Landscape Identification and Formation: The Development of a Test to Measure Student Knowledge and Confidence

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1. Introduction

Upper level students at UBC (Vancouver) decreased in their confidence with timescales of landscape formation at the end of the term, as measured by the Student Attitudes about Earth Science Survey (SAESS) (Fig. 1). In order to further investigate this result, the Landscape Identification and Formation Test (LIFT) has been developed. Students view images of various landscapes, identify them, answer a multiple choice question on the time it took to form, and rate their confidence in their answers.

The understanding of deep time and interpretation of landscapes is vital to the skill set of the geologist. Both the attitudes and confidence of students greatly impact the learning process, and the results of the LIFT can be used to understand it in greater detail. This poster details the methods used to develop the LIFT, including selection of images, student interviews, expert interviews, the final test, and administration, and introduces preliminary results.

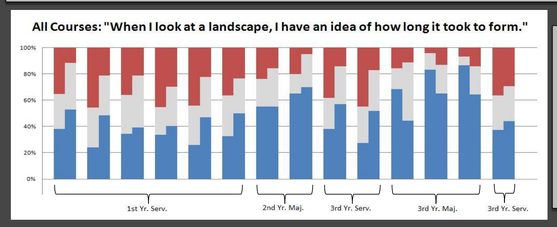


Figure 1: On average, students in third year majors courses shift away from the expert on the statement "When I look at a landscape, I have an idea of how long it took to form." Students in service courses shift towards the expert.

2. Selection of Images

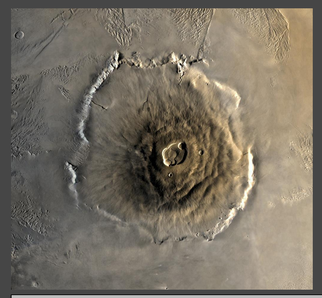
The SAESS statement (#13) used to measure the confidence of students in timescales of landscape formation is, "When I look at a landscape, I have an idea of how long it took to form." The test was created to touch on both of the points in the statement: first looking at a landscape (likely identifying it) and then thinking about how long it took to form. Viewing an unidentified image better simulates the "real world." Sixteen images were located online with the guidance of a common geomorphology textbook (Trenhaile, 2007) and the goal of touching on both a variety of environments and a range of timescales.

3. Student Interviews

Ten geology and geological engineering students (five lower level and five upper level) were interviewed in order to validate the test and make logistical decisions. These students were paid volunteers who first signed a consent form, answered the SAESS statement, and then went through the test silently on their own, writing out their answers on paper. Then they went back through the test, verbalizing their answers and thought processes, in what is termed a "think aloud interview". Finally, they answered the SAESS statement again, to determine if there were any changes after taking the test. If any questions were asked of the interviewer, they were not answered until after the interview.

The majority of the students preferred to view the images on a PowerPoint slide show over print outs on paper, as well as a confidence scale in fifths of percentages (<20%, 20-40%, 40-60%, 60-80%, and >80%) over a five point Likert-scale (1 to 5 strongly disagree to strongly agree).

Twelve images were chosen for the final test, some being removed for obscurity or lack of clarity and others changed or cropped to be clearer (Fig. 2 and 3).



Figures 2 (left) and **3** (right): Olympus Mons, on Mars, was originally used as the volcano image but was switched for Arenal in Costa Rica due to confusions observed with students in validation interviews. The former was found to be both obscure and unclear due to the bird's eye view of the photo. (http://commons.wikimedia.org/wiki/File:Olympus_Mons.jpg and http://commons.wikimedia.org/wiki/File:Arenal-Volcano.jpg)

4. Expert Interviews

Seven experts in the fields of geology and geography took the test, in order to build the answer key. Six of these were in person, and one was over email. Like the version of the test used in the student interviews, the questions were open ended. The experts were asked to provide an order of magnitude for the timescales of landscape formation, and sometimes gave a range. Any answer that less than three people said was eliminated from the possibilities for the answer key (these were always on the outside of the range of answers). Multiple choice questions were then created that only had one BEST answer and incorporated the range of responses given by students in the interviews.

Expert responses for hoodoos:
10s of 1000s, 1000s to 10s of 1000s, 1000s to ~~100s of 1000s~~,
10s of 1000s to ~~100s of 1000s~~,
1000s, ~~100s~~ to 10s of 1000s, ~~100s~~

eliminate responses that less than three people said

How long did this landscape take to form?
a) 10s of 1000s of years or less
b) 100s of 1000s of years
c) 1 000 000s of years
d) 10s of 1 000 000s of years
e) 1 000 000 000s of years or more

create a multiple choice question with only one correct answer

5. Final Test

In addition to the twelve images and their corresponding identification, formation timescale, and two confidence questions, eight questions on general geologic time were added to characterize the student's knowledge in geologic time, as well as distinguish between lower level and upper level students. Four of these questions were directly from the validated Geologic Time Assessment Tool (Rhajiak, 2009), two were slightly modified from this form by Dr. Stuart Sutherland for use as a pre-post test in a class about geologic time (Personal Communication, Stuart Sutherland, 2009), one was newly created by Sutherland, and the final one was newly created by the researcher.

List of images:
1. Alluvial fan 2. Lava flow 3. Impact crater 4. Hoodoos 5. Fault 6. Mountains
7. Sand Dunes 8. Volcano 9. River 10. Mud cracks 11. Landslide 12. U-shaped valley

Example landscape question:
a) What type of landscape is this? _____
b) How confident are you that you recognized the type of landscape that is present in the image?
<20% 20-40% 40-60% 60-80% >80%
c) How long did this landscape take to form? Choose the **BEST** answer.
a) 1000s of years or less
b) 10s of 1000s of years
c) 100s of 1000s of years
d) 10s of 1 000 000s of years
e) 1 000 000 000s of years or more
d) How confident are you in your estimation of the time the landscape took to form?
<20% 20-40% 40-60% 60-80% >80%

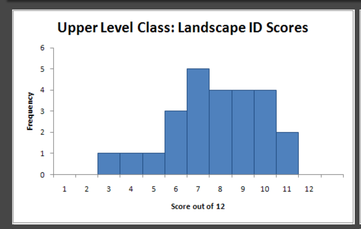
6. Administration

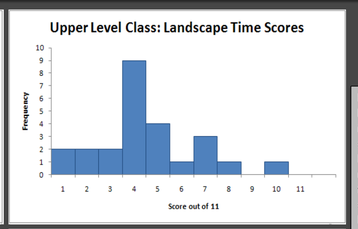
The full version of the LIFT was given to two classes at UBC during lecture time (taking approximately 25 minutes). One of these classes is a lower level class (Introductory Mineralogy, n=71) and the other is an upper level class (Advanced Paleontology, n=25).

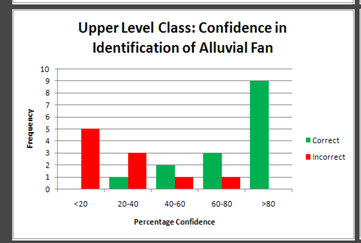
Students had a response sheet in front of them. They first answered the specific SAESS question, tore off this page, and handed it in (so they could not change their answer later on). After this they were given 45 seconds for each of the twelve images and their corresponding questions. Ten minutes was given for completion of the eight geologic time questions. Finally, the SAESS question was answered again. Data were filled out by hand and marked/transcribed by the researcher. All questions had a set number of selections and one answer, except for the open-ended landscape identification question. Demographic information was also collected in order to make comparisons between different populations.

7. Preliminary Results

Overall, students score much higher on the landscape identification portion of the test (Fig. 4) than the formation time portion of the test (Fig. 5). Their confidence levels with identification accurately reflect their knowledge (Fig. 6); however, their confidence levels with formation are much more varied (Fig. 7).







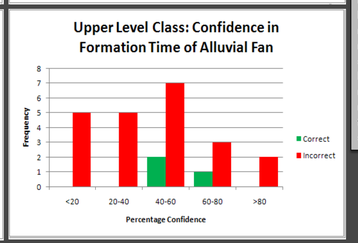


Figure 4 (upper left): landscape identification scores.
Figure 5 (upper right): landscape formation time scores.
Figure 6 (lower left): student self-rated confidence in identification of an alluvial fan.
Figure 7 (lower right): student self-rated confidence in formation time of alluvial fan.

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