

A Virtual Reality Game To Identify Locations in the Lehigh River Watershed

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Abstract. Immersive virtual reality (VR) is a learning technology that is emerging in secondary schools. We have designed and developed a prototype immersive VR learning game for urban students to learn about local features in the Lehigh River watershed in Pennsylvania, USA. We used a series of design principles to engage students who are unmotivated to learn in traditional classroom settings, students with disabilities and English learners. The VR game incorporates realism, immersion, and interactivity to promote learning. In the learning game, students must identify nine different locations in their watershed using geographic features. The initial prototype implementation resulted in high engagement, immersion, and a sense of flow.

Keywords: Virtual Reality, Learning Game, Watershed, Immersion.

1 Description

Traditional teaching and learning environments for secondary learners include didactic, lab, and field experiences. These experiences often cannot meet the learning needs of all students, especially students with disabilities or are English learners. Classroom learning environments have many distractions that include off-task talking, cell phone use, and gaming on laptop computers. In secondary urban classrooms, many learners are not engaged or motivated to learn. They avoid challenges, do not complete tasks, and are satisfied to “just get by” and are at-risk for dropping out of school [1]. To address this, we have designed and developed an immersive Virtual Reality (VR) game for secondary students to learn about locations in their watershed.

Immersive VR is a learning technology that is emerging in schools and colleges [2]. Immersive VR is an interactive computer-generated experience that takes place within a simulated environment. Immersive VR technology uses VR headsets to generate realistic images and sounds and hand-held controllers that together simulate a user's physical presence in a virtual environment. A person using VR is able to move and look around in an artificial world and interact with virtual features or items. The effect is commonly created by VR headsets that display a small screen in front of the eyes. Immersive VR offers learners an active rather than passive experience. It provides learners an immersive experience without distractions through immediate learner engagement,

and can be designed and developed to provide a novel learning experience to help students understand complex concepts and develop important skills. In a VR environment, authentic imagery, content, data, animations, video, and narration can be incorporated to provide learners with an improved learning experience. Prior studies have identified positive benefits of VR as an educational tool for English learners [3], emotional/behavior disorders [4], and visual disabilities [5].

We designed our watershed VR environment using Unity. The VR space includes a map-based interface using 3D map with labels, realistic models of objects, topography, and terrain. We developed an OpenVR controllers input C# script to enable the learner to “fly” and move through the VR environment. We use a series of design principles to assist diverse learners within the VR environment. These include navigational and map aids, audio options for listening to text to help build mental representations of key vocabulary terms, highlighting key vocabulary text that is being read, avoiding green and red colors, and UI elements such as buttons, pictures, and text.

When the user first enters the VR system, they are placed in a tutorial area and select a virtual tutor that will help them to learn about the watershed location identification game (Figure 1). The user is introduced to the game’s contextual challenge: They are volunteering to help out at the Lehigh Gap Nature Center to get equipment and arrive to a locked door. The key has been lost at one of nine locations in the Lehigh River watershed. The user must go to visit all locations and correctly identify each one to acquire the key.

The user then enters the location game. It initially places the user in the center of their city where there are nearby locations that are readily apparent. The virtual tutor instructs students how to use the handheld controllers to move in the VR environment and interpret the navigational and map indicators. When the user selects a target location, a pop-up question appears that prompt the user to identify the location (Figure 2). If the user selects an incorrect answer, contextual hints appear and the user tries again. When the correct answer is selected, an icon specific to that location appears on the badge board. The game is over when the student collects all nine icons on the badge board. The key is always found when the last location is correctly identified. The user’s last mission is to return to the LGNC and open the door.

During Summer 2018, the initial prototype was used with a secondary learner from our target population of an urban school in which all students are economically disadvantaged. The outcomes were high student engagement, immersion, and a sense of flow. Revisions have been made and the VR game and will be used in Spring 2019 with students in a secondary Environmental Science class. We will investigate students’ flow experience, their sense of immersion and presence, their attitudes toward using VR, and their perceptions of using VR in school learning environments.

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Fig. 1. The tutorial area of the VR watershed location game.



Fig. 2. VR watershed location game displaying response choices when a location target is selected.