WHIOCE PUBLISHING PTE. LTD.
PROVIDING
FIRST-CLASS SCIENTIFIC INFORMATION
FOR TOP SCHOLARS

2025 Volume 3, Issue 8
Contemporary Education Frontiers
ISSN (Online): 3029-1860 ISSN (Print): 3029-1879

The Construction of Metaverse Precision Teaching Fields from the Perspective of Embodied Cognition

Hongbin He
Ziyang Airport Economic Zone No. 1 Primary School Affiliated to Sichuan Normal University, Ziyang 641300, Sichuan, China

Abstract: In the new round of educational reform, large-scale personalization and teaching precision have become the current educational demands and practical challenges. Faced with the bottlenecks existing in the current precision teaching model, such as single data source, detachment from the needs of learning subjects, and limited research scope, from the perspective of embodied cognition, it is of typical significance to use metaverse technology to construct diverse teaching fields, conduct more accurate data analysis on learners in an intelligent environment, and build a generative knowledge system. Through the guidance of precise teaching design, strong correlation interaction characteristics are achieved, and the interactive relationship among individuals, activities and environments in the metaverse precision teaching scenarios and models is established. The intelligent environment provides adaptive feedback to individual learners, and conducts "intelligent adaptive" multi-modal spatial push to learners based on feedback data, thereby forming a data feedback mechanism and creating an operation system for classroom fields, so as to realize precise teaching supply.

Keywords: Metaverse; Precision teaching; Embodied cognition

Online publication: September 26, 2025

1. Introduction

The integration of education and technology is inevitably the development trend of educational reform. The precision teaching model, which features "student-centered and personalized customization", is highly dependent on data and is a typical example of "Internet + Education". This model can highlight learning behaviors, realize personalized guidance through measurement and tracking, and adapt to the needs of cultivating talents in the new era. Precision teaching can be regarded as the optimal choice for realizing smart education learning strategies and building future learning spaces [1]. The metaverse provides a new idea for solving such problems. From the perspective of metaverse space reform, immersive experience is realized through digital twin to construct a mirror effect connected with the real world, which exerts an influence on the intersubjectivity of teaching subjects under the support of a new type of Internet that integrates virtual and real elements. This is an effective embodiment of using intelligent technology to promote the precision teaching model, and the greatest potential of metaverse application lies in the field of education.

2. Problem statement

2.1. Development from the formation of precision teaching concept to the application of immersive scenarios

Based on Skinner's behavioral learning theory, O.R. Lindsley proposed Precision Teaching, which is the origin of this teaching model [2]. Initially, precision teaching tracked and investigated learners' learning status by designing measurement processes, and provided decision-making suggestions based on the collected data. Later, precision teaching was defined as an efficient teaching method or a behavioral assessment method. Some scholars also regard it as a basis for helping teachers make decisions on teaching implementation strategies. In addition, scholars in China such as Liang Meifeng, Zhang Lingzhi, Zhu Zhiting, and Peng Hongchao have also defined precision teaching [3–5]. Based on the above review, we define precision teaching as a precision teaching model supported by information technology, which accurately identifies learners' problems, collects relevant information, and formulates learning objectives, learning content, learning evaluation and teaching strategies based on learners' academic status [6–10].

2.2. Analysis of main problems in existing precision teaching models

Although precision teaching is an effective teaching model, the traditional teaching model lacks technical support, and its data feedback on learners relies on academic performance as the basis [11–17]. This approach not only ignores process analysis but also overlooks the personalized needs of learners [18]. With the empowerment of big data in teaching, research on precision teaching at home and abroad has made great breakthroughs: first, big data is used to collect relevant data of learners, overcoming the limitations of subjectivity in traditional manual recording and analysis; second, big data is used to focus on the process of learners' behaviors, overcoming the defect that only learners' academic performance could be used as the basis for analysis in the early stage; third, based on the existing technical level and theoretical system, a complete set of process systems can be implemented in practical teaching, providing relevant analysis charts, and teachers can also provide suggestions based on the data.

However, the following main problems still exist: first, due to technical limitations, it is difficult to prove that data analysis can truly reflect the current academic status of learners; second, the rigid-oriented evaluation model is difficult to meet the personalized needs of learners; third, the research scope is too narrow, which is still limited to the discipline field, and almost only involves subjects such as English, history, and mathematics; fourth, the optimization model for data analysis is insufficient, leading to a single teaching model, and precision teaching has not been truly "precisely" implemented for each learner. We urgently need a new theory as the basis to carry out more precise teaching practice.

3. Embodied cognition theory provides support for the development of scenario-immersive precision teaching

3.1. Basic propositions of embodied cognition theory

Embodied cognition originated from the phenomenological works of Varela FJ and Merleau-Ponty. Among them, Merleau-Ponty, the author of The Phenomenology of Perception, stated that the body is the subject of perception, and the external world is connected through the body. Varela believed that embodied cognition refers to the types of experience that cognition depends on various sensory abilities generated by the body, and these sensory abilities rely on extensive psychological and cultural contexts for support [19]. Embodied cognition is also called "embodied cognition", which refers to the mind based on the body and the body's functions [20]. The mind is always the mind of the body, and the initial mind is the internal connection between the structure of the body and the activity schema. Therefore, it can be concluded that human cognition needs to consider the interactive relationship among the subject, activity and environment, and this trinity system occurs in practice. From this perspective, embodied cognition provides a dynamic and new learning perspective, which enables more precise teaching compared with the traditional teaching field by focusing on the integration of learners' mind, body and environment [21,22].

3.2. The precision teaching model of scenario immersion should meet the three attributes of embodied cognition

3.2.1. Situationally of scenario-immersive precision teaching

The emphasis on situationally is because under the precision teaching model, cognition is not a universal behavior divorced from scenarios, situations and contexts, but should be embedded in the environment. The development of cognition occurs in a dynamic system composed of scenarios, the brain and the body. Precision teaching initially attempted to track the data of learners' learning status through designing measurement processes to realize "scientific teaching". Up to now, precision teaching refers to the teaching model supported by big data technology, which takes learners' learning as the center, accurately analyzes learners' academic status, designs teaching links, and helps educators design more efficient and accurate teaching activities [23]. Against the background of this cognitive theory that generally advocates learners' conscious thinking, we still need to reflect on the impact of external factors, not just internal factors, on learners' cognition.

3.2.2. Embodiment of scenario-immersive precision teaching

Scholars of objectivism regard learners as passive participants in the learning process. In traditional teaching, teachers only need to implement the established teaching process and use information technology to conduct mechanical score evaluation on learners (process evaluation is also conducted through mechanical score evaluation), which is the so-called precision teaching. However, learners live in a complex and diverse real world, and human cognition should not be separated from the external environment. Education should take "embodiment" as the starting point, provide learners with various learning resources they truly need, make learners the main body of learning events, and enable learners to truly participate in the classroom. This is a return to the essence of education and another foundation for constructing precision teaching.

3.2.3. Generativity of scenario-immersive precision teaching

The generativity of scenario-immersive precision teaching is reflected in the fact that the cognitive process is not a static, stagnant, mechanical and linear process, but a dynamic and developing system formed by the interaction of various factors from the brain, the body and the environment. Due to the particularity of learners as human beings, learning itself is a continuous cycle of "embodiment-cognition", rather than a fixed process strictly following "consciousness-result". Precision teaching needs to pay attention to the dynamic academic status of learners in order to form a generative mechanism beyond object dependence. For example, in traditional teaching without technical support, repeated and regular discussions can also symbolize specific problems. However, the above teaching methods based on the theory of faculty training ignore the subjective initiative of learners. In mechanical repetition, extended guidance and contextualized forms are not emphasized, thus limiting the possibility of learners' sustainable growth.

It may still be difficult to realize the model that combines rich environment construction, learners' practical participation and generative feedback mechanism. However, it is very necessary to make dynamic and flexible adjustments in advance according to the teaching process and learners' needs. Therefore, we need to break through the traditional perspective to examine the realization path and enter the field of metaverse research, which will be a new starting point for understanding precision teaching.

4. Basic path of constructing immersive precision teaching fields using metaverse

4.1. Basic development context of metaverse technology

The term "metaverse" first appeared in the science fiction novel Snow Crash. 2021 is known as the "first year of metaverse", and the influence of metaverse continued to rise in various industries in 2022. As early as 1990, Qian Xuesen translated "metaverse" as "Lingjing" (meaning "being personally on the scene"). Therefore, educational metaverse is a digital space that integrates human experience and thinking, civilization and wisdom, imagination and creativity. Thus,

metaverse refers to the large-scale integration of technologies such as artificial intelligence, VR/AR/MR, blockchain, communication technology, cloud computing, big data, and digital twin. It is a comprehensive manifestation of various information technologies.

It can be seen from the above that the construction of the metaverse digital space has a certain foundation. In the fourth stage, the metaverse will realize two-way human-computer transmission through brain-computer interface technology, that is, feeding back sensory and brain signals to users, who can control various parts of the body with their thoughts. In the experience of combining virtual and real elements, a more comprehensive and humanized data feedback mechanism brings possibilities for the realization of the precision teaching model.

4.2. Inherent implications of constructing immersive precision teaching fields in metaverse

The core of embodied cognition is to promote the cognitive development of the subject through the interaction between the body and the environment. Therefore, the key of embodied cognition is to enhance learners' multi-channel perception of learning content and learning activities generated in the learning scenario, so as to promote the development of learners. To realize precision teaching under embodied cognition, it is necessary to use metaverse as an intermediary bridge, as follows:

On the one hand, the virtual space of the metaverse is the second digital space of the metaverse relative to the real world. It provides immersive experience for learners through extended reality and other technologies, and presets and improves activities in the real world through the activities of virtual characters in the metaverse. This provides a more personalized basis for our behaviors, thus realizing precise scheme design [24]. The metaverse digital space provides multi-dimensional interactive teaching resources, making teaching content more vivid and three-dimensional, and providing learners with simulated learning scenarios to the greatest extent.

On the other hand, the effectiveness of teaching is reflected in both meeting the personalized needs of learners and maximizing the transfer of scientific knowledge to learners. To realize more targeted teaching scheme design, precision teaching needs to grasp the personalized goal needs, diversified teaching resource needs and dynamic academic feedback of learners. Only by building a complete and reasonable cycle system of goals, content and evaluation and endowing implementable technical basis can the realization of precision teaching be guaranteed.

4.3. Construction of precision teaching fields integrating metaverse

4.3.1. Essential characteristics of metaverse empowering precision teaching

First, adhere to learners' development as the teaching goal. Learners' development is regarded as the symbol of effective teaching. Metaverse technology can mobilize various sensory systems of learners, enabling them to fully participate in the learning environment constructed in various spaces. The development obtained is no longer limited to linear cognition but presents a diversified cognitive system. From the perspective of precision teaching, the development of learners is not a single repetitive model. It is precisely based on this understanding that metaverse precision teaching can create personalized learning spaces for learners, provide massive learning resources, and pay attention to the development of learners' practical behaviors while caring for the mobilization of learners' internal needs and learning motivation.

Second, provide innovative teaching design. It includes the construction of intelligent scenarios, the selection of teaching content, and the organization of teaching activities, all of which reflect innovative methods and more precise teaching design. The construction of intelligent spaces using somatosensory technology, extended reality and other information technologies is a necessary condition for the effective development of metaverse precision teaching; design activities and content that include the interaction mechanism of environment, subject and activity. In metaverse precision teaching, teaching resources are mainly carried by the scenario integrating virtual and real elements. Rich scenario resources can be used to organize different activities and set up content to meet the different needs of individuals, and also enable interactive experience between teachers and students, and among students.

Third, personalized data feedback. It is reflected in the diversity of data feedback and the accuracy of data analysis. Data can be fed back through learners' personal experience, mainly through learners' self-reflection to dynamically adjust

learning goals, and can also obtain data feedback through the third perspective; the embodiment of data feedback: using integration technology, big data and other intelligent technologies to track in real time, enabling teachers to provide targeted guidance to learners based on the obtained data.

4.3.2. Model framework construction of metaverse precision

Based on the theoretical perspective of embodied cognition, in the process of using metaverse technology to construct the field of precision teaching, on the one hand, based on the intelligent adaptive demand recommendation for individual learners provided by the metaverse technology cluster, including learning path guidance, behavior suggestions, resource push and process intervention; on the other hand, as the leader of teaching, teachers' optimal intervention on learner groups is based on big data analysis, continuously optimizing and improving teaching design with the support of information technology, and designing more effective and personalized teaching decisions.

With this as the main axis, taking embodied cognition as the theoretical cornerstone and the intelligent technology cluster as the support, the basic model paradigm of the metaverse precision teaching field can be constructed, as shown in **Figure 1**.

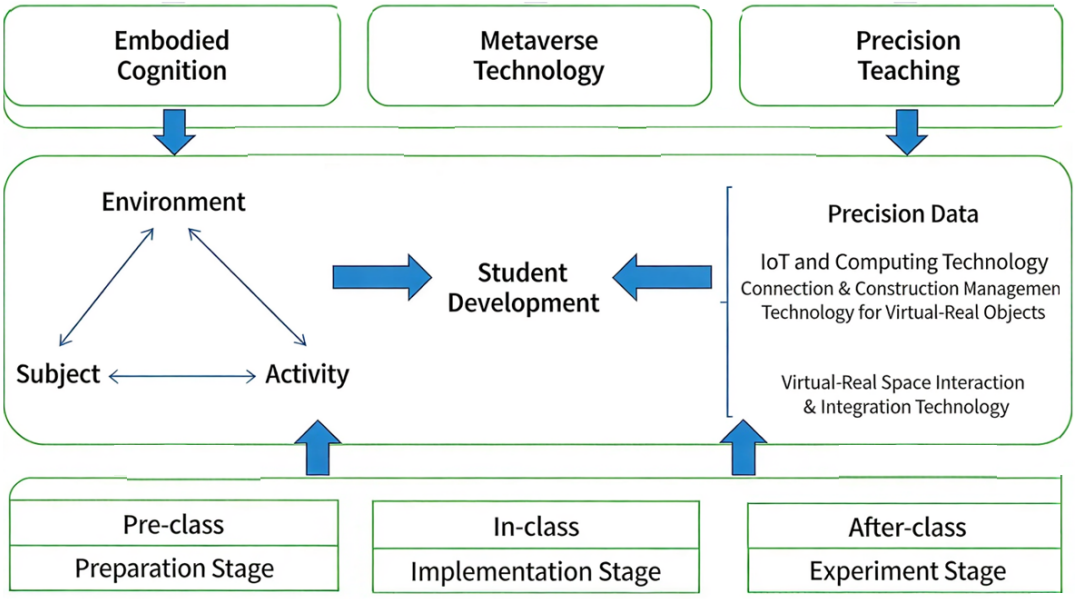

Figure 1. Basic model paradigm of the metaverse precision teaching field.

As shown in the figure above, the model consists of three parts: the first part is the theoretical basis of metaverse-enabled precision teaching; the second part covers the core elements involved in precision teaching and the related technologies for providing feedback data; the third part is the specific implementation steps of precision teaching. These three parts are interrelated and well-structured, forming the basic framework for constructing the metaverse-based precision teaching field.

4.3.3. Technical agent module of metaverse-enabled precision teaching

The metaverse is a cluster or ecosystem of digital applications constructed based on advanced digital technologies such as hybrid reality technology, brain-computer interfaces, blockchain, cloud computing, and next-generation communication technologies. It features openness, permanence, immersion, sociality, and richness [25–28]. To design precision teaching schemes and realize real-time data tracking, it is necessary to embed more intelligent technologies into the core of the metaverse, enabling it to empower the education sector to build a smart education environment and serve as the support for

an intelligent field integrating the virtual and the real. In fact, the metaverse is not a new technology; rather, it represents the comprehensive application of existing information technologies and a new phase derived from the development of information technologies. Among the diverse array of technologies, the metaverse space mainly leverages management technologies, network and computing technologies, virtual-real object connection, management and modeling technologies, as well as virtual-real space interaction and integration technologies, all of which provide support for the construction of precision teaching scenarios [29–35].

5. Conclusion

Since 2021, the concept of the "metaverse" has continuously come into public view. With the continuous maturity and innovation of various technologies, the popularization of the metaverse virtual space is no longer a distant prospect. At present, the integration of the metaverse and education is in a stage of gathering momentum for accelerated development, boasting enormous potential, yet it still faces several challenges.

First, there are ethical and moral issues [36–39]. Furthermore, the educational metaverse is a more free and inclusive space; how to establish ethical and moral principles recognized by both the metaverse and society based on a decentralized framework deserves further research. Second, challenges exist in terms of security and privacy. Third, technical limitations persist: even with the adoption of the X-network, current costs and technological development make it difficult to deliver immersive experiences to students.

Therefore, on the one hand, we must continuously innovate technologies to optimize learners' experiences. On the other hand, educators need to continuously improve their information literacy, proactively learn relevant knowledge, bravely embrace the teaching conveniences brought by AI technologies and internet big data, develop innovative thinking, and break through the "third barrier" to integrating technology into teaching scenarios.

In conclusion, empowering education through technology has become an irresistible trend, and leveraging metaverse technologies to construct precision teaching scenarios will become the new normal of education in the future [40].

Disclosure statement

The author declares no conflict of interest.

References

[1] Ministry of Education of the People's Republic of China, 2022, Key Points of Work in 2022[EB/OL]. (2022-02-08), visited on 2025-08-13, http://education.news.cn/2022-02/08/c_1211560325.

[2] Ministry of Industry and Information Technology of the People's Republic of China, 2022, Development Plan for Integrated Application of Virtual Reality and Industry (2022–2026) [EB/OL]. (2022-11-01), visited on 2025-08-13, https://www.miit.gov.cn/zwgk/zcwj/wjfb/tz/art/2022/art_775aaa3f77264817a5b41421a8b2ce22.html.

[3] Liang M F, 2016, An Analysis of "Precision Teaching". Fujian Education Research, 2016(06): 4–7.

[4] Zhang L Z, 2016, Research on the Precision Teaching Model in Flipped Classroom. Journal of Wuhan Metallurgical Manager's Institute, 26(02): 50–52.

[5] Zhu T, Pan H, Li Y, 2018, Intelligence Education: Practical an Approach to Smarter Education. Open Education Research, 24(08): 13–24 + 42.

[6] Peng H, Zhu Z, 2016, Generative Design of Precision Instruction Activities in Smart Learning Context. e-Education Research.

[7] Pan Y, 2009, The Demand for "Precision" in the Selection of Teaching Materials for Politics Courses. Ideological and

Political Education Teaching, 2009(06): 33–34.

[8] Li Y, Zhu Z, 2016, Precision Instructional Decision-Making Based on Data Analysis from Pre-learning. China Educational Technology.

[9] Cheng B, Liu C, 2015, Positioning Precise Objectives, Focusing on Efficient Classroom. New Curriculum (Primary School), 2015(10): 42–43.

[10] Peng H, Zhu Z, 2016, Generative Design of Precision Instruction Activities in Smart Learning Context. e-Education Research.

[11] Yang X, Li X, Xie B, 2018, Analysis of Construction and Trends of Educational Big Data Practical Framework for Smart Education. e-Education Research.

[12] Lindsley O, 1992, Precision Teaching: Discoveries and Effects. Journal of Applied Behavior Analysis, 1992(01): 51–57.

[13] Xu Y, Gao H, Sun H, et al., 2018, The Research on Changes of Learning Space in the Era of Artificial Intelligence. Journal of Distance Education, 36(06): 85–93.

[14] Peng H, Zhu Z, 2017, Assessment as Learning: The Core Mechanism of Precision Teaching in the Context of Smart Education. e-Education Research, 38(03): 94–103.

[15] Cao X, Zhang Y, Pan M, et al., 2019, Research on the Recognition Method of Learning Engagement from the Perspective of Artificial Intelligence. Journal of Distance Education, 37(01): 32–44.

[16] Shi F, Peng C, Tong W, 2019, Research on the Generative Recommendation Strategy of Precise Personalized Learning Path Based on Learning Profile. China Educational Technology, 2019(05): 84–91.

[17] Huang Y, Mao L, Zhang X, et al., 2021, Analysis and Process Design of Online Immersive Teaching System Based on Digital Twin Podium. Journal of Distance Education, 39(01): 51–62.

[18] Bai L, 2021, Precise Online Instructional Design Based on Teaching Community During the COVID-19 Pandemic: A Case Study of the C Language Programming Course. Computer Education, 2021(01): 36–41.

[19] Zhang X, Mou Z, 2018, Research on the Design of Precision Teaching Model Oriented to Personalized Learning in a Data-Driven Learning Environment. Modern Distance Education, 2018(05): 65–72.

[20] Merleau-Ponty M, 2001, Phenomenology of Perception, The Commercial Press.

[21] Varela F, Thompson E, Rosch E, 2010, The Embodied Mind: Cognitive Science and Human Experience, Zhejiang University Press.

[22] Lave J, Wenger E, 2004, Situated Learning: Legitimate Peripheral Participation, East China Normal University Press.

[23] Wang J, Chen W, 2012, Embodied Cognition Theory and Its Implications for the Application of Instructional Design and Technology. Journal of Distance Education, 30(03): 88–93.

[24] Griffin C, Murtagh L, 2015, Increasing the Sight Vocabulary and Reading Fluency of Children Requiring Reading Support: The Use of a Precision Teaching Approach. Educational Psychology in Practice, 31(02): 186–209.

[25] Livingstone D, Kemp J, 2006, Proceedings of the Second Life Education Workshop at the Second Life Community Convention. 3: 4.

[26] Cheng K, Tsai C, 2020, Students' Motivational Beliefs and Strategies, Perceived Immersion and Attitudes Toward Science Learning with Immersive Virtual Reality. British Journal of Educational Technology, 51(06): 2140–2159.

[27] Liang S, 2018, VR and 3D Education Blue Book. Beijing: People's Posts & Telecommunications Press: 5.

[28] Li Z, Li P, Zhou N, et al., 2018, Embodied Cognition Learning Environment Design: Characteristics, Elements, Application and Development Trends. Journal of Distance Education, 2018(05): 81–90.

[29] Liu G, Gao N, Hu H, et al., 2022, The Educational Metaverse: Characteristics, Mechanisms, and Application Scenarios. Open Education Research, 28(01): 24–33.

[30] Wang W, Zhou F, Wan Y, et al., 2022, A Survey of Metaverse Technology[J/OL]. Journal of Engineering Science: 1–14.

[31] Fettweis G, 2014, The Tactile Internet: Applications and Challenges. IEEE Vehicular Technology Magazine, 9(01): 64–70.

[32] Shi F, Ning H, Huangfu W, et al., 2020, Recent Progress on the Convergence of the Internet of Things and Artificial Intelligence. IEEE Network, 34(05): 8–15.

[33] Kim W, 2021, Edge Computing Server Deployment Technique for Cloud VR-Based Multi-User Metaverse Content. Journal of Korea Multimedia Society, 24(08): 1090–1100.

[34] Hourcade P, Braud T, Zhou Y, et al., 2024, All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda. Foundations and Trends® in Human–Computer Interaction, 18(2–3): 100–337.

[35] Torres Vega M, Liaskos C, Abadal S et al., 2020, Immersive Interconnected Virtual and Augmented Reality: A 5G and IoT Perspective. Journal of Network and Systems Management, 28(04): 796–826.

[36] Bi M, Wang Y, Cai Z, et al., 2020, A Privacy-Preserving Mechanism Based on Local Differential Privacy in Edge Computing. China Communications, 17(09): 50–65.

[37] Ning H, Hu S, He W, et al., 2012, nID-Based Internet of Things and Its Application in Airport Aviation Risk Management. Chinese Journal of Electronics, 21(02): 209–214.

[38] Sun H, Zhang X, Zhang Y, et al., 2015, Brain-Computer Interface Technology Based on EEG Signals. Anhui Science and Technology, 2015(04): 54.

[39] Ai X, Li W, 2021, Immersive Teaching Based on Embodied Cognition: Theoretical Framework, Essential Characteristics, and Application Exploration. Journal of Distance Education, 39(05): 55–65.

[40] Wang H, Ning H, Lin Y, et al., 2023, A Survey on the Metaverse: The State-of-the-Art, Technologies, Applications, and Challenges. IEEE Internet of Things Journal, 20(16): 14671–14688.