Educational Use of SVVR: A Scoping Review on Harnessing EduVenture-VR in Learning and Teaching

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Abstract: Virtual reality (VR) technology creates immersive user environments and has diverse applications, including education. A subset of VR, called spherical video-based virtual reality (SVVR), uses 360-degree videos to simulate realistic scenarios and can be easily accessed through mobile phones and low-cost head-mounted displays (HMDs). EduVenture-VR is an integrated SVVR learning platform used for SVVR-supported teaching in classrooms. While some studies have examined SVVR in education, there is a lack of research on the SVVR production platforms like EduVenture-VR. This scoping review aims to explore EduVenture-VR's current state and prospects in education, summarizing existing research design paradigms with collaborative learning elements, and proposing new research directions for future studies.

Keywords: SVVR, collaborative learning, EduVenture-VR

1. Introduction

Virtual reality involves interactive computer simulations detecting user input and modifying sensory feedback, creating a profound sense of immersion in a virtual environment (McGovern et al., 2020; Mihelj et al., 2014). Immersion, interaction, and imagination (3ls) are the three significant features of virtual reality (Burdea and Coiffet, 2003). Di Natale et al. (2020) distinguished between different levels of immersion, from non-immersive (desktop) VR, to semi-immersive (partial field of vision, eg, Fulldome, EMRELE, Smart Glasses) to immersive (eg, Cardboard, HMDs, CAVE). VR has gradually been integrated into education, for instance, computer science education (Agbo et al., 2021), patient education (Pandrangi et al., 2019), and physical education (Ding et al., 2020). However, there are numerous obstacles to the promotion and application of VR in education, with overhead expenses and the need for specialized training being the primary hindrances (Kavanagh et al., 2017). SVVR, a form of immersive video-based virtual reality, offers convenient accessibility through mobile phones and inexpensive cardboard goggles (Jong, 2022). Besides, advancements in technology, mobile applications, and 360-degree cameras enable the public to easily create their own 360-degree spherical images or videos with speed and convenience (Wu et al., 2021). It is characterized by its affordability, ease of use, and user-friendly nature, making it a suitable option for teachers seeking to provide immersive learning experiences with technological support, even if they are not highly proficient with technology (Chien et al., 2020).

Collaborative learning serves as an overarching framework encompassing diverse educational methodologies that entail collective cognitive endeavors among students, or between students and teachers. Typically, learners operate within groups, engaging in cooperative endeavors to jointly seek comprehension, resolutions, interpretations, or to collaboratively create a product (Laal & Ghodsi, 2012). The degree of active learner engagement during both the instructional design and implementation phases frequently influences the effectiveness of a learning intervention (Trentin, 2010). Thus, emerging technologies and platforms that facilitate online collaborative and interactive learning among students deserve further attention. EduVenture-VR is an integrated location-oriented

context-aware learning system launched in Hong Kong in 2016, consisting of EduVenture-VR Composer and EduVenture-VR App. The former enables teachers to design interactive outdoor learning materials without coding, using various question formats. Students use EduVenture-VR App to access the teaching materials in SVVR. Studies have shown positive impacts on student learning through SVVR-based teaching strategies on EduVenture-VR (Li, 2023; Liu, 2023; Chen, 2022; Huang, 2022; Li, 2022; Ruan, 2022; Wu, 2022; Chen, 2021; Huang, 2021; Lin, 2021; Chang, 2020). The paper, utilizing EduVenture-VR platform as a focal point, conducts a scoping review to encapsulate the research trends of EduVenture-VR and also briefly summarizes the design paradigms with collaborative learning elements in EduVenture-VR classes.

2. Methods

2.1 Protocol

This scoping review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR) guidelines (Tricco et al., 2018) and Arksey and O'Malley (2005)'s methodological framework to gather, select, summarize, analyze, and interpret evidence related to the review questions.

2.2 Eligibility Criteria

Included papers used EduVenture-VR for research, published between 2016-2023 in English, and related to education. It considered quantitative, qualitative, and mixed-method studies for assessing SVVR-supported approaches. Conference papers using EduVenture-VR and related to education were also included, with duplicate conference papers excluded.

2.3 Information Sources

Searches used two electronic databases: Scopus and Web of Science, to capture a comprehensive sample of literature for records published from 2016 to March 2023 in the English language.

2.4 Search terms

Search terms included 'eduventure-vr', 'spherical video based virtual', 'svvr', '360-degree video', '360° video', and 'panoramic video' with "OR" (Boolean relationship) to ensure that the studies met the inclusion criteria captured.

2.5 Charting, Collating, Summarizing, and Reporting the Results

After screening, 28 journal articles and conference papers are included for synthesis (see Figure 1 & Table 1). EduVenture-VR's usage for educational research has steadily increased since its launch in 2016. Current users are mainly from Mainland, Taiwan, and Hong Kong, and it has extended to international high school students in Thailand (Zhao & Yang, 2023). Implementation occurs across various education levels, particularly in universities and secondary schools, with Chinese language education and natural science being the main disciplines benefiting. EduVenture-VR is commonly used for short-term learning activities in schools, covering different SVVR experimental designs, mainly employing quasi-experimental methods (Wu et al., 2021). Experiential learning is the most common pedagogical use.
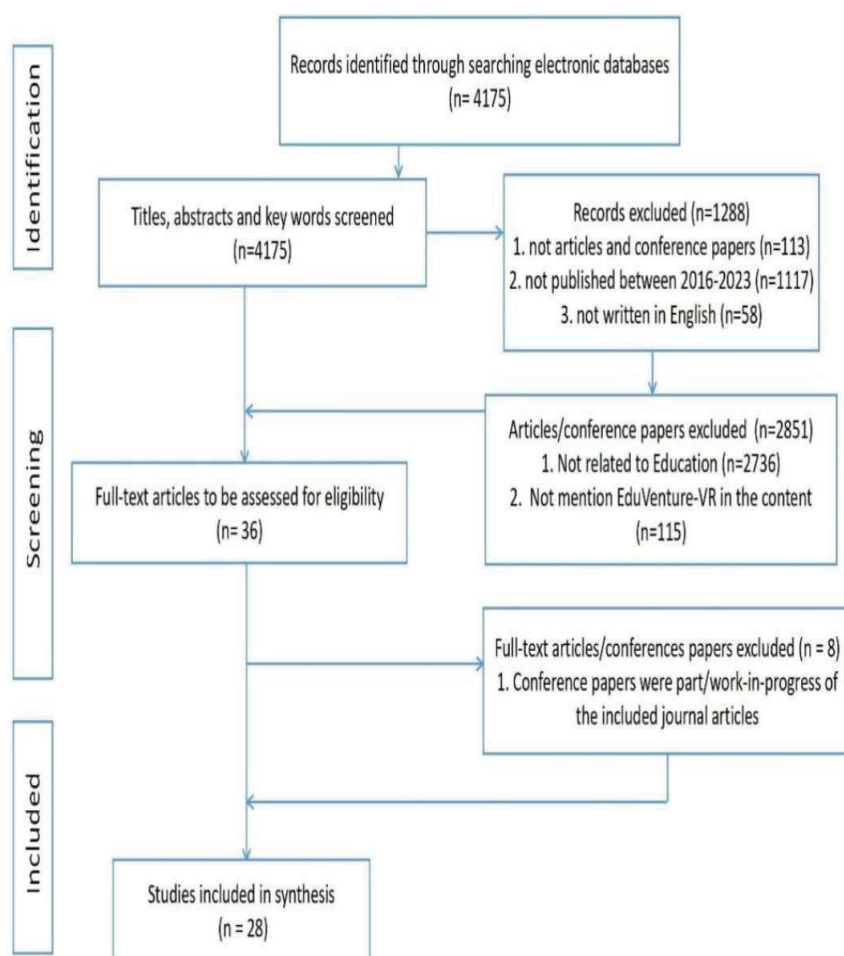
Figure 1. PRISMA-ScR flowchart of the study selection process.

Table 1. *Literature List*

First Author (Year)	Title
Chang (2020)	The effects of spherical video-based virtual reality implementation on students' natural science learning effectiveness
Chen (2021)	Teachers' Conceptions of Teaching Chinese Descriptive Composition with Interactive Spherical Video-Based Virtual Reality
Geng (2021)	Understanding the pedagogical potential of Interactive Spherical Video-based Virtual Reality from the teachers' perspective through the ACE framework
Zhao (2023)	Promoting international high-school students' Chinese language learning achievements and perceptions: A mind mapping-based spherical video-based virtual reality learning system in Chinese language courses
Wu (2021)	A Spherical Video-Based Immersive Virtual Reality Learning System to Support Landscape Architecture Students' Learning Performance during the COVID-19 Era
Lin (2021)	Engaging university students in a library guide through wearable spherical video-based virtual reality: effects on situational interest and cognitive load, Interactive Learning

	Environments
Wu (2021)	Effects of the self-regulated strategy within the context of spherical video-based virtual reality on students' learning performances in an art history class
Jong (2022)	Flipped classroom: motivational affordances of spherical video-based immersive virtual reality in support of pre-lecture individual learning in pre-service teacher education
Wu (2022)	Effects of Multisensory Integration through Spherical Video-Based Immersive Virtual Reality on Students' Learning Performances in a Landscape Architecture Conservation Course
Chien (2020)	Effects of peer assessment within the context of spherical video-based virtual reality on EFL students' English-Speaking performance and learning perceptions
Jong (2020)	Integrating interactive learner-immersed video-based virtual reality into learning and teaching of physical geography
Li (2022)	Investigating Learners' Engagement and Chinese Writing Learning Outcomes with Different Designs of SVVR-Based Activities
Chen (2022)	Promoting deep writing with immersive technologies: An SVVR-supported Chinese composition writing approach for primary schools
Yang (2021)	From experiencing to expressing: A virtual reality approach to facilitating pupils' descriptive paper writing performance and learning behavior engagement
Huang (2021)	Facilitating decision making in authentic contexts: an SVVR-based experiential flipped learning approach for professional training
Huang (2022)	Technological solutions for promoting employees' knowledge levels and practical skills: An SVVR-based blended learning approach for professional training
Chen (2022)	Effects of experiencing authentic contexts on English speaking performances, anxiety and motivation of EFL students with different cognitive styles
Ye (2021)	Classroom misbehaviour management: an SVVR-based training system for preservice teachers
Ruan (2022)	VR-Assisted Environmental Education for Undergraduates
Lin (2021)	Supporting dyadic learning of English for tourism purposes with scenery-based virtual reality
Chen (2021)	Modeling learners' self-concept in Chinese descriptive writing based on the affordances of a virtual reality-supported environment
Chang (2020)	Integration of the peer assessment approach with a virtual reality design system for learning

	earth science	
Chang (2020)	Effects of applying a VR-based two-tier test strategy to promote elementary students' learning performance in a Geology class	
Liu (2023)	Effects of an article-structure strategy-based spherical video-based virtual reality approach on EFL learners' English reading comprehension and learning conceptions	
Jong (2021) Conference paper	Motivating Ethnic Minority Students in Hong Kong to Learn Chinese Culture with EduVenture-VR	
Jong (2022) Conference paper	Pilot Study of Using ARCS Model to Investigate Motivational Affordances of EduVenture-VR from Perspective of Construction Management Students	
Chen (2019) Conference paper	Students' Conceptions of Interactive Spherical Video-based Virtual Reality Supported Chinese Writing Learning	
Chao (2019) Conference paper	Educational Use of Spherical Video-based Virtual Reality: A Preliminary Study from the Teacher Perspective	

The review identifies three design paradigms. Some studies use SVVR as an independent variable and assess its effectiveness by comparing an experimental group with SVVR and a control group without SVVR. Other studies use a teaching strategy as a variable and compare an SVVR approach with and without this teaching method. The remaining studies explore conceptions of SVVR in specific disciplines, particularly Chinese language education. For example, Chen et al. (2021) examined teachers' conceptions of SVVR in Chinese descriptive writing, while Chen et al. (2021) investigated students' self-concept in Chinese writing with SVVR. Li et al. (2022) found that a double-loop SVVR-based learning approach improved students' Chinese writing acquisition. Yang et al. (2021) found that SVVR enhanced writing performance but not creative thinking. Jong et al. (2021) explored ethnic minority students' motivation to learn Chinese culture with SVVR. Zhao and Yang (2023) applied a mind-mapping strategy to teach Chinese to non-native speakers and reported positive outcomes. Apart from that, in the most of SVVR-supported classes, students typically engage with SVVR-based learning materials in groups. During or prior to the experiential phase, teachers commonly assign pertinent questions aligned with the class objectives. Subsequently, during the discussion phase, students have the opportunity to share their experiential insights and collaboratively explore solutions to the inquiries with peers and teachers. In comparison to traditional teacher-centered classrooms, encouraging students to take a more proactive role in their learning endeavors.

3. Discussion and Future Research

The results show that EduVenture-VR is applied in diverse subjects and age groups, indicating broad development potential. However, in Chinese language education, research mainly focuses on descriptive writing for first-language speakers. Exploring teaching strategies for Chinese language education and expanding to non-native Chinese-speaking regions require further investigation. Additionally, there is a need for a new framework for formal education using SVVR, as most studies focus on informal learning. The LIVIE framework by Jong et al. (2020) exemplifies SVVR integration in formal geography education. Future research should design SVVR-supported teaching methods for specific disciplines, promote long-term classroom application, and engage students actively in the SVVR material design process. In addition, SVVR primarily serves as a means of delivering content and

factual knowledge through direct instruction, limiting its potential for interactive scaffolding and assessment within the video (Li et al., 2023). Furthermore, while some studies have systematically reviewed the educational value of SVVR (Rosendahl & Wagner, 2023), there remains a dearth of research exploring the interactive use of educational SVVR.

4. Limitation and Conclusion

The limitation of this paper is that this study only focuses on the EduVenture-VR platform and cannot comprehensively summarize the SVVR learning in education.

The aim of this scoping review is to explore the current research status of EduVenture-VR in education, briefly summarize the research design paradigms with collaborative learning elements, and identify potential research directions. The paper examines 28 journal articles and conference papers to synthesize the existing research on EduVenture-VR in education. Most studies use quasi-experimental designs to develop SVVR-based teaching approaches and evaluate their effectiveness in Chinese language education or natural science through short-term school activities. EduVenture-VR is applied across various education levels, with universities, secondary schools, and primary schools being the most common. The review summarizes the experimental design paradigms and proposes new research directions for EduVenture-VR, providing a basis for future empirical research in this area.

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