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Emanuele Bardone · Yueh-Min Huang
Editors


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Immersive Learning Environments: Fostering Self-directed Learning in Junior High School Students Through Virtual Tours

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Abstract. This study investigates the impact of virtual reality (VR) technology on enhancing self-directed learning skills among junior high school students through the development of online learning environments. Participants engaged in creating and sharing virtual tours, employing self-directed learning strategies. Utilizing a posttest design, the research assessed students' perceived growth in self-directed learning abilities through questionnaires, interviews, and analysis of participant-created content. Results revealed significant enhancements in students' capabilities to identify learning needs, set goals, engage actively in learning, and evaluate their learning experiences. These findings suggest that VR-supported online environments can effectively promote self-directed learning among junior high students. The study advocates for educators and researchers to utilize these insights to develop similar VR-supported learning environments, with the aim of fostering self-directed learning skills.

Keywords: virtual reality · self-directed learning · junior high school students

1 Introduction

The landscape of education is undergoing a transformative shift, driven by rapid technological advancements and a growing recognition of the importance of lifelong learning. In this dynamic context, the ability to learn independently, or self-directed learning, emerges as a cornerstone of personal and professional development. Self-directed learning, a concept popularized by scholars [1–4], is no longer a supplementary skill but a fundamental necessity for navigating the complexities of the 21st century [5]. Scholars' assertion that the illiterate of the future is not that who cannot read or write but that who cannot learn, unlearn, and relearn underscores the shift from traditional forms of education toward a model that prioritizes the cultivation of lifelong learning capabilities.

The essence of self-directed learning lies in its focus on empowering individuals to take charge of their educational journey [6]. This involves not only the acquisition of knowledge but also the development of skills to assess, direct, and evaluate one's learning process [7]. The traditional education model, characterized by a teacher-centered approach, is increasingly being supplemented by pedagogies that promote student autonomy, reflecting a broader educational objective to prepare individuals for the challenges of modern society [8]. As articulated by educational theorists and practitioners alike, the profound development of the knowledge society necessitates that individuals learn independently and cultivate self-directed learning abilities [9].

Numerous scholars have put forth models for self-directed learning. Merriam and Bierema [10], as well as Song and Hill [11], highlight that self-directed learning consists of the cyclical phases of planning, action, and reflection. Knowles [12] delineated a more detailed five-stage model, including: (a) recognizing learning requirements, (b) setting educational aims, (c) identifying learning resources, (d) choosing and applying learning strategies, and (e) evaluating educational outcomes.

The self-directed learning model begins with assessing learners' needs and setting clear goals. Learners then gather resources, select suitable strategies, and evaluate their progress against objectives. This cycle ensures effective learning and allows for necessary adjustments.

In the present study, we integrate these established frameworks into a model that emphasizes four core elements: (a) diagnosing learning needs, (b) formulating learning goals, (c) engaging in the learning process, and (d) evaluating learning. This framework is grounded in the design of our study's activities and the theoretical underpinnings laid out by prior research.

The rapid expansion of information technology has introduced new dimensions to the learning process. The Internet, digital platforms, and, more recently, virtual reality (VR) technology, have created unprecedented opportunities for interactive and immersive learning experiences [13]. VR, in particular, offers a unique medium through which cultural and self-directed learning can be facilitated [14]. Through the creation of virtual environments, learners can engage with content in ways that transcend traditional classroom boundaries, offering a more engaging and participatory form of education [15].

This study is situated at the intersection of technological innovation and educational theory. It explores how VR technology, through the creation and sharing of virtual tours, can enhance self-directed learning among junior high school students. The integration of VR into educational settings presents a novel approach to learning that combines the sensory engagement of immersive environments with the principles of self-directed learning. Students are not merely passive recipients of information but active participants in their learning process, utilizing technology to explore, create, and share knowledge.

The relevance of VR in education extends beyond the novelty of the technology itself. It aligns with the broader educational goal of fostering skills essential for the knowledge economy, such as critical thinking, problem-solving, and the ability to collaborate across digital platforms. Virtual tours, as a component of VR-based learning, offer a particularly compelling case study. They enable students to explore cultural sites, historical events,

and scientific phenomena within a virtual space, providing a context for learning that is both engaging and informative.

Despite the potential of VR to transform educational practices, research on its impact on self-directed learning, especially in the context of cultural education, remains limited. Cultural learning activities, which involve creating and engaging with cultural content, play a critical role in broadening students' perspectives and enhancing their understanding of diverse cultures. These activities, when supported by technology, can significantly enhance students' self-directed learning abilities by providing opportunities for exploration, collaboration, and reflection.

Given the transformative potential of VR technology in education and the importance of cultivating self-directed learning abilities, this study aims to fill a gap in the existing literature. It seeks to explore how the use of VR for creating and sharing cultural virtual tours can impact the self-directed learning abilities of junior high school students. This exploration is timely and relevant, as educators and policymakers increasingly recognize the need to integrate technology into learning environments in ways that support student autonomy and engagement.

The significance of this study lies not only in its contribution to educational research but also in its practical implications for teaching and learning. By examining how VR can be utilized to foster self-directed learning, the study provides insights that can inform the design of educational programs and the integration of technology in the classroom. It also addresses a broader question of how education can adapt to the demands of the digital age, preparing students with the skills and mindsets necessary for lifelong learning.

Given the context and objectives outlined above, this study is guided by a central research question: How does the use of virtual reality technology in creating and sharing cultural virtual tours impact the development of self-directed learning abilities in junior high school students? This question aims to capture the essence of the study's investigation, focusing on the relationship between technological integration in education and the enhancement of self-directed learning capabilities. Through this lens, the study seeks to contribute to the ongoing discourse on the role of technology in education and its potential to empower students as autonomous learners.

2 Method

This study employed a convenience sampling strategy to recruit 16 junior high school students from China, all non-native English speakers learning English as a foreign language. The participants, aged 13 to 14, were selected for their similar levels of English proficiency and prior experience with creating VR virtual tours. Each student also had a minimum of three years of computer experience.

Ethical approval was obtained prior to the study's commencement. Participants and their guardians were informed about the study's purpose, the nature of the learning activities, expected duration, and other relevant details. Informed consent was obtained from all participants.

The research unfolded over five weeks (see Fig. 1). Initially, participants were introduced to the study's goals and the online learning platform, where they registered and introduced themselves. In the following weeks, they selected cultural themes, learned to

create virtual tours, and developed their projects. These tours were shared and refined based on peer and onlooker feedback.

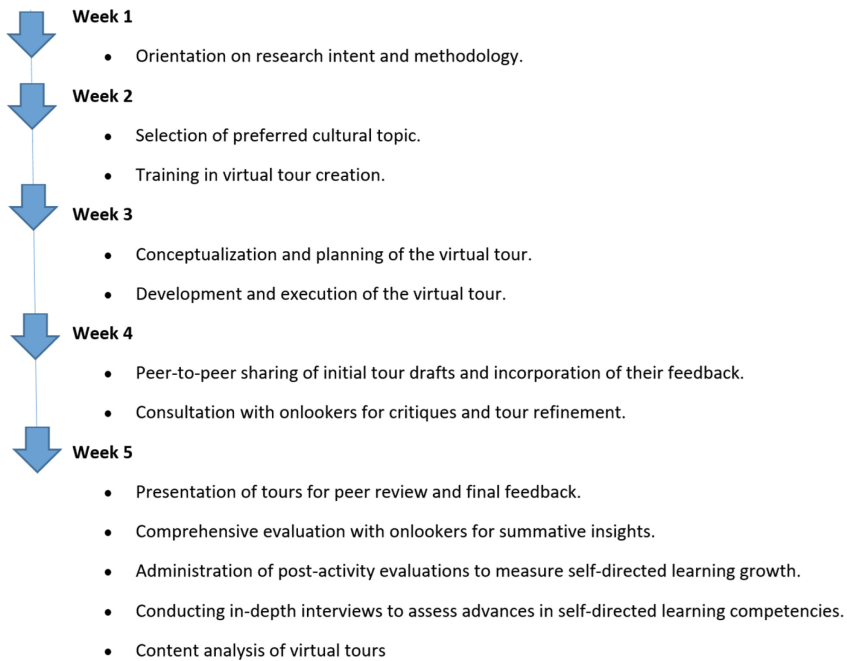


Fig. 1. Research procedure.

The final week involved a summative sharing of their tours and completion of a post-test questionnaire, alongside semi-structured interviews with the participants. To facilitate self-directed learning, various strategies were implemented, focusing on diagnosing learning needs, formulating learning goals, engaging in the learning process, and evaluating learning outcomes. Teachers guided the students through these phases, with students actively participating in creating and refining their virtual tours based on feedback from peers and onlookers.

The cultural learning process involved students selecting cultural topics, creating virtual tours, and iteratively refining these tours through feedback. This process was designed to enhance students' understanding of cultural diversity and their ability to convey cultural experiences through VR.

The technology utilized for producing virtual tours comprised a panoramic camera and a dedicated VR tour creation platform. Participants employed the Insta360 One X panoramic camera to capture images (Fig. 2). Subsequently, they crafted virtual tours by stitching together multiple panoramic images. The virtual tour creation platform was specifically developed to facilitate the cultural learning activity and enhance information literacy, enabling users to generate panoramic images, assemble virtual tours, view these tours, and interact with fellow participants. The participants experienced the virtual tours through head-mounted display devices (Fig. 2).



Fig. 2. 360-degree camera to create VR tours, head-mounted display to watch VR tours, and a screenshot of VR tour.

Cultural virtual tours utilizing 360-degree video technology can significantly augment self-directed learning by offering immersive experiences. This technology enables students to explore cultural landmarks and sites in a realistic manner, fostering engagement and a tangible sense of presence. Such tours provide autonomy, letting students navigate at their own pace and select sites of interest, promoting personalized learning. They also break down geographical barriers, allowing global access to cultural education and exposing students to a diversity of perspectives. Furthermore, these tours engage multiple senses and can include interactive elements like quizzes, enhancing the learning process. By providing context and background information, they deepen students' understanding of cultural significance. Overall, 360-degree video tours serve as a dynamic supplement to conventional educational materials, fostering a comprehensive and self-paced educational experience.

The research employed multiple instruments to collect data. *Questionnaires:* Adapted from Barnard et al. [16], these were used to assess students' self-directed learning abilities. The questionnaire, utilizing a five-point Likert scale, was completed by

students at the end of the study, with a 100% response rate. *Content Analysis*: The content of virtual tours was analyzed to evaluate changes in students' self-directed learning abilities. This involved transcription and coding of the data, with discrepancies resolved through discussion to reach consensus [17]. *Semi-Structured Interviews*: Conducted with students to gain deeper insights into their learning experiences [18]. Interviews, averaging 30 min, consisted of open-ended questions to understand students' changes in their self-directed learning abilities. Transcripts were independently coded by two researchers, employing Strauss and Corbin's [31] open coding technique. Discrepancies were reconciled through discussion, securing data analysis reliability.

This multi-faceted approach, combining quantitative and qualitative data, provided a comprehensive understanding of how VR technology can support the development of self-directed learning abilities in junior high school students.

3 Results

At the end of the study, the effectiveness of the learning activities in enhancing students' ability to identify their learning needs was evaluated. Data from Table 1 showed students achieved high scores in areas such as environment structuring ($M = 4.50$, $SD = 0.531$) and time management ($M = 4.15$, $SD = 0.421$), which are critical for diagnosing learning needs. This suggests that the designed learning activities effectively supported students in recognizing their educational requirements.

Table 1. The results related to self-directed learning abilities.

Dimension	Mean (total)	SD (total)
Environment structuring (3 items)	4.50	0.53
Time management (3 items)	4.15	0.42
Formulation of learning goals (3 items)	4.48	0.38
Task strategies (3 items)	4.27	0.39
Help seeking (3 items)	4.15	0.44
Evaluation of learning (4 items)	4.22	0.43

Supporting this, interviews with students and analyses of virtual tour content revealed notable enhancements in their diagnostic abilities. For example, students reported an increased awareness and proactive management of their learning needs as they progressed through the activities. Students noted improved efficiency in identifying learning gaps and adjusting study strategies accordingly. Such insights, drawn from interviews and virtual tours, underline the pivotal role of the technology-enhanced cultural learning activities in developing students' diagnostic skills.

Regarding the formulation of learning goals, students reported high effectiveness post-activity ($M = 4.48$, $SD = 0.384$), indicating the activities' success in aiding students to set precise learning objectives. Interviews and virtual tour analyses further confirmed

this outcome; students described learning to establish and refine goals under teacher guidance, underscoring the activities' contribution to their goal-setting capabilities.

In assessing students' engagement in the learning process, findings showed high perceived competence in adopting task strategies ($M = 4.27$, $SD = 0.389$) and seeking help ($M = 4.15$, $SD = 0.438$). Evidence from interviews and virtual tours indicated that students felt more motivated and capable of participating in the learning phases, with students noting increased confidence and highlighting the benefits of diverse learning strategies and peer feedback. This collective evidence suggests that the cultural learning activities significantly boosted students' active engagement in the learning process.

Lastly, students' proficiency in evaluating their learning showed high scores ($M = 4.22$, $SD = 0.427$), pointing to the activities' effectiveness in enhancing evaluative skills. Students acknowledged their development in this area, with their detailing how feedback and examples from teachers and peers improved their evaluative judgments. This indicates that the cultural learning activities, supported by technology, were instrumental in advancing students' abilities to assess their learning progress effectively.

4 Discussion and Conclusion

In our study, we explored the benefits derived from a technology-enhanced cultural learning activity, specifically focusing on the creation of virtual tours to foster self-directed learning skills. A notable outcome was the improvement in students' capacity to identify and address their learning needs. This enhancement can be attributed to several factors. Initially, the structured guidance and feedback from educators during the activity encouraged students to reflect on their learning requirements while designing virtual cultural tours. For example, through the act of producing these tours, students recognized the necessity of preparing computer equipment in advance of each session, enhancing their project execution efficiency. This proactive approach, along with constructive interactions with peers and external observers, led to a refined understanding and improved ability to pinpoint their learning needs.

Our results resonate with prior research highlighting the pivotal role of educator guidance and peer interaction in sharpening students' awareness of their learning demands [19–22]. These studies underscore the significance of communicative exchanges in enhancing self-awareness and diagnostic capabilities among learners.

Furthermore, the study revealed that the virtual reality-supported cultural learning activity positively impacted students' engagement in the learning process. Various aspects contributed to this finding. Active participation in the creation, sharing, and evaluation of their cultural tours, along with receiving and providing feedback, significantly boosted students' engagement levels. Additionally, the personalized feedback from educators tailored to each student's progress served as a motivational catalyst for continuous self-directed learning. Effective communication with a broader learning community, including peers, observers, and family members, also facilitated the adoption of suitable learning strategies, further enriching the learning experience.

This aligns with existing literature emphasizing the value of comprehensive student involvement in learning activities to foster a keen interest in learning [23–25]. The influence of positive feedback from educators and the role of autonomous communication

are also recognized as crucial elements in promoting active participation in the learning process [6, 26, 27].

Moreover, the study indicated that the cultural learning activity facilitated by virtual reality supported students in developing their ability to self-assess their learning progress. The continuous assessment and feedback from educators, coupled with students' engagement in self-evaluation, laid the foundation for this improvement. Regular encouragement from educators to critically assess and refine their virtual tours played a significant role in teaching students about the evaluative process. The practice of sharing their work with a wider audience and refining it based on collective feedback further honed their evaluative skills.

These findings are in line with other research emphasizing the critical function of educator-led evaluation and feedback in nurturing students' capacity for self-assessment [28–30]. The importance of effective communication throughout this evaluative process has also been highlighted as a key contributor [30].

Lastly, students underscored the value of the cultural learning activity in enhancing their self-directed learning abilities. The opportunity to revise their tours based on feedback and to incorporate insights from peers' suggestions, combined with the activity's engaging and relevant nature, led to favorable perceptions of the technology-supported cultural learning experience.

The outcomes of the present study highlight the potential of technology-supported cultural activities to advance self-directed learning. The process of designing virtual tours, coupled with feedback and active dialogue, was deemed meaningful and relevant by students, showcasing the broader applicability of such approaches in education. The study's novel exploration into using virtual reality for cultural learning provides a foundation for further research and practical applications in educational settings. Recommendations include developing similar activities to enhance students' autonomous learning and emphasizing structured guidance to support self-directed learning. Despite limitations like the small sample size and the study's short duration, these findings contribute to the evolving dialogue on integrating technology to foster student autonomy and engagement, offering a pathway for future educational innovations and policy development.

In this initial study, we examined the influence of VR technology on boosting self-directed learning skills among junior high school students by developing online learning environments. Participants engaged in creating and sharing virtual tours, applying self-directed learning strategies. While this study primarily focused on enhancing these skills, our next research will concentrate on developing innovation and entrepreneurship skills. Students will continue to create and share virtual tours, utilizing innovation and entrepreneurship learning strategies. For example, they may formulate business plans to promote their tours, collaborate with local businesses to incorporate promotional content, or design interactive elements to engage users in new ways.

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