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AUTHOR Boone, William J.
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ABSTRACT

At many colleges and universities undergraduates pursuing nonscience majors complete introductory science courses which are structured to provide a broad overview of the field. Commonly such courses include large lecture sections which meet twice a week, and small lab sections that are held once a week. A survey was developed to evaluate the attitudes of non-major undergraduates towards geology labs at a large state university. The survey required students to rate 13 different labs using 9 different criteria. A probabilistic multifaceted model was used to evaluate the data. In general, a number of patterns became apparent when the ordering and spacing of labs and rating criteria were reviewed. Review of the lab materials supplied to the students suggests that those labs which had the greatest number of connections to topics students were familiar with, were the highest rated labs. The other most highly rated lab involved evaluating the jaws and teeth of different animals, and developing connections between what is observed in present day humans and animals. The results imply that some application must be injected into the labs so that the activities are viewed as relevant, regardless of a student's major. Contains 23 references. (LZ)

Undergraduates' (Non-Science Majors) Evaluations of Geology Labs

William J. Boone

Program in Science Education
School of Education 3068
Indiana University
Bloomington, IN 47405
(812) 856-8132
wboone@ucs.indiana.edu

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Undergraduate Non-Science Majors Evaluations of Geology Labs

At many colleges and universities undergraduates pursuing nonscience majors complete introductory science courses which are structured to provide a broad overview of the field. Commonly such courses include large lecture sections which meet twice per week, and small lab sections that are held once per week. Usually professors of these courses structure labs to serve as a hands-on application of the lecture and text material. There are many factors which effect the learning of these students within such a course, however, the structure, and organization of such labs are critical components of such courses. This paper will present the results of collecting and evaluating the attitudes of undergraduates towards geology labs presented in non-major classes at a large state universities. The results provide insight for those interested in improving the instruction and learning of science by nonscience majors during lab periods and during lecture sections.

Many studies have been conducted to investigate the attitudes of science students towards a variety of science topics and towards laboratory experiences. However, very little work has been conducted with regard to the attitudes of students toward earth science, the attitudes of students towards geology labs, and the implications of these attitudes for instruction and learning. Fortner and Mayer (1991) collected data from 5th and 9th graders regarding attitudes towards oceans and the great lakes, and in 1984 Mayer evaluated students' attitudes toward Crustal Evolution Project Modules. In 1984 Kern and Carpenter reported on the attitudes of undergraduates to 30 earth science themes. Other than these studies, no other work regarding geology attitudes seems to have been conducted to better understand factors which may influence geology learning.

In the science education literature a number of researchers and educators have outlined labs for the topics surveyed in this study: Radiometric Dating (Pankhurst, 1990), Sea Floor Spreading (Dutch, 1986), Minerals (Pasteris, 1983), Igneous Rocks (Eves and Davis, 1987), Sedimentary Rocks (Perdue, 1991), Fossils (Rowland, 1984), Limestone (Kent and Ross, 1975), Evolution (McComas, 1988), Hominids (Riss, 1993), Earth's Circulation (Dudley, 1984), Field Trips (Fazio and Nye, 1980), Groundwater (Mayshark, 1992), and Acid Mine Water (Sanderson, 1988).

To evaluate the attitudes of undergraduates towards geology labs a survey was developed for students attending a large state university. The survey required students to rate 13 different labs using nine different criteria. This meant that following each lab students provided an evaluation of the lab using the 9 criteria. One hundred and seventy eight students evaluated the labs. The response rate for the survey was roughly 96%. The survey was developed by using expert judges, course instructors, and a small scale pilot data collection. The statements were developed with the professor of geology who guides the course and labs. The 9 topics were ones that she felt were important aspects of the labs.

A probabilistic multifaceted model was used to evaluate these data. This technique enabled the ordinal rating scale to be converted to an interval scale. Also this model allowed incomplete data to be evaluated, the errors of items, labs, and raters (the undergraduates) to be calculated, and idiosyncratic responses of students to be easily identified. The multifaceted model is useful for it enables corrections in raters severity of judgement to be made. This provides a more accurate measure of overall lab rating (which labs were viewed as the best) and topic rating (which criteria were most highly rated across labs). Rehfeldt (1990) points out that researchers have attempted to solve the problem of subjectivity in rating scales. And that rank order statistics have been used to evaluated rating scale data. He points out that the ranking problems do not solve problems of objective scales of measurement.

The issue of correcting for raters has been discussed by many individuals (e.g. Jager, 1991; Planke et al., 1991). The multifaceted model has been utilized for data with the same structure as that presented in this paper. Although this model has yet to be reported in the science education community it has been successfully applied within the health professions (Lunz and Stahl, 1990), and industry (Rehfeldt, 1990) as well as for the evaluation of state wide assessments (Engelhard, 1994).

A summary of the data which has been fully analyzed is provided in the attached figure. Figure 1a presents the attitudinal ordering of the labs while the ordering of the rating criteria is presented in figure 1b. In addition to the ratings supplied by the students (who judged each lab), the errors of each rated term are also included as error bars. In general a number of patterns become apparent when the ordering and spacing of labs and rating criteria are reviewed. In figure 1a roughly four groupings of labs are present. The acid mine water lab was viewed as the most poor (group 1) while geology of the campus and evolution and the fossil record (group 4) were viewed as the best labs. Review of the lab materials supplied to the students suggests that as one might predict, those labs which had the greatest number of connections to topics students were familiar with, were the highest rated labs. The campus is something that students experience every day and the lab was one that included an outdoor activity. The other most highly rated lab involved evaluating the jaws and teeth of different animals, and developing connections between what is observed in present day humans and animals and what is suspected of past animal life. The lowest rated lab was one in which students had to manipulate chemical equations which expressed chemical reactions that take place between mine waters and surrounding minerals. The students of the region probably have never lived near a mine, nor had to confront the detrimental effects of contaminated mine water. Within science education at all levels there is an interest in connecting curriculum to past experiences that students have had. The overall ratings of these labs, seem to bear out the importance of connecting material to the life experiences and goals of students. Figure 1b presents the ordering of criteria used to evaluate each of the labs. In general there are four clusters of rating criteria. Overall, students felt that the mechanical directions which could be supplied (equipment, verbal directions, written directions) were quite good. However, they did not feel, as a group, that the labs would either help them in the course, or were relevant to their lives outside of the classroom. Clearly, if this geology department wants to improve their labs, they must try to inject some application into the labs, so that the activities are viewed as relevant, regardless of a student's major.

The learning and instruction of students of all ages depends upon many factors. For those attending a nonscience major course, the size of the class, the text, the organization of labs, presentation techniques, and topic selection can all effect learning and instruction. One way to gain insight into science learning is through the collection of attitudinal data described above. By learning how students evaluate the laboratory exercises presented in a curriculum, a university college department can learn what labs are appealing to students and which are not. This study contributes in a number of ways to science education. First, very little work has been done with regard to college earth science classes, and particularly earth science labs. Second, the results of this study provide important guidance to scientists who may teach undergraduate classes, and who may often have to been shown data as to the importance of relating material to cognitive frameworks and personal experiences of the students enrolled in a class. Finally, this study utilizes a statistical tool that can be used by science educators who wish to collect rating scale data that is more complex than the simple case of raters evaluating items.

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* L-Acid Mine Waters
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* L-Fossil
* L-Density Driven Ocean Circulation
* L-RadiocDecay L-IgneousRx
* L-Weathering&Sediment L-Limestone
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* L-Groundwater L-Formation&DestructionOfSeaFloor
* L-Minerals L-Evolution of Hominids
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* L-Geology of Campus L-Evolution and Fossil Record
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Figure 1a

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*Will help me understand the world around me.
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*Was interesting.
*Will help me understand class lectures.
*Will to understand class readings. Made me think.
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*Written directions were adequate.
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*Verbal directions were adequate.
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*Equipment supplied was adequate.

Figure 1b

Results of utilizing lab criteria to evaluate the 13 earth science labs. Labs at the top of the page (figure 1a) were ones rated as being of the lowest quality while those at the base of the page were rated as being the best labs. The overall ordering of lab criteria is also supplied (figure 1b). Those criteria at the top of the page were ones that students were least likely to view as being present in the labs, while those at the base of the page were criteria that were viewed as present in the majority of the labs. Thus, students felt that directions and equipment were adequately supplied, but they felt labs would not help them in their future career.