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Enhancing Spatial Reasoning Capability Using Virtual Reality Immersive Experience

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Spatial reasoning is the ability to think about objects in two and three dimensions. Spatial reasoning skills are critical in science, art, and math and can be improved with practice. This research's main objective is to explore how virtual reality (VR) immersive experiences can enhance spatial reasoning capability. Past research revealed the vast differences between traditional user experiences and immersive experiences. VR uses tools to create artificial digital worlds that simulate physical ones. With head-mounted displays, users can detach their senses of sound, sight, and space from their surroundings to fully 'immerse' in simulated, computer-generated realities. Immersive experiences are everyday in the consumer space, particularly in the world of video gaming, but have become rapidly adopted by learning and education.

In this study, we propose a two-stage comparison experiment to explore the spatial reasoning skills of participants, who are selected from diversified backgrounds with reasonable spatial abilities and experience in virtual reality. In the first stage, participants will experience traditional hand drawing techniques in the physical environment before moving forward to drawing in a VR environment with Gravity Sketch application, and in the second stage, they are invited to conduct the traditional drawing session once more. Each session is designed as the following flow: begins with task introduction, then object and drawing process brainstorming, followed by object drawing, and ends with object related questions. During the experiment, Galvanic Skin Response (GSR) device is attached to participants in order to collect users' reflection pattern, followed by interviews of which the results are analyzed using text analysis technique to obtain more insights into participants' thoughts, and lastly, a survey is conducted to measure learning performance and immersive tendency of the participants. The preliminary results support the hypotheses and reveal that user immersion has a significant impact on user efficiency, user effectiveness, and user satisfaction, which are related to learning outcomes, and hence, to user spatial reasoning capability. These results have inspired us to plan further investigation regarding how the differences in backgrounds affect the process for a more comprehensive understanding about this topic. This research provides more insights into the applications of VR in learning spatial reasoning, which could be utilized and developed in educational settings, especially in STEAM (science, technology, engineering, art, mathematics), and other aspects as well.

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