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The Educational Metaverse and Vocational Education in the Web 3.0 Era: Development Demands, Practical Paths, and Risk Governance

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Abstract: ***The educational metaverse is one of the several major application fields of the metaverse and a new educational form for the future, and its implementation technologies and ecological characteristics—immersion, interactivity, digital twins, persistent virtual space, and decentralized identity—coincide closely with the development demands of vocational education in the new era. This alignment matters at considerable scale: China operates roughly 11,000 vocational institutions enrolling about 35 million students, yet many programs remain constrained by the high cost of physical training equipment, since industrial robot cells, CNC machining centers, and automated production lines can absorb a substantial share of a program's capital budget—an obstacle that virtual training environments are well positioned to offset. The main demands of vocational education in the Web 3.0 era include eliminating social prejudices while accelerating development toward digital and intelligent directions; innovating evaluation methods and constructing a comprehensive evaluation system capable of dynamic tracking and data orientation; deepening the concepts of "bringing in" and "going out" while keeping pace with the globalization of vocational education; and improving the top-level design of vocational education so as to actively cope with the pains of industrial transformation. Based on these demands, the metaverse can assist vocational education along five practical paths: virtual teaching equipment that compensates for shortfalls in the capacity to run vocational schools; digital virtual environments that promote the occurrence of deep learning; digital virtual teachers that meet students' personalized learning needs; NFTs that facilitate the construction of "credit banks" and the implementation of the "1 + X certificate" system, a reform launched in 2019 under the National Vocational Education Reform Implementation Plan alongside the National Vocational Education Credit Bank; and vocational education training communities that promote the sharing of vocational education resources and educational fairness. Institutional momentum is already evident, as the 2022 EDUCAUSE Horizon Report identified the metaverse as an emerging technology for teaching and learning, and several Chinese provinces have begun building VR-enabled training bases in cooperation with technology enterprises. Finally, it is necessary to pay attention to taking the necessary measures to prevent risks such as data privacy leakage, illegal activities and false content, and the risk of lack of subject awareness.***

Keywords: Educational metaverse, Vocational education, Web 3.0, Digital virtual environment, NFTs, Credit bank, 1 + X certificate system, Risk prevention.

1. Introduction

In the 1980s, the Institute of Modern Educational Technology led by Beijing Normal University and East China Normal University began to explore the strategic methods and practical models of applying information technology to education. To this day, on the path of the integrated development of technology and various types of education, we have experienced the “web1.0 + education” model dominated by PC computers, the “web2.0 + education” model dominated by mobile applications, and now we are on the eve of the booming development of the “web3.0 + education” model dominated by artificial intelligence and the metaverse. The impact of technology, especially emerging technologies, on education is mainly positive.

In 2021, the metaverse technology exploded. Its essence is to construct a “third space-time” that combines virtual and real by integrating blockchain, artificial intelligence, virtual reality, and visual immersion technology. In this unique space-time environment, multi-modal teaching will be easier to achieve. Of course, the technological revolution will surely bring changes from ideology to theoretical model and then to application scenarios, which is the internal logic of the birth of the educational metaverse. Therefore, the metaverse provides new ideas for the digital and intelligent development of vocational education. As a brand-new conceptual model, the most prominent feature of the metaverse is that it can provide a completely immersive virtual teaching environment for both teachers and students, create favorable conditions for the cultivation of deep learning, critical thinking, and innovative thinking, and make it possible to build a dynamic tracking and data-driven comprehensive evaluation system. At present, with the dual support of policy promotion and market demand, the development of vocational education has gradually entered the fast lane. Vocational education is not only one of the foundations of the country’s economic and social development but also the main means to narrow the talent supply-demand gap and fill the talent gap. Therefore, it is urgent to master and accelerate the integration and application of the metaverse and vocational education. Based on an understanding of the actual needs of the industrial community, how to promote the development of the vocational education metaverse, how to solve the “three highs” (high cost, high risk, high pollution) and “four difficulties” (difficult to go down, difficult to operate, difficult to observe, difficult to reproduce) problems in vocational education, and how to cultivate middle and senior talents with both morality and skills and in line with the development of the times are important contents to be explored and clarified in the future.

2. In the Era of web3.0, the Development Demands and Necessary Shifts of Vocational Education

2.1 Urgently Need to Eliminate Biases From All Sectors of Society and Accelerate the Development Towards

Digitization and Intelligence

The newly revised Vocational Education Law has clearly stated that vocational education has the same status as general education and is an important way to cultivate enterprise innovation talents, inherit technical skills, promote entrepreneurship and innovation, and achieve common prosperity for all people. This has, to a certain extent, alleviated the discrimination and prejudice that the society, especially employers, have long had against vocational education students. The improvement of the status of vocational education requires the attention of relevant national departments and the support of policy documents, as well as the joint efforts of vocational colleges and the industrial circle to explore a unique innovation path. At present, while cautiously expanding the scale of vocational education, it is necessary to avoid blindly replicating the educational experience of general undergraduate education, promote the integration of vocational and general education, the integration of industry and education, and the integration of science and education, and optimize the type positioning of vocational education. The virtual platform provided by the metaverse can connect all parties like a纽带. The government should do a good job in macro-control, coordinate the connection between emerging industries such as energy and environmental protection, aerospace, and intelligent transportation and schools, and further clarify the talent demand and cultivation direction; enterprises should provide virtual training platforms to guide students to master job skills proficiently and do a good job in the connection between students' internship and graduation; schools can, on the one hand, do a good job in external enrollment publicity, and on the other hand, display the school's advantageous majors and the experience of cultivating excellent students, and promote the comprehensive construction of the vocational education ecosystem.

2.2 There is an Urgent Need to Innovate the Evaluation Method and Build a Comprehensive Evaluation System That can be Dynamically Tracked and Data-driven

The existing evaluation system for vocational education is basically copied from general secondary and higher education. Under the existing evaluation system, biases such as "scores determine the future" and "vocational education students are just those who can't get into college and muddle along" are likely to emerge. Relying on the technologies and platforms provided by the metaverse, giving play to the evaluation role of stakeholders in vocational education, and doing a good job in data collection, analysis and feedback to break the inherent biases of "solely score-based evaluation" and "solely origin-based evaluation". At the macro level, dynamically monitor the quality of talent cultivation and professional development, abandon the previous subjective evaluation and the single evaluation method mainly based on the employment rate, encourage all localities to explore and build a scientific, standardized, dynamically tracked and data-driven comprehensive evaluation system based on big data, and pay attention to giving play to the functions of process data monitoring and evaluation and data feedback and early warning, comprehensively and accurately diagnose the advantages and problems in the professional construction and talent cultivation of vocational colleges, and accordingly put forward improvement measures. At the micro level, it is necessary to improve and iterate the personal evaluation system of students, unite the three parties of the government, schools and enterprises to establish an evaluation system and tools mainly oriented by occupation, based on students' performance, their own potential and skills advantages, help students establish virtual personal files and personalized learning paths, and form periodic reports, helping students strengthen their sense of subjectivity and competitiveness and actively engage in the path of improving their own vocational skills.

2.3 Deepen the Concepts of "introducing in" and "going global", and Keep Up with the "globalization" Trend of Vocational Education

In recent years, under the background of policy support and the Belt and Road Initiative, vocational education has achieved good results, including establishing stable connections with more than 70 countries and educational departments along the Belt and Road, jointly running "Luban Workshops" with vocational colleges in nearly 20 countries, and launching "Chinese + Vocational Education" characteristic projects in more than 40 countries and regions. However, in the process of "bringing in" and "going global", many problems have emerged. For example, many vocational colleges directly copy the talent cultivation programs and curriculum settings of foreign countries. Due to the lack of observation and learning of excellent cases and industrial practices, neither domestic teachers nor students can well adapt to the industrial structure transformation and the reshaping of production relations brought by new technologies in a short period of time, and thus cannot deeply understand the changes in production processes brought by these technologies. In addition, the actual application effects and practice experiences of the combination of these technologies and industries in foreign countries are significantly more solid and rich than those in China. Without sufficient understanding of the national conditions and industrial development characteristics of the partner countries, some vocational colleges blindly establish campuses and start classes. During the teaching process, due to the cognitive deviation in the use of professional terms and foreign teachers and students, they cannot communicate well, and lack an educational concept that combines internationalization and localization, and have not formed a vocational education talent cultivation model with local characteristics. We should always be clear that bringing in is not a simple "copycat approach". The purpose is to selectively introduce excellent talent cultivation models and scientific practices of integrating industry and education from other countries to optimize and improve the existing courses and cultivation programs. Going global is not "blind expansion" either. The purpose is to enhance international influence and the level of internationalized education, and cultivate compound high-precision professional talents with an international perspective under the cooperation mechanism of mutual learning, joint consultation, sharing, and friendly competition.

2.4 Strengthen and Improve the Top-level Design of Vocational Education to Actively Address the Pains of Industrial Transformation

Government coordination and policy drive are both essential for the top-level design of vocational education. At present, China is facing an important development opportunity for the transformation and upgrading of the industrial structure, and vocational education has also reached a crucial period of "reducing the fat and increasing the muscle" and optimizing its own system. Vocational education not only plays a connecting role in economic construction but is also a key link in the effective allocation of labor resources. As the intermediate link between vocational education students, society, and enterprises, vocational education should not only focus on school-age students but also consider various social groups such as veterans, unemployed people, migrant workers, and new-generation farmers as much as possible, create a good educational atmosphere for them, and implement the educational principle of teaching students in accordance with their aptitude and making the best use of their talents. However, there are still many pain points in the process of accelerating the integration of industry and education, reforming and implementing the training plan. For example, some vocational schools overemphasize the mastery of vocational skills and neglect the cultivation and shaping of the moral education of vocational education students; schools strongly advocate curriculum reform but lack scientific design and subsequent iteration mechanisms, without the participation of first-class experts in the industry and senior technical personnel of enterprises. It is simply that teachers and students are going in circles in place, and the effect of talent cultivation is not satisfactory; the training plan of higher vocational schools is out of touch with the actual employment needs of enterprises, and the school-enterprise cooperation mechanism is superficial and unrealistic; the school-enterprise cooperation and industry-education integration cooperation mechanism are imperfect, and some enterprises are not active enough; curriculum resources, technical facilities, and training platforms are not fully utilized, resulting in a waste of a large amount of resources. The top-level design should be both far-sighted and down-to-earth. Therefore, while the government formulates relevant policies, it should also deeply participate in the specific work of implementing the training plan, school-enterprise collaborative education, constructing the standard system, and building digital resources, play a role in coordinating, supervising, and standardizing the work of all parties, so as to promote the skill transformation of practitioners and comprehensively improve the efficiency of the industry in the face of industrial structure upgrading.

3. Potential Risks of Metaverse Empowering Vocational Education

3.1 Risk of Data Privacy Leakage

The metaverse is a virtual "utopia" characterized by openness, co - construction, and sharing. In an ideal state, vocational education students will enter the metaverse education platform by replacing their real bodies with virtual avatars. Given that the current platform construction norms are not yet perfect and there are regulatory blind spots in algorithmic data, as virtual avatars interact deeply with other virtual objects, students' personal privacy data, including their personal physiological information, learning performance, and behavior trajectories, are easily stolen and misused. Once personal data privacy is leaked, it will have an impact on students' physical and mental health and personal reputation. Therefore, a privacy protection mechanism must be adopted for all personal information in the metaverse, and privacy data shall not be used for algorithm training, analysis, etc. without authorization, ensuring that the data flow is traceable and the application is visible.

3.2 Risks of Illegal Activities and False Content

In the virtual realm of the metaverse, any activity scenarios that are not permitted by the laws, regulations, or ethical and moral standards of the real world can be fabricated with creativity and imagination. Since vocational education students need to train their skills in different practical scenarios, they will inevitably come into contact with some violent factors and bad information that are not within the controllable range, which will have a profound impact on students' personal values and mental health. At the same time, since it is difficult to prevent the generation and spread of false content, some false information not only easily misleads students, causing them to become addicted, but also poses a great challenge to personal, public interests, and social ethical bottom lines. Therefore, measures must be taken to manage and supervise all scenarios and information in the metaverse, conduct real - name authentication for all entities, and optimize and improve the operation and operation mechanism of the metaverse platform to ensure the legality and standardization of the virtual environment.

3.3 Risks of Lack of Subject Awareness

Before entering the vocational education metaverse, students have absolute autonomy in creating and designing virtual avatars. They can customize various physical attribute information through the editor, such as height, appearance, gender, age, etc., to create an ideal digital human The stunt double that meets their own expectations. However, this compensates for the individual's' regrets' in the real world to a certain extent, this excessive shaping of "virtual characters" not only Contrary to the original intention of creating the vocational education metaverse platform, it has sparked ethical controversies in educational management. However, it also easily leads to students' self-awareness deviation in the virtual environment, confusion with the behavior and consciousness of real-world subjects, and subtly changes the original value judgment standards and rational decision-making level of real-world subjects Therefore, it is necessary to strengthen psychological counseling and awareness cultivation for students to ensure that they can view the metaverse platform scientifically and rationally, Standardize one's own behavior, so as to give full play to the maximum value of the vocational education metaverse platform, which Combining skill enhancement and scientific education

4. Paths for the Metaverse to Empower Vocational Education

Path 1: Virtual teaching equipment to address the shortcomings of vocational education

Compared with primary and secondary education, one of the

differences in vocational education is that it requires teaching equipment for the learning and practice of practical skills. Vocational colleges should not only pay attention to the achievement of practical skill teaching goals, but also equip various equipment required for teaching. For example, vocational colleges aiming to cultivate senior technicians in the automotive industry should equip a certain number of automotive parts for students to disassemble, repair and assemble; vocational colleges aiming to cultivate operators of certain large machinery should equip corresponding mechanical equipment for students to familiarize themselves with the operation. Some equipment not only occupies a large area, has high requirements for the operating environment, but also is expensive and needs to be upgraded and maintained regularly. This not only affects the normal teaching of vocational schools, but also poses great pressure on financial funds. The digital virtual teaching equipment in the metaverse can easily solve such problems. Various highly simulated virtual equipment can simulate real equipment in the real world to the greatest extent, allowing students to complete operation exercises under nearly real scenarios. Conducting vocational skill teaching and training in the metaverse can effectively avoid and solve a series of problems such as high upfront investment in physical teaching equipment, complex upgrade and maintenance, and possible machine damage caused by incorrect operation. At present, in some specific professional fields such as military training and aerospace in government departments and scientific research institutions, the use of digital virtual equipment for training is gradually becoming popular, proving the feasibility and practical value of vocational skill training in the metaverse environment. Vocational schools with the necessary conditions need to carry out further exploration and attempts.

Path 2: Digital virtual environments facilitate the occurrence of deep learning

In the vocational education metaverse, people, objects, and fields are all virtual, corresponding to virtual digital humans, virtual objects, and virtual environments. From the perspective of embodied cognition theory, the outstanding advantage of the metaverse empowering vocational education is that it can create a digital virtual environment, which breaks through the limitations of physical space and enables both teachers and students to complete a series of teaching-related interactions in the identity of virtual digital humans. At the same time, three-dimensional virtual environments have been used in science education for more than a century and have been proven to be able to effectively reduce cognitive difficulties and promote the occurrence of deep learning. We should fully recognize the potential "virtual-real symbiosis" vocational education learning environment that the metaverse may achieve in the future, and targetedly transform regular teaching content into intelligent, digital, and visual forms, creating favorable conditions for teachers and students to complete immersive multi-modal teaching interactions in the metaverse. In the near future, an integrated environment supported by 6G networks, artificial intelligence, and brain-computer interfaces will be able to enter the virtual environment at any time for the service of vocational college teachers and students. Students can fully immerse themselves in various teaching scenarios that combine teaching and fun to complete deep learning. Currently, a number of domestic and foreign universities and enterprises have completed the development of virtual course resources and have tried to place some courses in the virtual environment for teaching. Teachers and students can use external devices such as VR glasses, gamepads, and sensors to practice some practical skills. Although the existing course resource development is not yet perfect and the actual experience may be unfamiliar, more and more scientific research institutions and vocational colleges have realized the potential value of the metaverse and actively participated in the construction of virtual environments and virtual teaching resources, contributing to the upcoming vocational education metaverse ecosystem.

Path 3: Digital Virtual Teachers Meet the Individualized Learning Needs of Students

In January 2018, the State Council issued the "Opinions on Comprehensively Deepening the Reform of the Construction of the Teacher Team in the New Era", which specifically mentioned that it is necessary to "improve the quality of vocational college teachers as soon as possible, aiming to build a group of high-quality dual-qualified teacher teams". Based on the research and analysis of the current situation of vocational college teachers, it is not difficult to find that there is a lack of "dual-qualified" teachers who have both theoretical and practical teaching abilities and are also compatible with the majors they teach. Digital virtual teachers created using technologies such as artificial intelligence, the metaverse, and digital twins can largely solve the problem of teacher shortages in vocational education institutions. Moreover, digital virtual humans have been successfully implemented in the media field and have appeared frequently in scenarios such as the Olympics, holiday galas, and concerts in recent years. Highly anthropomorphic digital virtual humans can bring a strong sense of embodiment, participation, and satisfaction to the audience. In the vocational education metaverse, digital virtual teachers with professional theoretical and practical teaching abilities can be created by pre-setting knowledge bases, knowledge graphs, and configuring corresponding scripts according to needs and scenarios. Such teachers can not only improve themselves through deep learning during teaching and interaction with students, but also provide 24-hour uninterrupted personalized teaching services, Provide guidance and correction to students' questions raised in theoretical learning and practical operations at any time, and allow students to experience a "warm" education firsthand, enabling them to efficiently complete learning in a companion and immersive virtual environment.

Path 4: NFT Facilitates the Construction of "Credit Banks" and the Implementation of the "1+X Certificate" System

From 2019 to the present, the state has successively issued documents such as the "National Vocational Education Reform Implementation Plan", the "Pilot Plan for Implementing the 'Academic Certificate + Several Vocational Skill Level Certificates' System in Vocational Colleges", and the "Regulations on the Construction of the National Vocational Education Credit Bank (Trial)". It can be seen from the detailed rules of the documents that the "Credit Bank" system focuses on the accumulation of students'

achievements, while the "1 + X certificate" system emphasizes the comprehensive evaluation of students. Both are important directions for the digital reform of vocational education and the main means to promote individualized teaching and multiple evaluations in vocational education. Based on the "Credit Bank" system, it is possible to better coordinate different types of education methods such as school education and non-school education, adult education and vocational training. Students can convert their academic achievements, work experience, and skill levels into corresponding credits and deposit them in the "Credit Bank"; the implementation of the "1 + X certificate" system encourages students to actively participate in learning and competitions during their school years to obtain more vocational skill certificates. This system is not only a proof of students' comprehensive abilities during their school years but also enhances their future employment competitiveness. In the metaverse, NFT (Non-Fungible Token), implemented using blockchain technology, can be perfectly integrated with these two reform measures and applied to vocational education. NFT can distributively record students' learning achievements, work experiences, and the skill certificates they have obtained. At the same time, through encrypted credentials between blocks, NFT can freely circulate between different digital ledgers. Its decentralized, unique, and immutable characteristics greatly ensure the security and ownership of students' personal data. NFT can also distribute priced virtual items as rewards to outstanding students, and students can obtain learning incentives with different experiences. After the metaverse and the real world reach a state of virtual and real symbiosis in the future, all the achievements and experiences of vocational education students recorded by NFT will not only be digital assets but also have greater social value.

Path 5: Create a vocational education training community to promote the sharing of vocational education resources and educational fairness

On the premise of grasping the trends of industrial transformation, it is necessary to further build a vocational education and training community featuring the integration of industry and education and coordinated development. Based on the characteristics of the metaverse's virtual-real fusion environment and its ability to break through geographical restrictions, a vocational education and training community can be created, which can be further divided into a learning community for students, a training community for teachers, and a school-enterprise interest community for school-enterprise cooperation. The learning community enables vocational education students from different countries and regions to exchange experiences and discuss technologies they are interested in learning, which can not only broaden students' horizons but also promote cultural exchanges; the training community helps teachers from different regions and majors improve their teaching and practical deficiencies and absorb the experience of excellent teachers from other regions, promoting the professional development of teachers; the school-enterprise interest community can further deepen cooperation between different countries and regions, enabling enterprises and schools to have more exchanges and integrations in aspects such as the vocational education and training system and industrial structure adjustment. Different organizations and individuals are no longer restricted by real geographical locations, common identities, common majors, etc. as before, and can freely join various types of communities in the metaverse environment according to interests, geographical locations, professional directions, etc. Such a relationship among multiple subjects not only gives full play to collaboration, mutual benefit, and sharing but also indirectly realizes vocational education fairness. Of course, the formation of such a vocational education and training community ecosystem also depends on the overall planning, scientific design, and leading participation of the government. With the joint efforts of the government as the core, enterprises, schools, information technology departments, and other stakeholders, the vitality of different vocational education communities can be maximally stimulated, ultimately meeting the future development and lifelong learning needs of vocational education students.

5. Conclusion

With the support of national policies and all sectors of society, vocational education will explore more teaching models and training scenarios. At the same time, as the underlying support technologies of the metaverse platform become more mature, the practical paths for the metaverse to empower vocational education will become clearer. On the basis of taking preventive and avoidance measures, it will be better able to cope with the risks and challenges brought by the metaverse, further play the subjective role of students in the virtual field, and provide more possibilities for achieving the core goal of efficient education in vocational education.

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