ABSTRACT

The demand for competent geoscientists and engineers is high, and the development of a new resource has addressed a gap in the traditional education framework. Spatial understanding is a key component of geoscience competence, but it has proven to be difficult for students to grasp 3D concepts using 2D teaching media. A new 3D digital model of Ontario’s Paleozoic Geology created in partnership by the Geological Survey of Canada, Ontario Geological Survey, Ministry of Natural Resources and Forestry, Oil Gas and Salt Resources Library, and Carter Geologic (Carter et al., 2019) has the potential to effectively complement the existing teaching resources and vastly improve an understanding framework for geoscientists and engineers. The Department of Earth and Environmental Sciences at the University of Waterloo has been developing a teaching framework for this revolutionary new resource in undergraduate courses. Applying this new 3D digital geological model in the class called Earth 235: Stratigraphic approaches to understanding Earth History has helped bridge the dimensional and interactive gaps that exist with the traditional education framework. To interpret the data shown in the 3D geological model, the new Paleozoic lithostratigraphic chart for southern Ontario was used in conjunction with the 3D model. By examining the 3D model and lithostratigraphic chart as well as enlisting the help of students and professionals, a list of the Top 10 Important Aspects of Ontario’s Paleozoic Geology is being compiled to help guide development of a new education framework. The next steps in creating an effective learning tool that connects to professional competencies, provide a focus on certain features and resources that are hidden in the wealth of information in the 3D model, and link key features to core geologic concepts that could be transferred to other sedimentary basins.

GOALS AND OBJECTIVES

Enhance Student Learning

The overarching goal of this thesis project is to enhance the learning experience of students at the University of Waterloo in the Earth 235: Stratigraphy and Earth History’ lab. This course is a fundamental knowledge-base requirement for professional geoscience accreditation in Ontario. Students have traditionally found difficult developing 3D spatial thinking skills from paper maps, but when they are able to extract the full educational value from the new 3D digital model, they are accelerated along this component of their path to geoscience competence.

Develop a Learning Framework

Worthington (2019) found that the digital model has so much detail that students were overwhelmed by its capability. In order to implement the model in an effective manner, a learning framework was developed that uses key features and concepts to direct students on a path of discovery through the model.

Unite Students with the 3D Digital Model

The developed framework will be considered successful if students are able to do the following. First, they can efficiently use the Leapfrog® software to navigate through the model. Second, they make concept connections that didn’t occur with other learning media. Third, they develop core skills that can be applied in other sedimentary basins throughout the world.

PRELIMINARY OUTCOME

High Student Engagement

Students were excited to work with the model and observed learning benefits, such as better understanding of the model during the labs, and high quality qualitative feedback in a post lab survey.

Effective Framework

88% of students who responded to the post-lab survey said that the learning framework helped them understand the model better.

Consistency Between Lab Sections

Because grades between all lab sections were statistically similar, the lab groups can be treated as an aggregate grade. This was the expected result, as significant effort was taken to make sure that all sections of the lab were consistent between lab sections.

CONCEPT CONNECTIONS IMPROVED FROM WEEK 1 TO 3

A statistical increase in the average percentage between labs 1 and 3 confirmed that students became more proficient in using the software, and improved at using the model to make concept connections.

Leapfrog is an Efficient Tool for University Students

Students were able to learn how to use Leapfrog Viewer® proficiently with twenty minutes of instruction and approximately 30 minutes of practice with the ‘Learning Leapfrog’ topic on the second lab. With this focused introduction time, students were then able to proficiently use Leapfrog Viewer® to make concept connections.

KEY TAKEAWAYS

Enhance Student Learning

- There was a statistical increase in grades when using the digital model
- Students were motivated and engaged in their learning
- New concept connections were frequently made while using the model (i.e., visualizing the Algonquin Arch in 3D helped explain the 2D surface expression)

Develop a Learning Framework

- In a post-lab survey, 88% of respondents stated that the ‘Top 10’ learning framework helped them understand the model better
- Students were engaged in dialogue about the ‘Top 10’ list, and provided valuable input to refine and clarify the items on it

Unite Students with the 3D Digital Model

- By far the best way to use the 3D digital model did a better job than the paper map at helping students understand data limitations, locate specific information, and make accurate predictions of subsurface geologic features

HELP Make the Next Generation of Geoscientists

We want to hear from you! The final part of Jeremy’s undergraduate thesis is to get input from Open House attendees. In your professional experience, what is most important about Ontario’s Paleozoic geology? Please tell Jeremy your ‘Top 5’ or more important features or concepts that future geoscientists need to understand about Ontario’s Paleozoic geology. Then Jeremy will investigate to see if the items on your list have been or can be incorporated into the educational framework, and explained in their digital model.

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3D Physical Model (OV, 2018)

3D Digital Model (GSC, 2019)

Paper Map (GSC, 1991)

2D Physical Model (OV, 2018)

3D Digital Model (GSC, 2019)

Paper Map (GSC, 1991)