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CONSTRUCTION AND IMPLEMENTATION STRATEGY OF ONLINE-OFFLINE INTEGRATED TEACHING MODE OF "SUPPLY CHAIN MANAGEMENT" BASED ON DIGITAL TWIN

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ABSTRACT

With the continuous development of the modernization needs of education, the pure online or offline teaching mode can no longer fully meet the educational needs, and the online-offline integration teaching mode based on digital twin comes into being. Based on Bloom's taxonomy, this study constructs an online-offline fusion teaching model from the dimensions of teaching links, student activities, teaching resources, teacher activities and teaching evaluation. This study also explores the intrinsic mechanism of digital twin-driven online-offline fusion, and finally proposes a path for the implementation of the new teaching model, including infrastructure construction, teacher training, curriculum design and teaching evaluation reform, which provides a theoretical basis and specific suggestions for online-offline integration teaching practice.

Keywords: Digital twin, Online-offline integration, Teaching mode, Education modernization.

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1. INTRODUCTION

Higher vocational education is one of the important components of national education.It is a form of education most closely associated with economic and social development, and bears the important responsibility of cultivating high-quality technical and skilled talents[1]. Supply Chain Management is one of the professional core courses for the major pruchasing and supply management. It is of great significance to the development of students' key competencies and modern logistics operation and management abilities based on supply chain. The course cultivates students' supply chain professional skills from the perspective of understanding supply chain - constructing supply chain - planning, organizing and controlling supply chain operation and management. In the context of the booming digital economy and digital transformation of education, many colleges try to adopt the online-offline blended teaching mode in the teaching of this course. But due to the lack of teacher supervision and teaching interaction in online teaching, students generally suffer from the problems of inattention and poor learning experience, which directly affects the implementation effect of online-offline blended teaching.

The pure form of online and offline blended teaching has become an important factor affecting the effectiveness of blended teaching [2], and how to move from "blended" to "integrated" has become an important issue in the new situation. In this regard, based on the digital twin technology, this research constructs an online-offline integrated teaching model from the connotation of "integration" in terms of teaching links, student activities, teaching resources, teacher activities, and teaching evaluation, and further analyzes the mechanism by which the digital twin empowers the integration of online and offline and puts forward the implementation strategies. The academic value of this study lies in designing a new model of online-offline integrated teaching, deepening the education community's understanding of the law of student learning, enriching the research connotation and application scenarios of Bloom's taxonomy, and providing new ideas for the change of teaching mode under the influence of digital technology. The value of practical application is to strengthen teachers'

understanding and knowledge of the online-offline integrated teaching mode, fully utilize digital technology to provide support for better implementation of online-offline integrated teaching and enhance teaching effectiveness.

2. DESIGN OF COURSE TEACHING MODE BASED ON DIGITAL TWIN

In constructing a teaching model for online and offline integration, it can be designed based on Bloom's taxonomy,which is considered the widely used framework for designing educational goals[3]. It divides cognitive goals into six levels: knowledge, understanding, application, analysis, evaluation and creation [4]. This part constructs an online-offline integrated teaching model (Figure 1) from multiple dimensions, including teaching links, student activities, teaching resources, teacher activities and teaching evaluation, and according to three time stages: before class, during class and after class.

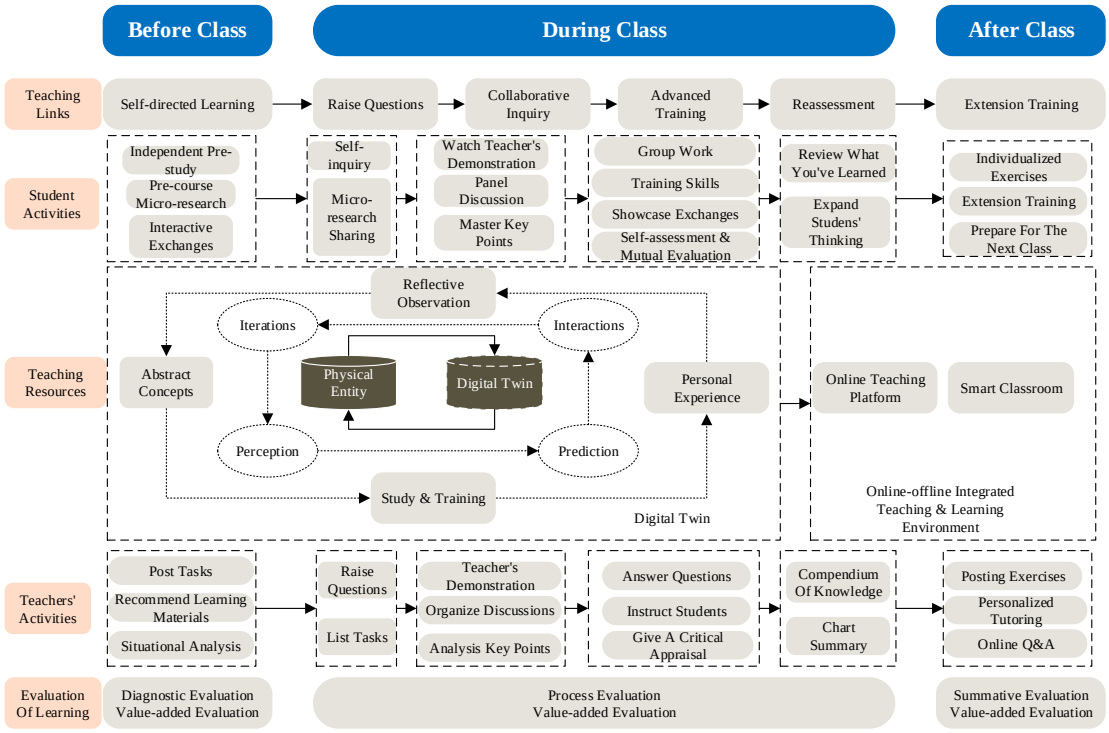

Fig 1 Online-Offline Integrated Teaching Model

2.1 Analysis of teaching process

The teaching process is a complex and systematic project, involving the careful design of multiple links. The complete teaching process of the new model can be divided into six main links, which are interrelated and progressive, constituting the main framework of teaching. The link of “Self-directed Learning” emphasizes students' initiative, allowing them to prepare for the new lesson through self-study and form a preliminary understanding. Subsequently, the “Raise questions” link is to stimulate students' interest in learning, through the vivid scene setting, to guide students into the learning state. In the “Cooperative Inquiry” section, students further deepen their understanding of the knowledge points through group discussion and cooperative problem solving. This session not only exercises students' teamwork ability, but also cultivates their analytical and problem-solving skills. The next session, “Advanced Training”, is a targeted training for students' knowledge mastery, which helps students consolidate and expand their knowledge through higher level challenges. This session is often accompanied by teacher guidance and instruction to ensure that students are moving in the right direction. “Reassessment” is an important part of the teaching process, which requires students to review and summarize what they have learned, and find out their own shortcomings and omissions, so that they can improve in their future learning. At the same time, the teacher will also reflect on the students' feedback and further optimize the teaching strategies. The “Extension Training” session is a tutoring and question-and-answer session for students' practice, which helps them solve their learning confusion and improve their learning effect through targeted explanation and practice.

2.2 Analysis of student activities

In the learning process of students, independent pre-study, pre-course micro-research and interactive communication are three crucial links. They not only help students understand the course content in advance and get ready for classroom learning, but also promote communication and cooperation among students to jointly improve the learning effect. Independent pre-study is the starting point of students' learning activities, which requires students to have a preliminary understanding and thinking about the upcoming content before class. In the process of previewing, students need to utilize the online learning platform and read the textbook or related learning materials to mark the key points, difficulties and doubts, so as to pave the way for subsequent classroom learning. When previewing, students can make use of various learning resources, such as textbooks, tutorials, online courses, etc., to make preliminary exploration and understanding of new knowledge. Through previewing, students

can not only understand the basic framework and knowledge points of the course in advance, but also discover their learning blind spots and points of interest, so that they can listen to lectures and ask questions in a more targeted way in classroom learning.

In the process of pre-study, students need to independently complete the learning tasks and solve the problems they encounter, which helps to develop their self-management and self-driven ability. Pre-class micro-research is a further deepening of students on the basis of pre-study. Students can gain a more in-depth understanding of the course content and related background knowledge, so as to be more fully prepared for classroom learning. Pre-course micro-research can include collecting relevant information, understanding the background of the course, thinking about the focus of the course and other ways. Students can use the library, the Internet and other resources to find books, papers, news reports, etc. related to the course content so that they can understand and explore the relevant issues more deeply in classroom learning. Pre-course micro-research can also help students discover their own learning interests and directions. During the research process, students may develop a strong interest in certain issues, which will become an important direction for their classroom learning and future research.

Interactive communication is also an important part of students' learning activities, which helps students share their learning experiences, solve learning problems, and promote cooperation and progress among themselves. In interactive exchanges, students can inspire and complement each other, and work together to solve problems encountered in learning.

In the independent inquiry section of the class, students give full play to their own initiative and conduct in-depth study of the class content. This session emphasizes students' independent thinking and problem-solving ability. Students will find answers or solutions independently by reading the textbooks, searching for information and practicing according to the guidance or questions provided by the teacher. Students will encounter various challenges in the process of inquiry, but it is these challenges that stimulate their curiosity and desire to explore, prompting them to keep trying, verifying, reflecting and refining their knowledge.

Research sharing is a process in which students present and communicate the results of their pre-course research. In this session, students have the opportunity to introduce their research topics, methods, processes and conclusions to their classmates. This not only exercises students' oral expression and logical thinking skills, but also promotes information exchange and resource sharing among students. Through research sharing, students are able to understand the research perspectives and methods of other students, thus broadening their horizons and

enriching their knowledge system. At the same time, the interaction and feedback during the sharing process can also help students discover their shortcomings and stimulate their motivation for improvement.

Watching teacher demonstration is an intuitive and efficient way for students to learn in the learning process. In this session, the teacher will give a detailed demonstration and explanation of a certain knowledge point or skill to help students understand and master the relevant content. Through watching the teacher's demonstration, students can clearly see the operation steps and processes, and understand the key points and precautions. Teacher demonstration can also stimulate students' interest in learning and desire for imitation, prompting them to be more actively engaged in learning.

Group work is an important part of classroom learning that encourages communication and cooperation among students to solve problems together. In group work, students discuss a particular topic or project, and everyone has the opportunity to express their own views, while also needing to listen to others' opinions. Through group work, students are not only able to brainstorm the best solution to a problem, but they also learn to respect, understand and support each other.

In classroom learning, students will train their skills through various practical activities. Under the guidance of the teacher, students improve their skills through repeated practice and reflection. In the process of skill training, students will encounter various challenges and difficulties, but it is these challenges that stimulate their learning motivation and push them to make continuous progress.

Self-assessment and mutual evaluation is an effective form of assessment that encourages students to reflect on and evaluate their own learning outcomes, as well as receive feedback from their peers. Students will evaluate themselves according to their own learning and performance, and find out their strengths and weaknesses. At the same time, they will also evaluate the learning outcomes of other students and make constructive comments and suggestions. Civic and political discussion is an important part of classroom learning, which aims to lead students to think deeply about social and moral issues through discussion and debate. Students will focus on specific topics to help them establish correct values and worldviews and lay a solid foundation for their future development. In the final stage of classroom learning, students will review and summarize what they have learned. They will reorganize the key points of the lesson or the unit to deepen their understanding and memory of the knowledge points.

After the lesson, students enter the stage of individualized practice and extension training, which is an important part of consolidating knowledge and improving skills. Students chose the weak points of the exercises to practice according to their own learning situation and interest. In the process of doing problems, students constantly review classroom knowledge and deepen their understanding through practical application. Extension training pays more attention to the cultivation of students' abilities and the expansion of their thinking. Students will participate in some project-based learning. In the extension training, students learn how to collect information, analyze data, formulate hypotheses and test them.

2.3 Analysis of teaching resources

In the online-offline integrated teaching environment, digital twin can help students better understand and master abstract concepts. By digitally reconstructing real-world entities, processes or systems, digital twin forms a visual and interactive learning environment. Students can observe and analyze digital twin models to understand abstract concepts, such as the structure of a supply chain, more visually. In addition, digital twin can simulate business processes and outcomes, helping students predict the outcomes of supply chain management, thus deepening their understanding of abstract concepts. Digital twin also offers significant advantages in learning and training. With digital twin models, students can conduct virtual experiments and operations, which not only improves their practical skills, but also reduces experimentation costs and avoids potential safety risks. In addition, digital twin can provide personalized learning paths and feedback mechanisms to help students conduct targeted training according to their own learning progress and abilities, thus enhancing learning outcomes. Digital twin can provide students with hands-on learning opportunities. Through virtual reality and augmented reality, students can immerse themselves in the digital twin model and interact with it, thus obtaining a more realistic and vivid learning experience. This type of experiential learning helps to stimulate students' interest and motivation, and increase their engagement in learning. Digital twin also provides students with opportunities for reflective observation. During the learning process, students can reflect on and assess their learning outcomes by observing the behavior and performance of the digital twin. The visualization feature of the digital twin model enables students to clearly see their learning progress and problems, so that they can adjust their learning strategies and methods in time.

2.4 Teaching Evaluation

Value-added evaluation is not just an evaluation method in the field of education, but also an educational philosophy that focuses on students' progress and development and assesses

the effectiveness of education and teaching by measuring such progress. Value-added evaluation can be carried out throughout diagnostic evaluation, process evaluation and summative evaluation, providing a comprehensive and dynamic evaluation system for students, teachers and schools [5].

In the diagnostic evaluation stage, value-added evaluation is mainly reflected in the assessment of students' initial ability. Teachers can understand students' knowledge base, skill level and affective attitudes, so as to provide targeted guidance for subsequent teaching. At this stage, value-added assessment focuses on the changes in students from the baseline level at the time of enrollment to that after receiving education for a period of time, i.e. the “value-added” situation of the students. In the process assessment stage, value-added assessment focuses on students' growth and progress in the learning process. Process assessment focuses on students' performance in the learning process, and through timely feedback and adjustment, helps students identify their shortcomings and improve their learning methods. At this stage, value-added assessment can quantify students' progress by comparing their performance at different points in time, thus providing teachers and students with real-time feedback on teaching and learning outcomes. Finally, in the summative assessment stage, value-added assessment summarizes and evaluates the student's entire learning process. Summative assessment usually occurs at the end of the semester or at the end of the course and is used to assess the final learning outcomes of students. At this stage, value-added assessment allows for a comprehensive evaluation of student progress and development by comparing the level at which the student was enrolled and the level at the end of the semester. This type of assessment focuses not only on the learning outcomes of students, but also on the process of their growth, thus providing teachers and students with a more fair and objective evaluation standard.

3. INTRINSIC MECHANISM OF DIGITAL TWIN-DRIVEN ONLINE-OFFLINE INTEGRATION

Under the framework of Chester Barnard's systems-theoretic approach [6], we can deeply analyze how digital twin technology promotes the integration of online and offline teaching. As an innovative technology, digital twin provides new implementation strategies and optimization means for blended teaching by creating a real-time, dynamically corresponding virtual environment mapping real-world teaching scenarios and processes.

3.1 Willingness

In online-offline integrated teaching, the willingness of teachers, students and educational administrators is the primary factor driving the transformation of teaching mode. Digital twin can significantly increase the acceptance and willingness of all parties to participate in online-offline integrated teaching. For teachers, digital twin offers the possibility of observing and analyzing students' behavioral patterns in both physical classrooms and virtual spaces to better personalize teaching content and methods. For students, digital twin makes online learning less of an isolated event and more of a tightly integrated part of the interaction with the physical classroom, increasing the coherence and immersion of learning. For educational administrators, the use of digital twin for pedagogical analysis and optimization can significantly improve the quality of teaching and learning, which reinforces their willingness to adopt integrated learning.

3.2 Common purpose

The success of online-offline integrated learning relies on teachers, students, and other educational stakeholders sharing a common goal for education. Digital twin helps clarify this common purpose and provide the tools to reach it. First, digital twin can help clarify educational goals, whether they are improving academic performance, enhancing practical skills, or fostering creativity, which can be tracked and achieved with the help of data analytics and simulations in digital twins. Second, digital twin can provide a shared view for all participants of each student's progress and overall class performance, thus facilitating teachers and students to work together around reaching learning goals.

3.3 Linkage of Information

Effective information flow is key to the success of online and offline integrated teaching. Digital twin reinforces the efficiency and quality of information connections. In the digital twin environment, activities in the classroom can be captured and synchronized to the virtual model in real time through sensors and devices, and students' learning behaviors and outcomes offline can be transferred to the online platform without any obstacles, and vice versa. This two-way flow of information channels ensures that teachers can obtain timely feedback on students' learning status and adjust teaching strategies or provide individualized instruction. At the same time, students can also utilize the real-time feedback function of the digital twin to monitor their own learning progress and proactively seek help and resources to fill in gaps in their knowledge or skills.

In summary, digital twin facilitates the deep integration of online and offline teaching and learning environments by strengthening the three core elements of online and offline integrated teaching: willingness, common purpose, and linkage of information. It not only provides a more interactive and personalized learning platform for teachers and students, but also promotes continuous improvement and innovation of teaching activities through continuous data collection and analysis. With the further development and application of digital twin technology, the future online-offline integrated teaching will be more efficient and flexible, and will be able to better meet the needs of different learners and achieve personalization and optimization of education.

4. IMPLEMENTATION PATH OF ONLINE-OFFLINE INTEGRATED TEACHING MODE BASED ON DIGITAL TWIN

4.1 Building infrastructure

The construction of infrastructure adapted to digital twin technology is the material foundation for the implementation of online-offline integrated teaching. This includes not only high-speed and reliable network connections, powerful data processing and storage capabilities, but also the arrangement of various sensors, wearable devices and smart terminals, which are key components for collecting and synchronizing data on teaching activities. In addition, schools need to set up specialized digital twin labs or virtual classrooms to provide an immersive learning and teaching environment. The classrooms should be equipped with interactive whiteboards, Virtual Reality (VR) and Augmented Reality (AR) devices, simulation equipment, etc. to facilitate a seamless offline-to-online transition.

In addition to hardware facilities, the construction of software facilities is equally important. Colleges and universities should introduce and develop digital twin software platforms suitable for teaching, providing teachers with convenient teaching tools and students with rich learning resources. In addition, it is also necessary to establish a perfect data management and analysis system to effectively integrate and utilize the data generated in the teaching process and provide data support for teaching improvement.

4.2 Teacher Training and Development

To give full play to the role of digital twin technology in teaching, it is necessary to provide professional training and development for teachers. This includes improving teachers' understanding of the digital twin concept, mastering relevant techniques and tools, learning how

to design teaching activities suitable for digital twin environments, and how to use data analysis to optimize the teaching and learning process. Teacher training should not be limited to theoretical lectures, but should focus on hands-on practice, providing hands-on instruction through workshops, seminars and online courses. At the same time, communication and cooperation among teachers should be encouraged and supported to share best practice cases and form professional learning communities. In addition, teachers should be encouraged to participate in teaching research projects to explore the in-depth integration mode of digital twin technology and course teaching. Finally, an incentive mechanism should be established to recognize and reward teachers who have achieved outstanding results in the application of digital twin technology.

4.3 Curriculum Design and Reform

Traditional curriculum design is often difficult to meet the learning needs of the digital era. With the introduction of digital twin technology, curriculum design should follow the principles of flexibility, interaction and personalization. This requires teachers to rethink and redesign the course structure, transforming traditional teaching content into modules that can be explored and manipulated in the digital space. Curriculum design should be centered on the cultivation of core literacy and key competencies, emphasizing students' active learning and problem-solving abilities. At the same time, considering the advantages of real-time feedback and data analysis of digital twin, the course design should also include a tracking and evaluation mechanism for students' learning process.

4.4 Reform of Teaching Evaluation Methods

The traditional examination and evaluation methods are often criticized for not being able to fully reflect students' learning outcomes and abilities. The introduction of digital twin technology provides new possibilities for teaching evaluation. Teaching evaluation based on digital twins should pay more attention to students' process data and performance rather than just the final test scores. The reform of teaching evaluation methods requires the development of new evaluation tools and methods, such as project-based demonstration of learning outcomes, peer evaluation, self-evaluation, continuous learning data tracking, and value-added evaluation. These assessment methods can reflect students' cognitive development, skill acquisition, and attitude changes more comprehensively.

To summarize, digital twin-enabled online-offline integration is a systematic project that requires comprehensive consideration and careful planning from the top-level design, in

terms of infrastructure construction, teacher training, curriculum design and evaluation methods. Through the implementation of these measures, a richer, more efficient and personalized teaching and learning environment can be provided for educators and learners.

5. CONCLUSIONS

Both online and offline teaching modes alone have their limitations and cannot fully meet the needs of education modernization. For this reason, the online-offline integrated teaching mode based on digital twin has emerged, aiming to create a more efficient, interactive and personalized teaching environment. This study constructs an online-offline integrated teaching model based on multiple dimensions such as teaching links, student activities, teaching resources, teacher activities and teaching evaluation, and constructs an online-offline integrated teaching model according to the three time phases: before, during and after class, and describes the teaching model specifically. This study further explores the intrinsic mechanism of digital twin-driven online-offline integration from the three elements of willingness to serve, common purpose and information connection. Among them, the digital twin provides a revolutionary learning environment for teachers' teaching, students' independent learning and practical exploration, and promotes deeper integration of online and offline learning spaces and learning activities. Finally, this study proposes an implementation path for the new teaching model in terms of building infrastructure, teacher training and development, curriculum design, and reform of teaching evaluation methods. This study provides logical basis and reference suggestions for the implementation of online-offline integrated teaching.

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CONFLICTS OF INTEREST

The author declares no conflicts of interest regarding the publication of this paper.

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