Academic Education Publishing House

Research on Children's VR Anti-drowning Design Based on Embodied Cognition Theory

Yang Wan
Department of Art and Design, Guilin University of Electronic Science and Technology, Guilin, Guangxi, China

Abstract: Drowning is one of the primary hazards to children's safety in China. Traditional anti-drowning education suffers from insufficient situational immersion, lack of physical experience, and low efficiency in skill transformation. To improve the effectiveness and safety of children's anti-drowning education, this study, supported by the theory of embodied cognition and integrated with immersive VR technology, designs and develops a children's VR anti-drowning education system. With typical water areas of the Lijiang River as prototypes, the system realizes the construction of simulated scenarios and multi-scenario drill design. The study establishes a multi-layer system architecture and a closed-loop evaluation system covering learning, practice, assessment and feedback, achieving embodied training in risk identification, self-rescue and mutual rescue, and emergency disposal. The results demonstrate that the system can enhance children's physical perception and emergency response in a safe environment, effectively solving the educational dilemma of "knowing but not acting". This study provides a replicable and promotable technical paradigm for children's anti-drowning popularization.

Keywords: Embodied Cognition; VR; Children's Anti-drowning; Safety Education; Immersive Experience;

1. Introduction

Children's anti-drowning education is a livelihood project highly valued by the state, which is closely related to the well-being of millions of households and social stability. Drowning is one of the primary hazards threatening the life safety of adolescents and children. The Outline of Chinese Children's Development (2021–2030) has included "reducing injuries such as drowning among children" as one of its objectives. Although supported by abundant practical evidence, relevant research and application in China are still in the initial stage. In recent years, many disciplines have explicitly focused on the interaction between physical senses and the environment, emphasizing students' perception, experience and interaction [1]. Governments at all levels from the central to local levels have fully implemented their responsibilities and strengthened the coordination among families, schools and society, aiming to minimize tragedies and safeguard the healthy growth of children.

Although children's anti-drowning work is crucial, the popularization and mastery of anti-drowning knowledge still face remarkable challenges due to its high situational dependence and practicality. On the one hand, anti-drowning skills (such as self-rescue and others-rescue skills in water) can only be effectively mastered through practical experience and physical training, but real water environments are risky, making it difficult for children to practice sufficiently without protection. On the other hand, traditional theoretical education or simulated drills can hardly fully reproduce the emergency situations of drowning, resulting in insufficient responses of some children when dangers occur even if they have learned relevant knowledge. In addition, differences in water environments, rescue resources and social cognition in different regions lead to uneven coverage and effectiveness of anti-drowning education. Therefore, relying solely on knowledge popularization is far from enough. An effective anti-drowning safety network can only be constructed by combining multi-dimensional measures such as technical prevention and enhanced supervision.

With the emergence and vigorous development of virtual reality (VR) technology, scholars at home and abroad have begun to apply VR technology to the simulation design and research of various types of disasters. In 2021, Paola et al. explored the use of VR technology to teach children water safety skills. Their research confirmed that 95% of children improved their water safety knowledge after participating in VR water safety workshops [2]. The "Disaster Prevention Sugoroku" application developed by Japanese scholar. Shimpo et al. uses VR technology to simulate crowd evacuation in natural disasters such as fires and floods [3]. In 2022, Duan used a VR earthquake safety education system to simulate real environments and help children master earthquake escape knowledge [4]. In 2025, Shi et al. constructed a highly realistic and immersive earthquake experience and escape education platform by applying immersive VR technology, earthquake simulation system and artificial intelligence technology [5]. However, compared with VR simulation research on natural disasters such as earthquakes and floods, systematic and in-depth research is still needed for VR educational applications targeting drowning, a high-incidence accidental injury among children. This paper discusses the integrated application of embodied cognition theory and virtual reality technology, which provides a breakthrough solution for children's anti-drowning education. By offering new insights into the potential of VR simulation in anti-drowning safety education, this study contributes to the intersection of education and technology. The significance of this study lies in informing teaching practice, solving practical challenges, raising children's safety awareness, and guiding future educational technology programs.

2. Safety Education Methods for Anti-Drowning Under Embodied Cognition Theory

2.1 Educational Theory of Anti-Drowning Based on Embodied Cognition Theory

Embodied cognition emerged initially in phenomenological philosophy in the late 19th and early 20th centuries, serving as an important theoretical paradigm in cognitive science. Maurice Merleau-Ponty, a French phenomenologist, put forward the philosophy of embodiment in Phenomenology of Perception, arguing that human cognition is not completed solely by the brain independently but relies on the dynamic interaction between the body and the environment. Embodied cognition theory focuses on the information received by the human body and holds that cognitive learning is the result of the synergy among the body, mind and environment [6]. Cognition is influenced by the physical environment, psychological environment and socio-cultural context, meaning that cognition is not only rooted in the body but also occurs in specific situations [7]. Accordingly, this study proposes anti-drowning skill popularization education based on embodied cognition theory, which consists of three core elements: the learners' (disaster-affected subjects) physical perception ability, simulation of virtual water areas, and anti-drowning-related risk awareness, self-rescue knowledge, emergency skills and rescue equipment (Figure 1). The application of VR technology in anti-drowning education realizes the in-depth integration of embodied cognition theory and anti-drowning education practice, forming a complete cognitive closed loop of the three elements in the teaching process.

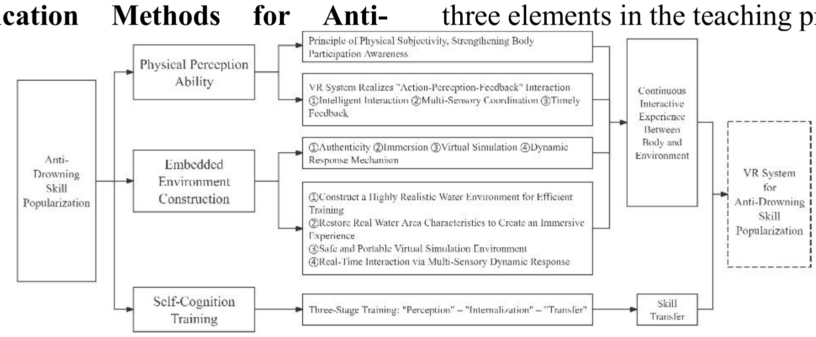

Figure 1. A Popular Science Education System for Children's VR Anti-Drowning Skills Based on Embodied Cognition Theory

2.1.1 Drowning interaction experience based on physical perception ability

As a key component of embodied cognition theory, physical perception serves as a vital channel for individuals to acquire knowledge. It relies on self-perception, physical experience, participatory experience, empathic experience, and the interpretation of the external world derived therefrom [8]. Guided by the principle of physical subjectivity in embodied cognition, traditional anti-drowning education is insufficient due to the lack of real situational experience, profound motor memory, and risk perception. With the support of a VR system, anti-drowning safety knowledge is transformed into visualized, experiential, and diversified content, establishing an interactive perception mechanism of "action–perception–feedback" to realize multi-sensory collaborative embodied interactive experience.

2.1.2 Construction of drowning scenarios with embedded cognitive environment

From the perspective of embodied cognition theory, anti-drowning education scenarios constructed by VR technology create an immersive cognitive space for children through highly simulated virtual water environments. Such environmental construction not only restores the physical characteristics of real water areas, such as hydrodynamic features and buoyancy changes, but also achieves embodied learning with in-depth interaction between the body and the environment through multi-sensory stimulation. This multi-dimensional perceptual field converts abstract anti-drowning knowledge into experiential body memory. Meanwhile, the virtual environment can adjust water flow and scenario difficulty in real time according to limb movements. This dynamic response mechanism perfectly interprets the core viewpoint of embodied cognition: cognition arises from the continuous interaction between the body and the environment.

2.1.3 Anti-drowning skill training under self-cognition

Embodied cognition theory emphasizes the body as the subject, through which cognition mediates communication between the brain and the outside world to construct an individual's cognitive world. Through a multi-level process of self-cognition construction, an effective transformation from skill learning to instinctive response can be achieved [9]. Recent neuroscience research shows that learners who receive systematic VR training exhibit a 62% significant increase in functional connectivity between the prefrontal cortex and motor cortex, and such neuroplastic changes directly lead to substantial improvements in emergency response speed. With the three-stage stepped training of "perception–internalization–transfer", the internalization of movement patterns is strengthened, and the automatic transfer of skills is finally completed in cognitive reproduction tasks. These findings fully verify that the VR training mode based on self-cognition can reshape neural connections and strengthen body memory, enabling learners to perform correct self-rescue skills instinctively in critical situations, thus effectively overcoming the dilemma of "knowing but not acting" in traditional anti-drowning education.

3. Design of Children's VR Anti-Drowning System

3.1 Requirement Analysis

3.1.1 Demand for stimulating children's learning motivation

At present, children's anti-drowning education is mainly popularized through texts, videos, local lectures, and family-school-community cooperation. Due to low participation, poor memory retention, and the educational dilemma of "understanding in class but panicking in danger", there is an urgent need to break through the lack of embodied cognition in traditional teaching. However, existing studies have found a significant correlation between VR environment and learning motivation. Relevant researchers have confirmed that VR feedback devices exert positive effects on children's knowledge comprehension and learning motivation. The children's VR anti-drowning system adopts immersive scenario design and first-person perspective to simulate the whole process of drowning. It eliminates cognitive detachment through consistent design of vision and vestibular sensation, and provides personalized teaching of anti-drowning skills based on children's real-time emergency response performance, so as to further enhance children's learning interest.

3.1.2 Demand for strengthening skill and knowledge popularization

The core challenge of current anti-drowning education is that traditional teaching methods can hardly restore real water risk scenarios, resulting in learners' failure to form effective crisis response capabilities. Studies show that only through theoretical teaching, learners' mastery rate of anti-drowning skills is less than 35%, and the correct response rate in real danger scenarios drops to 22%. The children's VR anti-drowning system is supposed to bring practical coping skills to children by simulating real drowning scenarios and authentic sensory experiences and feedback. Systematic training and testing strengthen children's escape skills and enhance their cognition and prevention of drowning disasters.

3.1.3 Demand for economy and usability

The popularization of children's anti-drowning education is still restricted by unbalanced regional development and uneven allocation of educational resources. Systematic and immersive safety education resources are relatively scarce, especially in rural areas and regions with high water risks [10]. Traditional anti-drowning education mostly relies on school lectures or short-term activities, which is difficult to achieve long-term and stable teaching effects. Therefore, economy and popularization should be prioritized in the design of the children's VR anti-drowning system to achieve wider educational coverage. VR technology has the advantages of strong replicability, flexible content update and diverse deployment modes. Hardware costs can be reduced through all-in-one devices or mobile adaptation, enabling flexible application of the system in schools, communities and even families. Nevertheless, current VR equipment still has a certain cost threshold. Thus, lightweight development strategy should be adopted in system design to reduce dependence on high-end devices, improve overall cost performance, and promote popularization in basic education systems.

3.2 System Framework Design for Children's Anti-Drowning

The application effect of VR technology in education has been widely verified [11], but systematic research on integrating embodied cognition theory with VR technology for children's anti-drowning safety education is relatively insufficient. Guided by embodied cognition theory, this study integrates VR technology with anti-drowning safety education content to construct the overall architecture of the children's VR anti-drowning system. The system adopts a multi-layer structure, mainly composed of theory layer, hardware layer, content layer and data service layer.

Among them, the theory layer, as the core foundation of system construction, mainly includes children's safety education curriculum standards, anti-drowning safety specifications, embodied cognition theory, situational learning theory and serious game design concepts, providing scientific basis and methodological guidance for system design. The hardware layer provides users with an immersive interactive environment, and core equipment includes VR all-in-one machines, head-mounted displays and interactive handles, which can be flexibly configured according to actual application scenarios. The content layer focuses on anti-drowning education, covering common drowning risk scenarios such as rivers, ponds, reservoirs and swimming pools, and further refining typical situations such as falling into water, entering deep water by mistake and leg cramps in water. The data service layer is responsible for collecting and analyzing learners' information and behavior data, including learning process data, operation behavior data and system evaluation indicators, to support personalized learning and feedback optimization.

Compared with traditional safety education systems, this study introduces embodied cognition theory as the top-level design basis, emphasizing the learning mechanism of "body participation–situation perception–cognition construction", so as to realize the in-depth integration of educational psychology theory and immersive technology and improve the effectiveness and practical value of children's anti-drowning education.

3.3 Design of Drill, Assessment and Evaluation System

In the VR-based children's anti-drowning safety education system, a multi-role participation mechanism is designed to enhance immersion and learning substitution. The system centers on three core roles: protagonist, inducer and guide. Through situational narration and task-driven mode, learners complete anti-drowning emergency drills in the virtual environment.

Protagonist: Set as a daily child role (e.g., a pupil playing by the river). Learners enter the system from a first-person perspective to play the protagonist, and complete judgments and operations in different drowning risk scenarios, such as identifying dangerous waters, choosing correct ways to ask for help and implementing self-rescue measures.

Inducer: Misleading behaviors or prompts are set in the scenario, such as encouraging approaching dangerous waters or ignoring safety warnings. If learners accept wrong guidance, adverse consequences will be triggered, so as to strengthen their risk identification ability and safety awareness.

Guide: As a positive feedback mechanism, guides learners to make correct decisions through voice prompts, animation demonstrations or situational interventions, promotes plot development and provides necessary knowledge support.

In terms of interactive design, the system mainly recognizes learners' actions through VR interactive equipment to realize "body-participatory" learning experience. Core interaction forms include gaze selection, handle click and drag operations: click operation is used for menu selection, path judgment and behavior decision; drag operation is used to simulate grabbing rescue tools, pulling floating objects and other actions. The mapping between virtual operations and real actions enhances learners' immersive experience and motor memory, thus improving the mastery effect of anti-drowning skills.

3.4 Design of Emergency Drill Assessment and Evaluation

In the children's VR anti-drowning system, the assessment and evaluation mechanism is a key link to improve learning effects, which strengthens learning outcomes through the mode of "promoting learning by practice and promoting improvement by evaluation". The system is equipped with two operation modes: "learning mode" and "assessment mode". In learning mode, the system helps learners master basic knowledge through situational guidance and real-time feedback, and conducts staged evaluation. In assessment mode, learners are comprehensively evaluated through complete drowning emergency drills.

Evaluation indicators mainly include response speed, decision accuracy, operation standardization and task completion time. Meanwhile, common error "situation traps" are set at key nodes to assess learners' risk judgment ability and emergency response ability. Each choice and operation of learners in the drill corresponds to relevant knowledge point scores, and the system realizes the whole-process quantitative evaluation through data recording and analysis. In addition, the system can be combined with physiological data collection equipment (such as heart rate monitors) to assist in analyzing learners' emotional changes and concentration in virtual scenarios, and evaluate learning experience from the perspective of embodied cognition. After the drill, the system generates a personalized evaluation report according to learners' performance, including knowledge mastery, behavior performance analysis and improvement suggestions, providing a basis for subsequent intensive training.

3.5 Data Management and Cloud Platform Design

The VR-based children's anti-drowning education system fully considers data-driven and intelligent feedback mechanisms in design, and constructs a cloud management platform integrating data collection, analysis and visualization. Through the closed-loop design of "learning–practice–evaluation–feedback–re-learning", the system integrates and analyzes data generated by learners at each stage to form dynamic learning files. In data processing, the system preprocesses and stores learners' behavior data, achievement data and learning trajectories, and generates statistical charts through visualization tools, such as learning progress curves, error type distribution and ability evaluation results, so as to intuitively present learning effects. The cloud platform can automatically generate personalized learning paths and intensive training programs based on individual differences such as age, cognitive level and learning performance, realizing precise teaching. Meanwhile, the platform can provide data support for teachers and managers to optimize teaching content and adjust teaching strategies. Supported by the data platform, the children's VR anti-drowning system not only improves the monitorability and evaluability of the learning process, but also enhances the system's adaptability and scalability, providing technical guarantee for the long-term implementation of anti-drowning safety education

4. Implementation of the VR-Based Children's Anti-Drowning Education System

4.1 Construction of Anti-Drowning Emergency Simulation Scenarios

The children's VR anti-drowning emergency simulation system based on embodied cognition theory is designed with reference to the typical water environment of the Lijiang River Basin in Guilin, Guangxi. The Lijiang River features complex water flow, significant variations in water depth, and frequent tourist activities, making it highly representative for anti-drowning education. Therefore, this study constructs typical drowning risk scenarios based on common activity scenes along the Lijiang River, such as playing on the riverbank, wading in shallow water, and moving near vessels.

The construction of 3D virtual scenes serves as the core foundation for system implementation, and its quality directly affects immersive experience and learning effectiveness. Firstly, 3D models of river channels, water bodies, riparian vegetation, ships, and characters are built to real scale by collecting geographic data, live-action images, hydrological characteristics, and environmental textures of the Lijiang River region. Secondly, action-response animations are produced for interactive objects in emergency drills, such as life buoys, tree branches, and floating objects, to support learner operation and interaction. Thirdly, the completed 3D models are imported into the Unity 3D engine for integration and rendering to realize the overall scene construction. Subsequently, the virtual scene is divided into multiple sub-modules according to functional requirements, such as safe areas, dangerous areas, and drowning areas, and modular integration is completed. Finally, dynamic water flow effects, wave changes, character struggling actions, and ambient sound effects (e.g., water sound, cries for help) are added to the scene to enhance realism and tension.

For special effects, water flow and splash effects are mainly realized through particle systems and physics engines. Parameters are adjusted according to the actual flow velocity and terrain changes of the Lijiang River to ensure the scientificity and authenticity of the simulated scenarios, thereby providing children with a highly immersive anti-drowning learning environment.

4.2 Anti-Drowning Emergency Drill and Assessment-Evaluation Mode

Based on embodied cognition theory, learners enter the children's anti-drowning education system developed in this study through VR devices. After completing device connection and account login, they select the "Anti-Drowning Emergency Drill" module to enter the virtual learning scenario and carry out immersive learning and training in accordance with the established process (Figure 2).

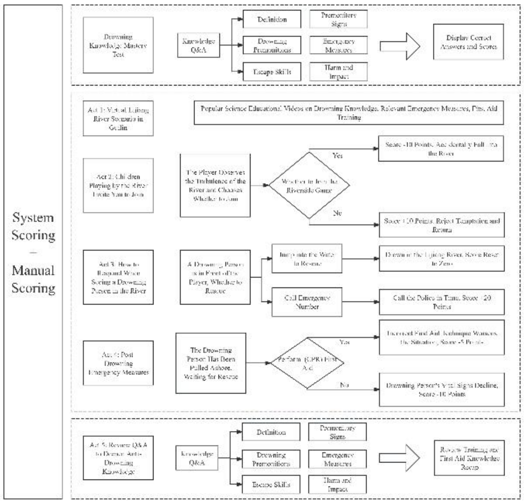

Figure 2. VR Children's Anti-Drowning Education Drill and Learning Process

4.3 Scenario-Based Act Design for Anti-Drowning Drills

To enhance children's immersive experience and embodied cognitive effects in the virtual environment, the system adopts a scenario-narrative and act-based learning process. Integrated with the typical water environment of the Lijiang River in Guilin and the anti-drowning knowledge system, the emergency drill is divided into five consecutive scenario modules, enabling learners to gradually master safety skills through the cycle of cognition–judgment–action–feedback–reinforcement.

Act 1: Virtual Lijiang River Scene and Basic Cognitive Learning

Learners enter the virtual environment of the Lijiang River in Guilin and learn basic operations under system guidance, including view control, movement, and interaction methods. Meanwhile, they acquire fundamental anti-drowning knowledge via situational explanations and Q&A, such as the definition of drowning, premonitory signs, high-risk behaviors, emergency measures, and escape skills. The system conducts an initial test in the form of multiple-choice questions and provides instant feedback on answers and scores to help learners establish a basic cognitive framework.

Act 2: Situational Inducement and Risk Judgment

In the riverside activity scene, the system sets a scenario where peers invite the learner to enter the water. Learners must observe water flow and environmental changes and decide independently whether to take risky action. If the learner chooses "enter the water", a risky

Academic Education Publishing House

situation such as accidental falling or being swept away by the current is triggered, with corresponding points deducted. If the learner chooses "refuse inducement and stay away from dangerous areas", positive scores are awarded. This process strengthens children's ability to identify dangerous behaviors and self-control awareness.

Act 3: Response to Sudden Drowning Incidents

The system simulates a sudden "someone is drowning" event, requiring learners to make emergency decisions. Choosing "blindly jump into the water to rescue" is judged incorrect and results in simulation failure. Choosing "call for help" or "use tools for indirect rescue" leads to the correct path and extra points. Through feedback on consequences of wrong actions and reinforcement of correct procedures, learners master the scientific rescue principle of "avoiding secondary injury".

Act 4: Post-Drowning Emergency Treatment and Rescue Decision

After the drowning victim is pulled ashore, the system enters the emergency treatment stage. Learners must decide whether to perform first aid such as cardiopulmonary resuscitation (CPR). Correct first-aid measures advance the scenario and earn rewards; ineffective measures lower the victim's vital signs and deduct points. This section focuses on training children's understanding and application of first-aid knowledge and reinforces awareness of the "golden rescue time".

Act 5: Knowledge Review and Comprehensive Evaluation Feedback

After the drill, the system reviews learning content through knowledge Q&A, covering the definition of drowning, risk identification, emergency measures, and analysis of improper behaviors. The system then gives a comprehensive score based on the learner's full performance, including decision accuracy, response time, operational behavior, and task completion, and generates a personalized learning report. The report evaluates three dimensions: knowledge mastery, skill application, and safety awareness, providing a basis for subsequent intensive training.

4. Conclusion and Discussion

This study integrates the three core viewpoints of conceptualization, substitution, and constitution proposed by embodied cognition theory, emphasizing the close connection between cognitive processes, physical experience, and environmental situations. Meanwhile, combining the advantages of immersion, interactivity, and contextual experience provided by VR technology, a VR-based children's anti-drowning safety education system is constructed. The main conclusions drawn from the system design, development, and testing are as follows:

The integrated application of embodied cognition theory and VR technology can effectively construct drowning scenarios that are difficult to replicate or risky in reality, allowing children to conduct immersive learning in a safe environment. By simulating water environments, drowning processes, and emergency behaviors, it not only strengthens children's understanding of anti-drowning knowledge but also improves their risk cognition and emergency response capabilities, thereby enhancing the overall quality and efficiency of anti-drowning education.

Compared with traditional education methods mainly based on lectures and watching, the children's VR anti-drowning education system designed in this paper has stronger situational reproduction and interactive experience advantages. Through an immersive learning environment and real-time feedback mechanism, the system realizes the visualization and evaluability of the learning process, and also has good transferability and scalability, which is conducive to popularization and application in different educational scenarios.

In the system implementation, functional modules such as gamified scenario design, emergency drill mechanism, process evaluation, and data recording and analysis are introduced to support learners in repeated training, thus deepening memory and consolidating skills. This model can effectively improve children's ability to respond to sudden drowning situations and realize an integrated teaching closed loop of "learning–practice–evaluation".

In the content design of anti-drowning education, a continuous story scenario is constructed to organically connect knowledge points such as risk identification, self-protection, and emergency rescue, guiding learners to complete the learning process driven by tasks. The embodied learning mode of "hands-on operation–situational experience–instant feedback" significantly improves learning interest, participation, and learning motivation.

In summary, the children's VR anti-drowning safety education system constructed in this paper has significant advantages in improving educational effects, enhancing learning experience, and realizing personalized feedback. However, this study still has certain limitations. For example, in terms of learning effect evaluation, it mainly relies on behavioral data and system scoring mechanisms at present, and the evaluation of children's emotional changes, internalization of safety awareness, and long-term behavioral transformation is still insufficient. In addition, the quantitative evaluation tools for children's risk cognition and emergency behavioral capabilities are not mature, which affects the comprehensiveness and accuracy of the research conclusions to a certain extent.

Future research can build a more scientific evaluation system of children's anti-drowning cognition and behavior based on existing research combined with relevant scales of educational psychology and developmental psychology. Meanwhile, the introduction of multimodal data (such as physiological data and emotion recognition technology) will further improve the accuracy of learning effect evaluation from the perspective of embodied cognition, so as to continuously optimize the design and application effect of the VR anti-drowning education system.

References

[1] Chen, H. W. (2023). Research on the application of embodied cognition theory in junior high school geography teaching. Education Circle, (10), 29–31.

[2] Araiza-Alba, P., Keane, T., Matthews, B., Simpson, K., Strugnell, G., Chen, W. S., & Kaufman, J. (2021). The potential of 360-degree virtual reality videos to teach water-safety skills to children. Computers & Education, 163, 104096.

[3] Shimpo, Y., Terayama, K., Koshino, R., et al. (2022). Development and educational effect of "Disaster Prevention Sugoroku" application for disaster prevention education using VR content. Journal of Japan Society of Civil Engineers, Ser. H (Education), 78(1), 1–9.

[4] Duan, L. H. (2021). Design and application of campus earthquake safety education system based on virtual reality technology (Master's thesis). East China Normal University, Shanghai. https://doi.org/10.27149/d.cnki.ghdsu.2021.002180

[5] Shi, N. N., Hao, J. K., & Wang, X. J. (2025). Virtual simulation experiment teaching based on VR+AI technology: Taking earthquake escape teaching as an example. Journal of Changchun Institute of Technology (Social Sciences Edition), 26(2), 75–78.

[6] Yang, X. (2013). Action research on primary school Chinese reading teaching from the perspective of embodied cognition theory (Master's thesis). Shanxi Normal University, Linfen.

[7] Yang, J. J. (2020). Research on the development of VR teaching resources based on embodied cognition theory (Master's thesis). Tianjin University of Technology and Education, Tianjin. https://doi.org/10.27711/d.cnki.gtjgc.2020.000126

[8] Ma, X. Y., & Sun, M. F. (2023). Evolution analysis of users' cognitive network of 360-degree knowledge short videos from the perspective of embodied experience. Chinese Journal of Journalism & Communication, 45(3), 130–156. https://doi.org/10.13495/j.cnki.cjjc.2023.03.007

[9] Han, D., & Ye, H. S. (2013). Physical dependence of cognition: From symbolic processing to embodied cognition. Psychological Exploration, 33(4), 291–296.

[10] Tian, B. W., Zhao, Y. R., Li, W. Q., et al. (2024). Emergency science education model of landslide disaster based on embodied cognition theory and VR technology. Journal of Catastrophology, 39(2), 178–184.

[11] Hu, Y. L., Nie, J., Zhang, T. Q., et al. (2021). A study on the effect of VR technology empowered experimental teaching from the perspective of embodied cognition. Modern Distance Education Research, 33(5), 94–102.