Learning about Ontario’s Paleozoic Geology with Virtual Reality Google Expedition Tours

Henry Visneskie (hevisnes@uwaterloo.ca), Jen Parks and John Johnston
Dept. of Earth and Environmental Sciences, University of Waterloo, Waterloo, ON

Abstract
How well can you interpret or place into context the different geological features or rock types that are exposed along roadways, rivers, coastlines or construction sites? Here in the Department of Earth and Environmental Sciences at the University of Waterloo, we recognize a gap between learning foundational geoscience knowledge (i.e. in traditional classrooms and lab settings) and applying this knowledge during field experiences. To bridge this gap and better prepare students for field experiences we suggest using virtual reality.

The Google Expedition Kit funded by the Dean of Science Undergraduate Teaching Initiative was chosen as the best entry level system because it is cost-effective, self-contained, already tested and versatile for teaching up to 20 people. Here we present the perceived advantages and disadvantages of this system to provide immersive learning experiences for improved understanding of Ontario’s Paleozoic geology. Initial use of this VR Kit has shown it can be used successfully to investigate Paleozoic rock outcrops across Ontario by using existing and student-created Tours, as well as self-guided and leader-guided Tours. There was increased motivation and engagement among students, improved familiarization and connections among a variety of outcrops in space and time. And there was also enhanced meaning and context for the many Paleozoic rock layers in Ontario, and an increased number of insightful questions. Although field experiences will always play a vital role in university geoscience education, virtual reality can help in improving understanding and compliment field experiences through its uniquely immersive capabilities. We suggest this would also be effective in professional geoscience practice and everyday life.

What is Virtual Reality?
Simulated 360° environments that are viewed with a headset (Oculus Rift, HTC Vive, Samsung Gear VR). The headset projects an image, which can be viewed from different perspectives as the user changes the orientation of their head. The degree of immersion scales with cost and technical proficiency. Basic virtual environments can be created with static 360° photospheres, while more advanced VR experiences allow users to view a 360° video or move around in a simulated environment.

Benefits of VR in Geoscience
• Bridges application gaps of knowledge between class and field environments
• Allows virtual travel and investigation anywhere in the world, accommodates persons with disabilities (cost and time efficient training)
• Immersive simulated environments increase student interest and engagement
• Familiarises students with locations to better prepare for field work and professional practice. Also mitigates anxiety before field work
• Exploration from different perspectives (eye-level, drone heights) and scales (ability to zoom in or out on features)
• Mechanism to train in one area and extrapolate to other areas (improve observation and prediction skills before and after fieldwork)

Limits of VR in Geoscience
• Distractions within virtual environments → can be mitigated via real-time teacher guiding, point-of-interest markers, and annotations
• Motion sickness and disorientation → can be reduced using the guide’s pause feature, regular fullscreen viewing mode, and as a compliment to lessons (rather than a replacement)
• Certain configurations and equipment can be costly for large classes → More feasible, entry level VR experience alternatives (e.g. Google Expeditions Kit)
• Necessary power and internet service isn’t directly available in the field → Can be a usable battery and download Tours to a host tablet/smartphone to guide Expeditions offline.

Simple VR Content Creation
Creating VR content can be a simple process supported by free Google software. Currently, we are using Google Street View as a repository of 360° images (photospheres), in order to create Tours. By selecting already-existing photospheres of geologically relevant locations, we are able to create Tours with Google Tour Creator and view them through the Google Expeditions mobile app or the Google Poly website. We are starting to capture our own images with a 360° camera to align with specific learning outcomes.

Student-Inspired Virtual Tours
Directly below are examples of VR tours created by Henry, Jen, and John with some ideas for how the Dours created by students in EARTH 235 (Fall 2019) - Stratigraphic Approaches to Understanding Earth’s History. Examples showcase the variety of technical capabilities in Expeditions Tours that support real-time teaching and application of foundational knowledge in simulated or real field experiences. These example Tours can be viewed at the poster session.

Outcrops Along the Niagara River

Bedrock of different ages in SW Ontario

Road Outcrop at Clappinson’s Corners

Recommended Readings
• Mobile and Immersive Learning (2019) - Applications, Experiences, Implications and Challenges
• Mobile and Immersive Learning (2019) - Applications, Experiences, Implications and Challenges
• Mobile and Immersive Learning (2019) - Applications, Experiences, Implications and Challenges
• Mobile and Immersive Learning (2019) - Applications, Experiences, Implications and Challenges
• Mobile and Immersive Learning (2019) - Applications, Experiences, Implications and Challenges
• Mobile and Immersive Learning (2019) - Applications, Experiences, Implications and Challenges