

Discussion on the Construction and Application of Virtual Reality-Based Curriculum Resources for Kindergarten Education

Wei Yao¹, Deyang Liu^{2*}

¹School of Teacher Education, Anqing Normal University, Anqing 246000, Anhui Province, China

²School of Computer and Information, Anqing Normal University, Anqing 246000, Anhui Province, China

*Corresponding author: Deyang Liu, deyang.liu@hotmail.com

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Abstract: The construction of early childhood curriculum resources serves as a vital vehicle and precondition for the implementation of collective teaching activities in kindergartens. However, traditional curriculum resources based on graphic language or the linguistic descriptions of early childhood educators often fail to provide children with an immersive experience during collective teaching activities, leading to a lack of initiative and interest in learning. This paper discusses the methods for building a kindergarten curriculum resource library and, based on this foundation, employs virtual reality technology for three-dimensional modeling of the library to enrich the curriculum resources in kindergartens. Furthermore, this paper proposes to train early childhood educators in virtual reality technology to enhance their abilities to operate and utilize virtual reality equipment, which can emphasize the children's central role in the learning process, better achieve educational goals, and improve teaching outcomes.

Keywords: Virtual reality; Curriculum resources; Kindergarten education; Preschool children

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1. Introduction

The development of a comprehensive and engaging curriculum is essential for the cognitive and developmental growth of young children. Traditional pedagogical approaches that rely on two-dimensional (2D) graphical representations or verbal descriptions by educators may not fully engage the learners in the educational setting. The lack of an interactive and immersive learning environment can result in diminished motivation and a reduced sense of curiosity among young learners. Integration of virtual reality technology into early childhood curriculum development not only enriches the educational resources available to young learners but also supports educators in their quest to provide a more effective and impactful teaching experience.

To enhance the overall quality of early childhood education and promote a more enjoyable learning environment, this paper explores the establishment of a digital repository of curriculum materials specifically tailored for early childhood education. By leveraging the capabilities of virtual reality (VR) technology, this

paper suggests the transformation of 2D materials into three-dimensional (3D) models, which can significantly enhance the interactive and immersive aspects of the learning environment. This not only makes the learning experience more vivid and tangible but also stimulates the children's innate curiosity and desire to explore. Additionally, the paper emphasizes the importance of professional development for early childhood educators in the field of virtual reality. By equipping educators with the necessary skills to effectively utilize VR technology, kindergarten teachers can be empowered to create a more dynamic and engaging educational environment, which can further reinforce the children's agency and foster a more active and participatory approach to learning.

2. Applications of virtual reality

2.1. Applications of virtual reality in education

Virtual reality technology represents a novel convergence of multidisciplinary achievements, encompassing computer graphics, human-computer interface technology, sensor technology, and artificial intelligence ^[1]. Leveraging its characteristics of immersion, interactivity, and conceptualization, VR technology has been increasingly applied within the educational domain. Compared to traditional teaching methods, VR-based instruction offers learners a range of positive emotions such as relaxation, enjoyment, and interest, which can stimulate their intrinsic motivation to learn ^[2]. Furthermore, by providing a rich array of perceptual cues and multimodal (e.g., auditory and visual) feedback, VR technology facilitates the transfer of knowledge from virtual scenarios to real-life contexts, meeting the demands of situated learning ^[3]. For example, Ma *et al.* ^[4] proposed that VR technology is a pivotal technology fostering educational transformation. VR has the capacity to address the visualization of teaching content and knowledge, enhance the immersion of the learning experience, and augment interactions among teachers, students, and between students and their environment. The Distance Education College of the Central Radio and Television University has made notable strides by leveraging a gaming graphics engine to create an interactive online platform that extends beyond mere browsing, offering a more engaging and practical educational experience for students. This approach exemplifies the potential of virtual reality to break down barriers and provide accessible, functional education through the integration of advanced technologies. In the realm of early childhood education, VR technology is garnering increasing attention from educators. However, the academic literature on the use of VR in early childhood education is relatively sparse.

2.2. Application of virtual reality in the construction of kindergarten curriculum resources

The construction of kindergarten curriculum resources is a prerequisite for ensuring the smooth conduct of collective activities for young children. Particularly in the context of informatization, leveraging information technology to build an informatized kindergarten curriculum has become an effective means to promote the development of early childhood education. Currently, with the advancement of virtual reality technology, models of kindergarten curriculum materials based on virtual reality have been emerging continuously. However, research on the systematic construction and application of virtual reality technology in kindergarten curriculum resources remains relatively limited. For example, Hu *et al.* ^[5] developed a comprehensive children's indoor fire escape education system that integrates human-computer interaction, sound, smoke, and animated demonstrations with a game-like style. This system effectively engages children's interest and reinforces their learning of fire escape knowledge, yielding positive educational outcomes in fire safety. By using VR technology, Zhang *et al.* ^[6] proposed to develop an educational virtual reality system by using static images. Sharma *et al.* ^[7] developed virtual reality materials for historical sites by integrating real-world elements

with artificially generated ones. Nonetheless, it is essential to further investigate the applicability of their approach across various academic fields to enhance students' learning experiences. In the work of Maskati *et al.* [8], a virtual reality program was created specifically for students who have learning disabilities. This application facilitates the learning of the alphabet for dyslexic students by enabling them to trace Arabic letters in a supportive environment. Rebollo *et al.* [9] introduced a pair of augmented reality (AR) games that were designed according to children's preferences aimed at teaching multiplication tables. Utilizing AR technology, the multiplication practice was transformed into a gamified experience, rendering it more entertaining and appealing to children. Schnurer *et al.* [10] suggested enhancing the maps in a paper school atlas with the addition of digital map features. Their prototype incorporated 3D visual representations to enrich the content of the atlas's map pages. To align the digital elements with the physical maps, they proceeded to merge georeferenced information into a gaming platform. Midak *et al.* [11] created a mobile app that visualizes the Solar System, offering valuable educational content for educators. In addition, students can utilize this app to effectively grasp knowledge about astronomy. Kang *et al.* [12] launched a children's mobile AR app named ARMath, comprising five distinct modules. This app is capable of identifying common objects and transforming them into interactive learning tools by illustrating their mathematical properties. Nonetheless, the application's focus on hand-eye coordination, potential differences between children's understanding and the AR presentation, and the stability of the device may restrict its practical application.

3. Common problems in the construction of kindergarten curriculum resources based on virtual reality

VR technology offers preschool educators a novel pedagogical approach and has emerged as a developmental trajectory for technological innovation in early childhood education. While VR technology has been widely implemented in the educational field and some VR curriculum resources have been developed for early childhood education, there are still several issues that persist.

- (1) The content of curriculum resources based on virtual reality is overly fragmented. Although numerous models of virtual reality curriculum resources have been developed, these resources lack continuity and systematicity. The majority constitute segmented teaching content, which fails to ensure the vertical and horizontal connections of knowledge in early childhood education. As a result, preschool children cannot derive a systematic construction of experience from them.
- (2) The pedagogical functionality of early childhood curriculum resources based on virtual reality remains to be refined. Given that the application of VR technology in education is relatively nascent, various technical aspects are still in the exploratory phase. VR technology in most educational applications predominantly provides users with situational experiences and rudimentary human-computer interactions, rather than being fully integrated into the teaching and learning process, particularly during collective teaching activities in kindergarten settings.
- (3) The effective application of VR-based curriculum resources in kindergarten education is contingent upon the guidance provided by early childhood educators. The extent to which VR technology curriculum resources can be fully and effectively utilized to enhance teaching outcomes and promote the development of young children hinges on how teachers employ these resources in the educational process. However, many early childhood educators are not proficient in the use of VR equipment and have a vague understanding of the integration of VR technology with early childhood education, which has led to an underutilization of their instructional role and a failure to manifest the children's agency in the learning process.

4. Construction path of kindergarten curriculum resources based on virtual reality

4.1. Modeling of kindergarten curriculum materials based on virtual reality

The construction of a VR-based kindergarten curriculum material library must satisfy the criteria of artistic integrity, harmony, and systematic organization. Moreover, the application of this VR curriculum material library necessitates the design of a 3D immersive experience system tailored for collective teaching activities in kindergarten settings. Consequently, in the development of kindergarten materials, it is essential to integrate the five key domains of kindergarten curriculum activities and to systematically undertake the 3D modeling and development of materials based on Unity, a comprehensive platform for creating and deploying interactive content. In addition to the systematic construction of models for various teaching domains, the development of material models must also address issues such as the realism, resolution, and potential health concerns associated with collective teaching activities in kindergartens. An in-depth investigation into the targeted presentation methods for different domain curricula is imperative to facilitate optimal reception and mastery by young learners. The VR kindergarten curriculum material library should be designed to provide an enriched and engaging educational environment that stimulates the cognitive and sensory development of children. It should incorporate elements that cater to the developmental stages and learning needs of young children, ensuring that the materials are not only pedagogically sound but also aesthetically appealing and technically robust.

4.2. Organic integration of virtual reality technology with traditional teaching methodologies

The application of VR curriculum resources in kindergarten collective teaching activities primarily faces three issues. Firstly, within a virtual environment, it can sometimes be challenging for young children to maintain their focus on learning activities; an overabundance of features and rich scenarios may distract them from the learning content. Secondly, the integration of constructed VR kindergarten curriculum resources into collective teaching activities in kindergartens tends to emphasize the children's proactivity and exploratory nature, where knowledge is acquired through active exploration and discovery. This necessitates a shift in the traditional teaching and learning paradigms for early childhood educators, requiring them to organically integrate VR technology with conventional teaching methodologies. To address these challenges, a strategic approach must be adopted that balances the immersive and interactive capabilities of VR with the educational objectives of kindergarten collective teaching activities. Educators must be adept at guiding young learners to navigate the virtual environment in a manner that fosters concentration and engagement with the learning content, while also leveraging the technology to stimulate curiosity and promote independent learning. Furthermore, the design of VR curriculum resources should be mindful of cognitive development stages, ensuring that the complexity and scope of the virtual scenarios are age-appropriate and conducive to learning. The educational content should be scaffolded in a way that gradually introduces more complex concepts and interactions, allowing children to build upon their existing knowledge and skills.

4.3. Professional development in virtual reality technology for early childhood educators

The successful implementation of VR in early childhood education settings requires a robust understanding of both the technological aspects and the pedagogical strategies necessary for its effective integration. Educators must be equipped with the skills to navigate the VR environment, create age-appropriate educational content, and facilitate learning experiences that are engaging, interactive, and developmentally appropriate for young children. To address this gap, it is essential to develop comprehensive professional development programs that focus on building the capacity of early childhood educators to effectively use VR technology. These programs should cover a range of topics, including the fundamentals of VR, best practices for integrating VR into lesson

plans, strategies for managing classroom interactions within a VR environment, and methods for assessing the impact of VR on children's learning and development.

5. Conclusion

The effective application of VR curriculum resources in kindergarten collective teaching activities requires a nuanced understanding of both the technology and the pedagogical strategies that support young children's learning. By thoughtfully integrating VR into the educational framework, educators can create a dynamic and engaging learning environment that fosters cognitive growth, creativity, and a love for learning among preschool children. Moreover, enhancing VR-related training and support for early childhood educators is a critical step toward realizing the full potential of VR technology in early childhood education. By investing in the professional development of educators, we can ensure that VR is used effectively to create rich, immersive, and developmentally appropriate learning experiences that contribute to the cognitive, social, and emotional growth of preschool children.

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References

- [1] Koolivand H, Shooreshi MM, Safari-Faramani R, et al., 2024, Comparison of the Effectiveness of Virtual Reality-Based Education and Conventional Teaching Methods in Dental Education: A Systematic Review. *BMC Med Educ*, 24(1): 1–15.
- [2] Lampropoulos G, 2024, Virtual Reality and Gamification in Education: A Systematic Review. *Educational technology research and development*, 2024(19): 1–95.
- [3] Maroukias A, Troussas C, Krouska A, et al., 2024, How Personalized and Effective is Immersive Virtual Reality in Education? A Systematic Literature Review for the Last Decade. *Multimedia Tools and Applications*, 83(6): 18185–18233.
- [4] Ma J, Wang Y, Joshi S, et al., 2024, Using Immersive Virtual Reality Technology to Enhance Nursing Education: A Comparative Pilot Study to Understand Efficacy and Effectiveness. *Applied Ergonomics*, 2024(115): 104159.
- [5] Hu C, Chun X, Chen S, 2016, Application Research on Children's Indoor Fire Escape Education System Based on Virtual Reality Technology. *Journal of System Simulation*, 28(4): 934–939.
- [6] Zhang Q, 2022, Development and Analysis of Educational Virtual Reality System Using Static Image. *Mobile Information Systems*, 2022(2022): 1–9.
- [7] Sharma RC, Sharma YP, 2021, Designing Virtual Reality Experiences in Education. *Learning Technology Technical*

Committee Bulletin, 21(1): 19–22.

- [8] Maskati E, Alkeraiem F, Khalil N, et al., 2021, Using Virtual Reality (VR) in Teaching Students with Dyslexia. *International Journal of Emerging Technologies in Learning (IJET)*, 16(9): 291–305.
- [9] Rebollo C, Remolar I, Rossano V, et al., 2022, Multimedia Augmented Reality Game for Learning Math. *Multimed Tools and Applications*, 2022(81): 14851–14868.
- [10] Schnurer R, Dind C, Schalcher S, et al., 2020, Augmenting Printed School Atlases with Thematic 3D Maps. *Multimodal Technol Interact*, 4(2): 1–23.
- [11] Midak LY, Kravets IV, Kuzyshyn OV, et al., 2020, Augmented Reality in Process of Studying Astronomic Concepts in Primary School, *Proceedings of the 3rd International Workshop on Augmented Reality in Education (AREdu 2020)*, May 13, 2020. Kryvyi Rih, Ukraine, 239–250.
- [12] Kang S, Shokeen E, Byrne V-L, et al., 2020, ARMath: Augmenting Everyday Life with Math Learning, *Proceedings of the 2020 CHI Conference on Human Factors in Computing System*. ACM, Honolulu, 1–15.

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