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Editorial

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Tracking Student Pathways to Competency in Online Geoscience Learning

Jeremy Dunning[1*]

[1]*Department of Geological Sciences, Indiana University, 1001 East 10th Street, Bloomington, IN 47405-1405, USA*

Currently, more than 100,000 college students take introductory geology courses in online or blended learning formats. For the most part, these courses utilize a "competency-based" assessment rubric.

Many geology professors contend that tracking students' knowledge of subject material via competency-based testing may not be well suited to the geological sciences. One concern is that students can "guess" their way through exercises and produce the "appearance" of competency without actually gaining sufficient knowledge of the material. Another concern is that since much of geological education emphasizes an understanding of "processes" beyond the fundamental memorization of empirical data, typical competency-based assessments may produce less than comprehensive results. In response to these concerns, a unique opportunity has arisen for "multimedia learning objects" in geology to help achieve a broader assessment of the student's actual understanding, by allowing the instructor to assess both the final answers provided as well as the "pathways" the student followed in obtaining the answers.

Tracking of student learning outcomes is becoming increasingly important to educational institutions and has a direct effect on student retention, graduation rates and accreditation. If the assessment of "competency" is not a true measure of what students have actually learned, it cannot be a dependable indicator of student success in future courses and endeavours of similar nature.

The link below provides a typical geologic example of a "competency-based assessment". It begins with a descriptive animation of a convergent plate boundary and ends with a "click and drag" assessment. The exercise requires that the student drag each of several "process" labels occurring in the boundary to its proper location in a diagram. If an answer is correct, the label remains in place, otherwise it snaps back to its original position. "Competency" is achieved when all of the labels have been moved to their correct locations. The inherent problem with the "typical" assessment method described above is that students can try several combinations of labels and locations until all labels are properly in place without really understanding the material presented in the animation (http://www.arjunald.com/geoinf/convergent.swf).

Another issue in the geosciences is that there is often a spectrum of "correct" answers to a problem that ranges from the best to the worst solutions. Often these solutions are based on the pathways and decisions that a student makes as he navigates through the exercise. As noted earlier, if the assessment were to contain both the "answers" that the student obtained as well as the "pathways" taken, the instructor would be able to assess competency in a far more rigorous manner. The challenge is to make the process seamless and efficient for the instructor.

Such an exercise is provided by clicking the link below. In the case presented, the student is asked to deal with a series of environmental hazards. At every step of the exercise the student is required to make choices on how best to determine the source of pollution. The final answers obtained are based on the "decision paths" taken throughout the steps of the exercise. A comprehensive assessment is sent to the instructor that provides both the answers obtained as well as a clear-cut "map" of the corresponding "pathways" taken (http://www.arjunald.com/geoinf/pubpollo).

Note that the relative "values" of the eight possible solutions are "weighted", as some of the decisions and pathways selected in the course of the exercise are more significant than others. Accordingly, the resulting "code" sent to the instructor (per the final screen of the sample exercise above) is most accurate and reflective of a student's actual understanding of the material, and clearly identifies the specific aspects of the topic that the student does not understand. This is a simple-to-execute "multimedia learning object" demonstrating the concept of "student performance mapping" and its ability to accurately assess student comprehension.

In conclusion, successful "competency-based" education in the geosciences is best achieved with measurable assessment that goes far beyond the common practice of tracking answers alone, by tracking corresponding pathways as well. Comprehensive, simple to interpret "mapping of student pathways" to problem solving is a uniquely effective way of achieving that goal.

***Corresponding author:** Jeremy Dunning, Department of Geological Sciences, Indiana University, 1001 East 10th Street Bloomington, IN 47405-1405, USA, Tel: 812-856-4448; E-mail: dunning@indiana.edu

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