12-2012

Grand Canyon as a Universally Accessible Virtual Field Trip for Intro Geoscience Classes Using Geo-Referenced Mobile Game Technology

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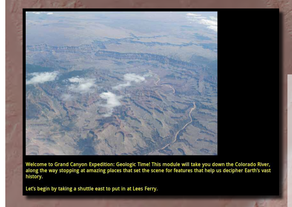
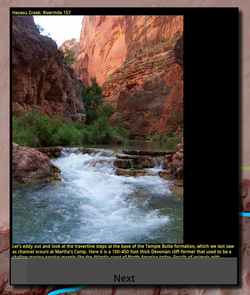


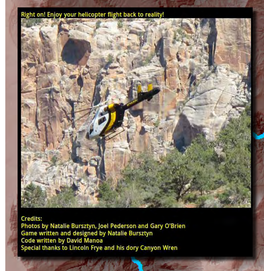
THE PROBLEM

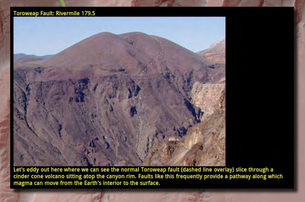
There is a well-documented and nationally reported trend of declining interest, poor preparedness, and lack of diversity within U.S. students pursuing geoscience and other STEM disciplines. We suggest that a primary contributing factor to this problem is that introductory geoscience courses simply fail to inspire (i.e. they are boring). Our experience leads us to believe that the hands-on, contextualized learning of field excursions are often the most impactful component of lower division geoscience classes. However, field trips are becoming increasingly more difficult to run due to logistics and liability, high-enrollments, decreasing financial and administrative support, and exclusion of the physically disabled.

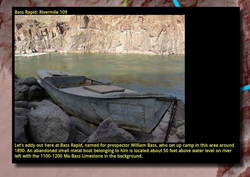
ASKING STUDENTS TO USE THEIR SMARTPHONES INSTEAD OF TELLING THEM TO PUT THEM AWAY

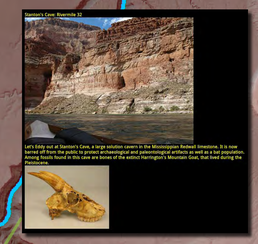
Recent research suggests that virtual field trips can be used to simulate this contextualized physical learning through the use of mobile devices – technology that exists in most students' hands already. Our primary goals are to enhance interest in introductory geoscience courses by providing the kinetic and physical learning experience of field trips through geo-referenced educational mobile games and test the hypothesis that these experiences can be effectively simulated through virtual field trips. We are doing this by developing "serious" games for mobile devices that deliver introductory geology material in a fun and interactive manner. Our new teaching strategy will enhance undergraduate student learning in the geosciences, be accessible to students of diverse backgrounds and physical abilities, and be easily incorporated into higher education programs and curricula at institutions globally.

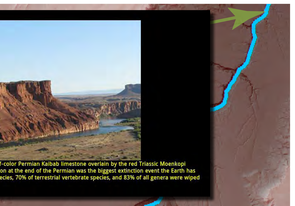






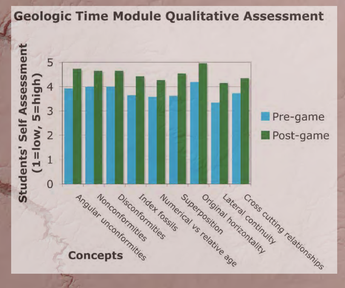






TESTING THE WATERS

Historical Geology and Physical Geology students (n=27) at Utah State University volunteered to play the prototype game module and complete anonymous evaluation surveys in the summer and fall of 2012. Students ranked the degree of fun and difficulty of the game, the content learned, and what features they liked or disliked.

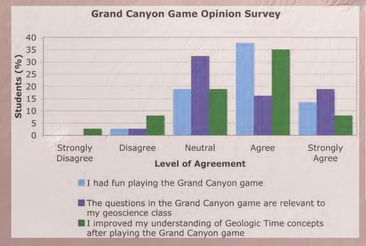


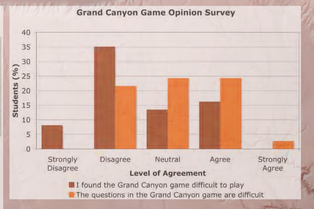
GRAND CANYON EXPEDITION: GEOLOGIC TIME

Our prototype module (Geologic Time) involves students virtually navigating downstream along a scaled down Colorado River through Grand Canyon – physically moving around their campus quad, football field or other real location, using their smart phone or a tablet. As students reach each designated location, a photo or video in Grand Canyon appears along with a geological question. The students must answer each question correctly in order to proceed to the next location and accrue points in the game. Multiple attempts at a question reduce the number of points earned when the correct answer is found. The questions are either multiple choice or involve touch-screen interaction to identify a specific geologic feature. In the future we would like to improve and "gamify" the points into a more robust and motivating reward system such as a collection of geologic treasures or the requirement of a certain point score in order to earn the helicopter ride out and "win" the game.

SURVEY SAYS

In both classes, participants were somewhat familiar with the geologic concepts presented in the game, as the pre-game survey results show. However, results indicate that students across the board gained greater comprehension of the concepts through game play. In addition, students found the pilot module fun to play as well as relevant to their class material. Importantly, they found it quite easy to play. This allows a student to concentrate on the content of the game instead of how to play it. Student comments on the surveys indicate that they enjoyed the mobile "exploration" nature of the game as well as experiencing photographs of actual geologic features rather than traditional textbook cartoons.





DISCUSSION AND FUTURE PLANS

The results of these early assessments are positive, both in regard to the improvement of students' understanding of key concepts and their enjoyment of learning with mobile technology. This is a positive first step in developing innovative teaching that utilizes powerful tools students are already intimate with in order to make first-year STEM courses unboring, and to make world-class field trips accessible to all!

This is the start of an idea that is being developed. Plans are to create four additional modules covering major topics taught in introductory geoscience courses (shown in the table to the right). We plan to test these modules in classes at educational institutions spanning a diversity of student backgrounds from community colleges to private universities.

TABLE OF ADDITIONAL MODULES FOR "GRAND CANYON EXPEDITION"

Module	Curriculum	Virtual Field Trip	Potential Kinesthetic Experience
Plate Tectonics & Deformation	Plate motions, faults, folds	Rafting through Grand Canyon to Pearce Ferry, making stops at a variety of geologic structures	Students navigate to each location where they make observations on photos, annotating them with symbols for the offset and type of structures. Students virtually collect GPS plate motion data for eastern vs. western Grand Canyon.
Earth Materials	Minerals, rock types, rock cycle	Hiking up out of Grand Canyon from river to rim through igneous, metamorphic, & sedimentary units	Students navigate and walk a distance scaled to represent elevation, observing photos and video, collecting inventory in order to assemble the rock cycle.
Surface Processes	Weathering, mass wasting, uplift vs. erosion	Circumnavigate rim of Grand Canyon, stopping at classic examples of geomorphic features & processes	Students navigate to locations where they explore geomorphic processes sculpting the landscape and collect a dataset of bedrock-unit mechanical strength, composing testable hypotheses to address their observations.
Water Resources	Hillslope & river hydrology, flooding, human modification	Going from Rocky Mtn headwaters to Mexico delta, seeing source areas, tributary junctions, reservoirs & diversions	Students navigate at a pace that is scaled to match the growing, then shrinking, discharge of water along the river system, observing video and collecting data on natural and anthropogenic changes in hydrology. Students then calculate the water balance & hypothesize possible solutions to water issues.

I would like to thank the Center for Women and Gender at Utah State University for providing a travel grant for me to attend the 2012 American Geophysical Union Annual Fall Meeting.