Construction of Experiential Learning Space Model Based on Virtual Reality Technology

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Abstract. In order to better help learners to improve their learning experience and learning efficiency, this paper starts from the interaction, immersion and imagination of virtual reality technology, and sorts out the evolutionary process of formal learning space, informal learning space and virtual learning space. It also proposes the conception of experiential learning space with the virtuality and reality combination. Aiming at the application of virtual reality technology in the knowledge presentation, simulation training and experience environment of experiential learning space, an experiential learning space model based on the virtuality and reality combination is constructed to enrich the learning environment and information presentation of learners, enhance learners' situational experience and improve their learning efficiency.

1. Introduction
Learning space refers to the place where learners engage in learning activities, which can be divided into physical space and virtual space. Physical space refers to entities that can engage in learning activities in the real world, such as classrooms, laboratories, studios, libraries, etc., while virtual space is a simulation space created by high-tech such as computer. Learners enter the virtual space through the network and other mobile terminal devices to learn and communicate, such as simulation learning platform, VR virtual laboratory and so on, which is characterized by virtuality and simulation.

In recent years, with the renewal and development of educational concepts, more and more educational concepts have been combined with technology. The new educational concepts emphasize learners' learning situation and learning experience. The integration of new technology not only provides teachers with tools and methods to explore teaching, but also provides learners with visual presentation, in which the integration of virtual reality technology and education has achieved remarkable results. Virtual reality technology is a kind of virtual simulation technology, which produces an immersive feeling by stimulating learners' body organs and immersing them in the virtual environment. It has the characteristics of interaction, immersion and imagination, which can create a rich situational experience learning environment for learners. Therefore, this paper starts from the virtual reality technology and the new educational concepts to construct a learning space that can be used to enhance situational experience, show and reproduce learning content, and strengthen the visibility of knowledge for learners.
2. Evolution of learning space model
With the continuous updating of the teaching concepts, the learning space model is also constantly changing. The evolution of the model is based on the teaching concepts, which is divided into formal learning space model, informal learning space model and experiential learning space model with the virtuality and reality combination. Formal learning space model is based on the teacher-centered teaching concepts, emphasizing the importance of teachers imparting knowledge, neglecting the initiative and inquiry of students' learning. This type of learning space is represented by classrooms, laboratories and other places. The informal learning space model is based on the student-centered teaching concepts, paying more attention to the autonomy of students' learning, and emphasizing collaborative learning and active learning among students. In order to better meet the students' autonomous learning, the informal learning space can be specifically designed to arouse the students' enthusiasm for learning. For example, a flexible, collaborative, interconnected and innovative learning space designed by Australia and the SCALE-UP and TEAL learning environments built by American universities which aimed at meeting the development need of students. Informal learning space is mainly represented by libraries, studios and other places. The model of experiential learning space with the virtuality and reality combination, based on the concepts of deep learning, combines technology with concepts to construct a kind of virtual learning space, which breaks through the limitation of region. And it provides high-quality learning resources to learners in the way of network sharing, presenting abstract knowledge to learners in a visual way. Moreover, it creates real learning situations for learners with the help of the characteristics of virtual reality technology to achieve the integration of virtual environment and real world, so as to optimize to meet the needs of experience of learners. This learning space is represented by online learning platform, VR virtual simulation center and so on. Figure 1 shows the evolution diagram of the learning space model.

![Evolution Diagram of Learning Space Model](image)

Figure 1. The evolution diagram of the learning space model.

3. The function of experiential learning space based on the virtuality and reality combination
The combination of virtual reality technology and education enables the abstract knowledge to be presented in a concrete way, combining the goal of school education focused on the learners' all-round development with the goal of post-job education focused on the learners' skill training. Increasing learners' learning autonomy and experience feeling has greatly narrowed the gap between school education and post-work education. Therefore, this paper approaches the function of experiential learning space with the virtuality and reality combination from the application of virtual reality technology in teaching.

3.1. Visual presentation knowledge
The traditional teaching method is the teacher teaches the principle knowledge, and the student understands independently. Due to the individual differences, the learning subject is polarized. The reason is the lack of imaginative, three-dimensional, visually presented knowledge. The simulation and immersive experience of experiential learning space based on virtual reality technology, on the one hand, can create a learning environment for learners to satisfy their learning needs; on the other hand, it enables the learners to go deep into the interior of the object from the first perspective, comprehend the structure and enhance the learners' overall perception and learning experience of
knowledge. Not only that, the experiential learning space with the virtuality and reality combination can also show and deduce the experiments and events that occurred in the past, occurring now, and will occur in the future. For example, learners can enter a historical event from the first perspective and experience it as a participant. These are difficult to present in traditional teaching methods.

3.2. Simulation training
The experiential learning space with the virtuality and reality combination can create a real simulation environment for learners. Different from laboratories and studios, it is a virtual learning space, which has the characteristics of virtual and digital technology. Whether it is school education, or post-job education, practical and experimental courses require continuous training and testing in order to improve learners' practical ability, while traditional experiments and training grounds require a lot of cost and time. The experiential learning space with the virtuality and reality combination integrates the characteristics of virtual reality technology to design and create an operating experience environment for learners according to the needs of learners. Experiential learning space can save cost, within which training and operation can be repeated and learners can improve their ability quickly. For another, it avoids the danger caused by other external factors, such as explosion tests, chemical experiments and so on.

3.3. Immersive experience environment
The immersion of the experiential learning space with the virtuality and reality combination is one of the core functions of the experiential learning space, which can create a real and interactive experiential learning situation for learners. Learners use the information and knowledge provided in the learning space to explore learning proactively, so as to complete the internalization and transfer of knowledge. In the immersive experience environment, emphasis is placed on the learners' learning experience, which contains entertainment and allows learners to learn in a relaxed and pleasant environment, thus achieving the integration of virtuality and reality. Experiential learning space is not limited by time, space or physical characteristics, so learners can create learning situations which cannot be created in the real world, such as virtual conference rooms, virtual stadiums and so on. The real experience environment constructed by the experiential learning space of virtuality and reality combination can stimulate learners to make use of the effective information and learning resources provided in the experience environment to learn proactively. Learners can also communicate with other members in the learning space or set goals together, then achieve the goal in a team way, in order to realize self-learning and collaborative learning.

4. Construction of experiential learning space model based on the virtuality and reality combination

4.1. Structural elements of experiential learning space based on the virtuality and reality combination
About how to construct an experiential learning space of virtuality and reality combination, many scholars at home and abroad have put forward different views and concepts. The activity theory represented by the former Soviet Union's scholar Vygotsky, etc., proposed that the basic elements of activities include subject, object and intermediary. In 1987, Engels further extracted the theoretical elements of activities, and presented that the six elements of activities were subject, object, community, rules, division of labour and tools. While, domestically, Guo Shaoqing and others represented the combination of E-learning space and school education which further improved the theory of learning space. However, the research on learning space was mostly focused on theoretical research, contrary to the shortage of research on the combination of technology and learning space. Therefore, this paper integrates the characteristics of virtual reality technology into the current learning space theory, and constructs an experiential learning space to meet the needs of learners in order to better solve the actual teaching problems.
Structural elements of experiential learning space based on the virtuality and reality combination include subject, object, community, situation, activities and tools. The subject and object refer to the learners who learn independently or accept learning in the experiential learning space of the virtuality and reality combination. That means, learners are the main body. And the organizers who organize or guide learners belong to the object in the learning space, and the roles of subject and object are the same as that of teachers and students in school education. The situation refers to the physical environment and VR technology needed to construct the experiential learning space. The situation in the experiential learning space with the virtuality and reality combination is superimposed in the physical space, which means taking the physical scene as the reference. Cooperate with VR technology to expand the entity information and presentation mode, provide learners with an all-round immersive experience environment, and realize the integration of virtual space and physical space. Activity and community refer to the group of subjects who create common goals in experiential learning space and complete tasks by means of task division, cooperative learning and so on. According to the virtual reality environment created, the community joins multiple subjects. As a result, group learning activities are generated, which mainly include four aspects: knowledge content, situational skills, information presentation and skill training. The learning space provides feedback through the activity information generated by the community, and adjusts the experience environment in time. Tools refer to the equipment and technologies needed to build experiential learning space and participate in activities, such as Gear VR, Oculus Rift, PlayStation (PS) VR, etc. Figure 2 shows the structural elements of experiential learning space based on the virtuality and reality combination.

![Figure 2. The structural elements of experiential learning space based on the virtuality and reality combination.](image)

4.2. Technical Framework of experiential learning space based on the virtuality and reality combination

The experiential learning space based on virtuality and reality combination is a technical superposition based on the E-learning space. The experiential learning space has the characteristics of the E-learning space, resources in which can be made full use of by learners for autonomous learning or teacher-guided learning. On the other hand, it has a real environment of virtuality and reality combination, in which learners can immerse themselves in interactive learning. In the experiential learning space with the virtuality and reality combination, the learner is the subject of the learning space, and the other resources are the auxiliary objects used to support the subject learning.
The experiential learning space technology framework based on the virtuality and reality combination is mainly divided into VR input layer, VR control layer, VR output device layer and VR environment experience layer. Its implementation principle is to output from the bottom VR input layer to the top VR environment experience layer. Through collecting the activity process and behavior evaluation data of the subject and object of the learning space in the VR environment experience layer, and then feeding back to the VR input layer and VR control layer, the experience environment in the learning space can be updated and adjusted in real time. The architecture layers in the learning space have their own characteristics. The VR input layer is mainly used to connect the ports of the VR terminal devices, provide a solid model and a class library used to render for the VR control layer, and help users achieve interactive input and output. It includes resource database, standard library, user library, knowledge base, interactive interface and equipment library. The VR control layer realizes the superposition of entity model and virtual environment through VR technology, and constructs the experience learning space of virtuality and reality combination. Its principle is to use WEB server to input entity model data to VR simulation server. Then match the data through the VR simulation server, so as to build a virtual environment, and finally render the virtual environment through the VR rendering server to present to the learners in a visual way.

The VR output device layer is a VR learning resource used to support learner autonomous learning or teacher-guided learning. It is also the basis for learners to create situations and set common goals and tasks, including curriculum, situations, activities, scenarios, tasks and so on. The VR environment experience layer mainly detects the learners and teachers engaged in learning or teaching activities in the experiential learning space with the virtuality and reality combination, records the behavior process, makes the behavior evaluation, and feeds the evaluation data back to the bottom layer. In order to adjust the learning space experience environment, optimize to meet the learning experience of learners. Figure 3 shows the technical framework of experiential learning space based on the virtuality and reality combination.

![Figure 3. The technical framework of experiential learning space based on the virtuality and reality combination.](image)

4.3. Experiential learning space model based on the virtuality and reality combination
The experiential learning space model based on the virtuality and reality combination is constructed according to the six elements of subject, object, tool, situation, activity and community. Learners build physical models and virtual reality spaces through physical devices such as VR devices, VR
simulation and rendering servers, and create learning situation based on learning goals and tasks. Or teachers specify learning tasks, create an appropriate experience environment to guide learners into experiential learning space. Learners complete learning activities and learning process through autonomous learning space resources or teamwork, and feedback process records in order to adjust the situation and enhance the learning experience of learners. Figure 4 shows the experiential learning space model based on the virtuality and reality combination.

![Experiential Learning Space Model](image)

Figure 4. The experiential learning space model based on the virtuality and reality combination.

5. Conclusion
The experiential learning space of the virtuality and reality combination is the superposition of entity and virtual environment. It has the advantages that traditional teaching space and learning space do not have. It enriches the way of information presentation and visualizes abstract knowledge, deduces and reconstructs historical events, enhances learners' personal experience and expands the existing teaching model. In addition, the integration of technology and education is conducive to the transformation from traditional learning space to experiential learning space with the virtuality and reality combination. It can deepen the concept of deep learning, reconstruct the structure between teachers and students, encourage learners to take the initiative to explore learning in the way of experience, and improve the motivation of learning.

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