



**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.

## What problem are we trying to solve?

- Traditional teaching and learning environments do not meet needs of all students (engagement, language learning, & accommodation of disability)
- Many distractions in secondary urban classrooms: off-task talking, cell phone use, gaming on laptop computers
- Many learners are not engaged or motivated to learn
  - Avoid challenges, do not complete tasks, and are satisfied to “just get by” and are at-risk for dropping out of school

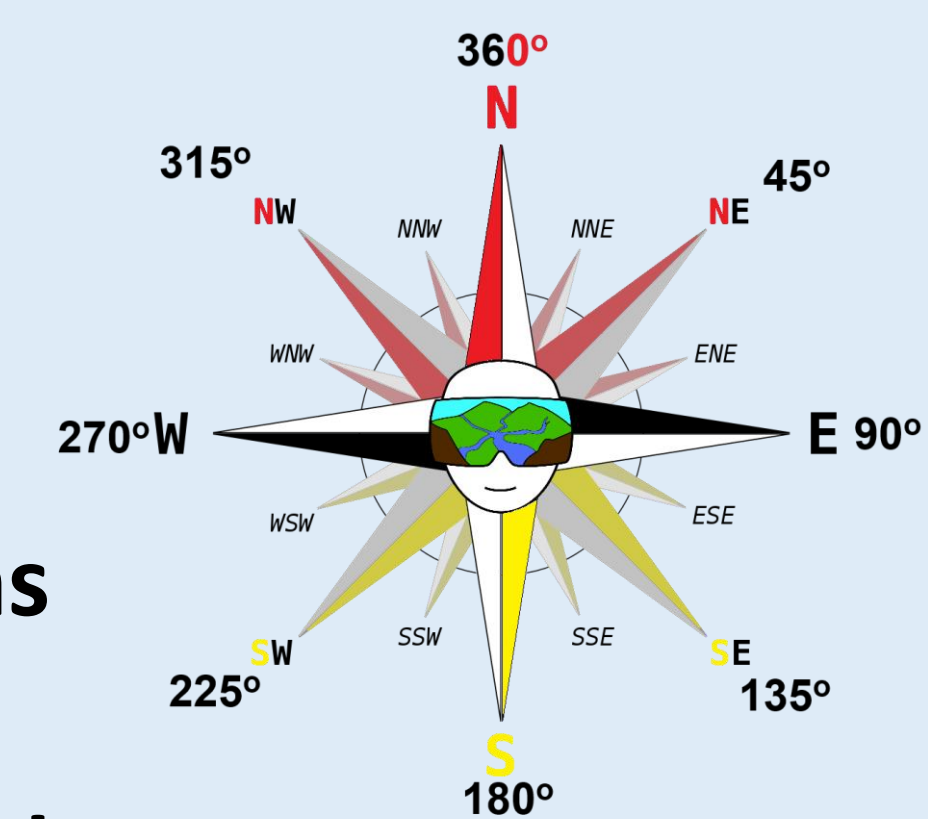
## Design of VR Environment

- Map-based interface using 3D map with labels
- Realistic models of objects
- Topography and terrain
- OpenVR controllers input C# script to enable the learner to “fly” like a drone
- Navigational and map aids



## Gaming Context

- Volunteering to help out at the Lehigh Gap Nature Center
- Arrive to a locked door
- The key has been lost at one of nine locations in the Lehigh River watershed
- User must go to visit all locations and correctly identify each one to acquire the key

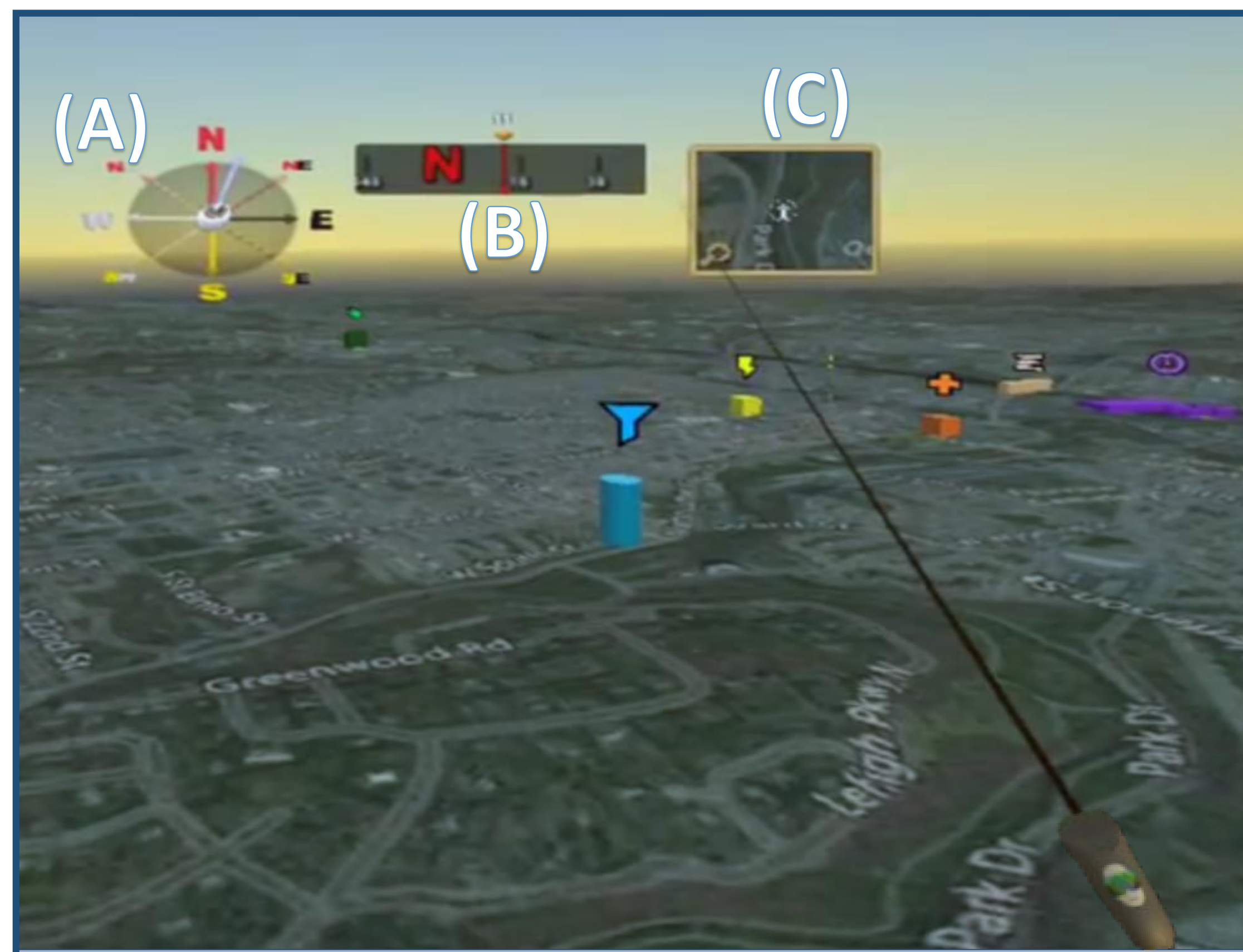


## Virtual Tutors

- Instructs students how to use the handheld controllers to move in the VR environment
- Interpret the navigational and map indicators



Location target, and geographical hints (on the board) to identify **Blue Mountain Resort**



Location targets throughout the city, and three navigational features: (A) compass rose (radar), (B) compass bar, and (C) minimap



Image shows a geographical hint to identify the **Water Filtration Plant**



## Pause Menu

- Highlights progress of game goals
- Badge board shows the progress of identifying each location and amount of time in the game
- Pointing to the “(?)” badge board provides the user with a geographical location hint



## Initial Prototype Findings

(Summer 2018 – HTC VIVE)

- High user engagement
- Immersion in the experience
- Sense of flow, losing track of time



## Initial Pilot Test

(May 2019 – Oculus GO headsets)

- 60 urban students ages 16-18
- Data collection with a valid and reliable 10-item flow measure, a 12-item perception of learning with VR measure, and 9 Focus groups of 30 min.



“ Our favorite focus group quote:  
How did your experience with VR compare to typical school activities?  
“When my phone buzzed in my pocket, I did not care to answer it. In any other class, I would have checked it immediately.”