# Identifying Landscapes and their Formation Timescales: Comparing Knowledge and Confidence of Beginner and Advanced Geoscience Undergraduate Students

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## Abstract

The Landscape Identification and Formation Test (LIFT) was created in response to previous data from the Student Attitudes about Earth Science Survey (SAESS) at the University of British Columbia (Vancouver). The SAESS data suggested that upper-level students become less confident in landscape identification and formation timescales over the course of a term. The LIFT specifically probes the relationships among student confidence and knowledge in landscape identification and formation timescales and general knowledge in geologic time. The LIFT was validated with "think-aloud" interviews with students and correct answers were determined from interviews with experts.

Results from the LIFT suggest that advanced students have higher conceptual knowledge, higher confidence in their knowledge, and are more self-aware than beginner students. Advanced students became more confident in landscape identification and formation timescales over the course of the term, contradicting the results seen in the previous administration of the SAESS. Students are better at identifying landscapes than assessing how long they take to form and are better with extreme timescales, two critical points that should be taken into consideration with future curricular reform.

## 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) (Figure 1). In order to further investigate this result, the Landscape Identification and Formation Test (LIFT) has been developed.

The LIFT combines questions assessing student knowledge in identifying landscapes from images, determining their formation timescales, and their confidence in each of these components. Finally, the student's general knowledge in geologic time is assessed (Rhajiak, 2009).

Results from the LIFT can be used to make curricular decisions in the department, and inform methods of teaching and learning.

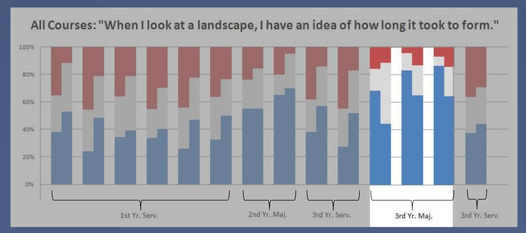



**Figure 1**: Students in upper-level majors courses ("3rd Yr. Maj.") become less confident with timescales of landscape formation by the end of term, whereas students in lower-level majors and non-majors courses ("1st Yr. Serv.", "2nd Yr. Maj.", and "3rd Yr. Serv.") become more confident. Blue (bottom) = agree with expert, grey (middle) = neutral, red (top) = disagree with expert. Left side of bar = beginning of term, right side of bar = end of term.

## Methods

Developing the LIFT (a validated test) is an iterative process, shaped by responses from both students and experts. Interviews ensure that the test is consistently interpreted and reasonable for the targeted audience. Then an answer key is created based upon expert responses. Four other multiple choice answers are chosen based on student responses and the test is administered.

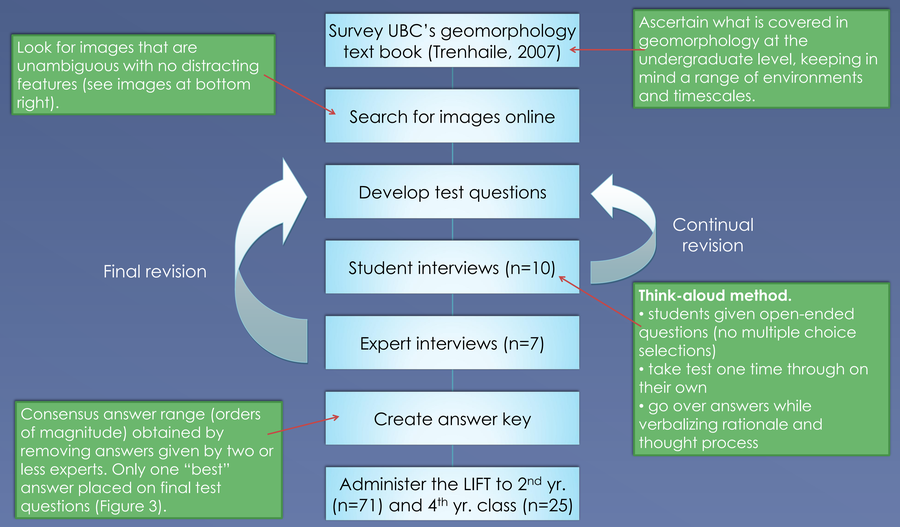



**Figure 2:** Outline of steps involved in development and administration of the LIFT.


**Figure 3**: Image (a) and corresponding question (b) from the LIFT. Copyright © B.P. Snowder; Image Source: Western Washington University Planetarium, http://www.wwu.edu/depts/skywise/a101_meteors.html

**3. a) What type of landscape is this?** (b)

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) minutes or less
b) 100s of years
c) 10s of 1000s of years
d) 100s of 1000s of years
e) 1 000 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%

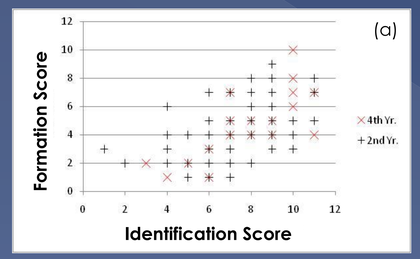
## Results

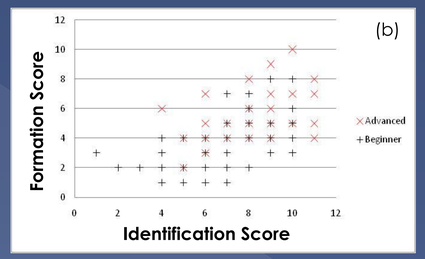
The LIFT has provided valuable information about knowledge, confidence, and self-awareness of beginner and advanced geoscience students. It also points to areas where students are lacking in knowledge, and suggests a new way to evaluate a student's level of expertise.

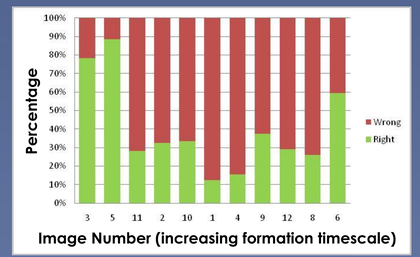
## Figure 4: Evaluation of Expertise

Students in the second year and fourth year classes (a) have varying degrees of geologic knowledge, which don't always align with the level of class that they are in. To account for this variety in expertise, students were re-grouped based on the eight question geologic time section of the LIFT.

Separation by this method more accurately represents the level of expertise of each student, evident in the change in distribution of the landscape identification vs. formation timescale score (b).



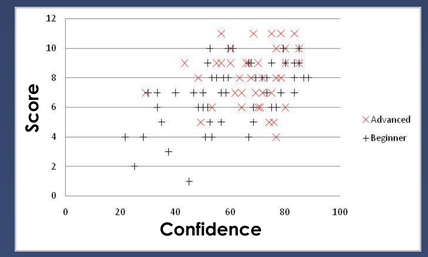




## Figure 5: Student Responses for Different Landscapes and Sections

Both beginner and advanced students are better at identifying less geologically and/or regionally specific images. They are also better with formation timescales on the extremes (minutes or less, tens of millions of years or more).

Overall, both groups score higher on the identification section than the formation timescale section. In fact, both groups have a failing average score on the formation timescale section (beginner = 3.80 out of 11, advanced = 5.24 out of 11).




## Figure 6: Advanced Students have Higher Knowledge and Confidence

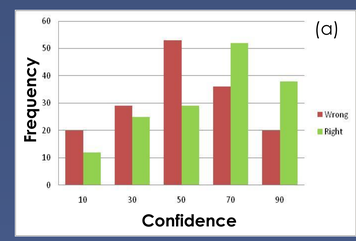
Advanced students have higher confidence and knowledge, and cluster more tightly. This suggests that they are better at gauging their knowledge, resulting in confidence levels that better reflect their abilities.

## SAESS Results not Supported by the LIFT Data

Advanced students do not display the decrease in confidence that was previously seen on the SAESS (Figure 1). There are some possible explanations for this difference. It could be that students still maintain a high level of confidence (and advanced students have higher confidence than beginner students) despite the decrease seen on the SAESS, and this high level of confidence is what is seen in this study. Or it could be that the advanced students in this study are not analogous to the 3rd year majors surveyed on the SAESS.

## Figure 7: Advanced Students are More Self-Aware

In addition to the tightness of the clusters of the beginner and advanced group on plots of section score vs. confidence (Figure 6), analysis of confidence ranges on formation timescales questions when landscape identification is correct suggests that advanced students are more self-aware (i.e., better at self-assessing their knowledge). Among the advanced group (b), there is a larger separation in average confidence between those who got the formation timescale right or wrong ($p=3.6x10^{-7}$) compared to the beginner group (a), ($p=0.001$).





## Implications and Recommendations

- Students generally lack knowledge in formation timescales, which could be addressed in curricula and teaching
- The middle range of timescales is particularly difficult for students, elicits the most disagreement among experts, and could be more explicitly emphasized
- Students abilities do not necessarily correlate to courses in which they are enrolled, and should be independently measured in similar future studies



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http://www.eos.ubc.ca/research/cwsei/landforms.html