education, making it difficult to describe their own needs in a way that matches the relevant concepts and practices of civil aviation higher vocational education in talent development. There is excessive reliance on enterprises to provide comprehensive construction plans. However, in reality, enterprises have a better understanding and mastery of virtual simulation technology, but the concept of how to integrate job responsibilities with enterprise technology is vague. Conversely, enterprises want to rely more on colleges to provide well-designed ideas. This creates a contradiction between the two parties, making it difficult for effective communication and the establishment of a virtual simulation teaching system that matches enterprise technology and meets the actual teaching needs of colleges.

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