Understanding Geological Time: A Proposed Assessment Mechanism for Beginner and Advanced Geology Students at The University of British Columbia (Vancouver)

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ABSTRACT

Having a firm grasp of geological time is essential to developing a full understanding of the Earth. Many studies have focused on students in the K-12 and entry-level college education systems. The proposed 20 questions, mainly multiple-choice, assessment mechanism is designed to probe the understanding of geological time and history among college (entry-level college) and advanced (graduate) students in a major’s geology program. A four-step process involving: establishing instructor expectations of students, development of an assessment mechanism with existing resources, think-aloud validation with student volunteers, and iteration-refinements process for the developed assessment mechanism revealed insights on student behavior and creating multiple-choice tests. Student behavior is assessed via displayed reasoning acts of recalling facts, posing questions, making evaluations, and pausing. From validation interviews students displayed gaps in their understanding of geoscience terminology and a lack of technical vocabulary when reasoning questions out-load. The refinement process revealed the following problems associated with developing multiple-choice questions: unclear wording, emphasis of key words, easily distracted distractors, limitations on cognitive levels of assessment, use of pre-validated questions outside of their context, and testing multiple concepts in one question. The implementation of this assessment should aid in developing the geology curriculum within the Department of Earth and Ocean Sciences at UBC through providing a method for other scholars to investigate of geological time education at UBC.

INTRODUCTION

Geological time is a fundamental concept in building a basic understanding of the Earth (Zen, 2001) and is fundamental to a student’s mastery of the geosciences (Dodick and Orion, 2003a). Previous work on the subject has focused within the domains of K-12 education and lower level college (Trend, 1998; Dodick and Orion, 2003b; Libarkin et al., 2005).

This study looks at instructor expectations of both beginner (2nd year in the program) and advanced (graduating) geology students, and how well students understand these concepts related to geological time. With an internal department review of the UBC geology curriculum underway since 2008, now is a good time to evaluate student capabilities. Hopefully this work may lead to development of curriculum that works to enhance student performance in appropriate ways. Focusing on beginner and advanced students sets it apart from other efforts and provides an opening for new directions in geoscience education research within the UBC context.

METHODOLOGY:

The development of this study can be summarized into four steps (Figure 1) which lead to the creation of the final assessment mechanism. Instructor expectations of students were established via interviews (Table 1), the results of which became the basis for making the first draft of the testing mechanism. Not all concepts outlined by instructors were included (Table 1) due to difficulties creating multiple choice questions that sufficiently tested those concepts.

Think-aloud validations were conducted with students to ensure that proposed assessment questions were interpreted correctly. This method is also a way to supplement the inherent weakness of multiple-choice tests to tease apart critical thinking processes (Norriss, 1990). Validation and refinement were iterative steps that produced the final assessment mechanism (Figure 2).

RESULTS:

The product of this study is a twenty-question assessment that addresses most of the key concepts identified by faculty members. The validation process revealed a number of expected reasoning acts (Norriss, 1990) plus unexpected observations of student behaviour (Table 2). Validation also made several areas of weakness apparent in the questions that were being asked (Table 3).

DISCUSSION:

The reasoning acts (Table 2) that were observed during validation interviews reveal some insights on how students think:

- Students tend to recall facts instead of working through problems with information that is provided.
- They will replace questions to themselves if the answer is not apparent.

- Students would often select answers that they felt ‘sounded’ correct as opposed to ones that they knew were correct.
- Silence leaves thought processes inaccessible to the interviewer but often followed the act of self-questioning.

- Gaps in student understanding of terminology reveals that many exam questions may, in fact, be testing vocabulary instead of understanding of a particular concept.

The multiple choice questions that were used throughout the validation process were refined in a few recurring ways (Table 3). These reveal important take-home messages for creating multiple choice tests:

- Clarity of wording provides the best chance of being a correct subject matter.
- Key words should be emphasized as allow students to focus on what is being asked of them.
- Using previously validated test questions outside of their context may provide inappropriate distractors for the intended test audience.
- Questions that test multiple concepts (Figure 2) do not indicate which portion of the distractor students do not know.

CONCLUSIONS:

This is an initial step in creating a scholarly approach to assessing student understanding of geological time within the Department of Earth and Ocean Sciences at UBC. The four step process outlined (Figure 1) has revealed several expected student behaviours (Table 2) with implications for instructors and areas of improvement for multiple choice questions (Table 3). Subsequent steps will need to involve the implementation of the proposed assessment, as well as the continued development of the test items through validation. I look forward to seeing what studies and changes in the department come out of this work.

ACKNOWLEDGEMENTS:

I would like to thank Dr. Cynthia Bonsall, Dr. David Halcrow, Dr. Timothy Libarkin, Dr. Shirley Adams, Dr. Cathy Mandarla, Dr. Mary Lee Bevin, Dr. Stuart Harris, and Dr. Mary Harris for contributing to this work through their contributions to this manuscript and support for this research. I would like to thank faculty and students for participating in this research. I would also like to thank my Morey School colleagues for their support and encouragement as well as the members of the UBC Geology Curriculum Committee.

WORKS CITED: