The Science of Teaching and Learning

It has long been a tradition of the *Journal of Geoscience Education* to present special issues dedicated to important themes. Topics such as the teaching of deep time, evolution, and mathematics education, among many others, have been well received by the geoscience education community. In recent years, this tradition has been institutionalized by reserving the January issue of each volume for a special theme. This year our theme is educational research within the geosciences, a topic of key importance for consideration by all educators.

As successful scientists, we are skilled in the construction of hypotheses and their subsequent testing, falsification, and reconstruction. As science educators, however, far too often we fail to apply our understanding of the scientific method to the assessment and enhancement of our teaching. As a result, evaluating learning outcomes, assessing teaching techniques, and enhancing student learning is little more than a series of disjointed efforts and antidotal measures that fail to significantly impact our classroom. Since we are trained as scientists, we are fully capable of conducting scientific research on teaching and learning. Yet, the processes of geologic and educational research are sufficiently different as to require us to look for help in the construction of meaningful educational research projects. It is towards this end that this special issue is dedicated.

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The first step in developing a successful educational research project is the establishment of learning outcomes. While this step seems obvious, it can be astonishingly difficult and wonderfully enlightening to attempt to articulate exactly what is we hope students learn in a traditional class such as mineralogy or structural geology. These problems become even more pronounced when we begin to consider large enrollment general education classes. The diversity of approaches to classes such as introductory physical geology allows for the establishment of content and learning outcomes based upon the interests and experiences of the instructor. No matter the course or the content, formalizing learning outcomes is essential to subsequent enhancement of teaching and learning.

Once learning outcomes have been formalized, the next step is the alignment of measures of student learning with the desired learning objectives. Commonly, students complain about material that was covered in class but not tested or, conversely, test questions that, in their mind, were not related to classroom discussions. This confusion on the part of our students is not always the product of a lack of effort on their part. Rather, when learning objectives are not fully envisioned, student assessment instruments only partially correspond to course activities. Instructors typically have a conception of what students should learn, but when such outcomes are out of alignment with the course process student learning suffers.

The papers that make up this special issue provide valuable insight into the many ways in which we can assess the validity of our methods of instruction. The publication of this issue, made possible by the gracious and skillful editorial assistance of Michelle Hall-Wallace, reflects to a large degree my vision for the future of our *Journal*.

As you read the articles herein, consider how the concepts and techniques discussed can be applied to an analysis of your teaching. Likewise, consider how you could share the lessons of your educational research with others. Be cognizant of the fact that future submissions to this Journal will be expected to contain a component of meaningful assessment in order to be accepted for publication. Such a requirement is driven more by the maturation of geoscience education as a field of research, than by a change in editorial policy of this *Journal*. As a group, we geoscience educators are becoming more sophisticated in the application of advances in teaching and learning techniques. By sharing experiences, both our successes and our failures, we can come to enhance the quality of geoscience education nationally.

Carl N. Drummond, Editor