TEACHING AN INTRODUCTORY PHYSICAL GEOLOGY COURSE TO A STUDENT WITH VISUAL IMPAIRMENT

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ABSTRACT

Any instructor, with some extra effort and preparation, can accommodate a student with visual impairment in an introductory physical geology course. Advance planning, frequent communication between the student and the instructor, assistance from the institution's Office of Disabled Student Services, modified laboratory exercises, and innovative props created for a physical geology course can assist in making the experience positive not only for the student with visual impairment, but also for other students enrolled in the course. Steps that were necessary for successful completion of this course included meeting the student with visual impairment and making arrangements to provide all the handouts and syllabi for the course prior to the commencement of the class, detailed planning of all lectures, class activities, and laboratory exercises, and mechanisms for providing feedback for the instructor and student throughout the duration of the course.

Keywords: Education - Visual impairment, physically disabled; Education - Laboratory.

INTRODUCTION

High-school students with disabilities increasingly are seeking admission to institutions of higher education. Furthermore, many colleges and universities have requirements that include successful completion of a laboratory science course in order to graduate. Based on the author's experience in a physical geology class, with some extra effort on the part of the instructor (and the student) it is possible for a student with visual impairment to fully experience a laboratory-based course. The accommodations adopted by the author ensured that the curriculum satisfied the non-discriminatory provisions of the American With Disabilities Act of 1990 (P.L. 101-336) and of Section 504 of the Rehabilitation Act of 1973 (P.L. 93-112).

Several key issues, for both the student and instructor, allowed successful completion of the course. Meetings with the student before commencement of the class were critical in order to come to know the student. Additionally arrangements were made to create a Braille version of all handouts for laboratory and lecture and to obtain audiotapes for the lecture and laboratory texts. During the course, daily activities in lecture and laboratory, such as demonstrations and slide shows involved considerable advance planning. Regular meetings with the student and staff from the Office of Disabled Student Services proved to be useful in order to obtain feedback on how things could be improved for both the student and me. The staff provided valuable resources and assistance during the planning stages prior to the course and by offering their services for exams and local field trips during the course.

Several models were created to explain basic geologic concepts and detailed verbal descriptions during slide shows aided in the learning process for not only the student with visual impairment, but for all the students in the class. This experience provided a challenging opportunity to develop strategies in an introductory geology course to accommodate and enrich the education of a student with visual impairment.

For the remainder of this paper, the student with visual impairment will be referred to as "the student" while the other students enrolled in the course will be referred to as "the students".

PLANNING THE COURSE

Teaching a physical geology course (or any course for that matter) to accommodate a student with visual impairment requires a considerable amount of planning prior to the commencement of the semester. I met with the student and personnel from the Office of Disabled Student Services (ODSS) for the first time during the semester prior to the course. The nature of the services and support provided by ODSS were discussed. Support during field trips and exams were critical for successful completion of the course. In addition to ODSS's role in the course, my teaching style and the nature of the course work were considered. I also elucidated details about the laboratory and field trip component of the course. During this initial meeting I gained insight into the student's learning style and prior experience in other courses. Most importantly, the preliminary meeting (and subsequent meetings prior to the beginning of the semester) allowed the student and me to get to know each other's personalities.

Approximately one month before the semester began; we met for the second time to discuss the mechanics of the course. I was able to provide a copy of the syllabus and laboratory and field trip worksheets to the ODSS personnel for conversion to Braille, thus enabling ODSS to have an advance copy of all the exam and field trip dates for the course. Moreover, ODSS now had plenty of time to make arrangements with the textbook publisher to obtain a copy of the book on tape. Arrangements also were made to have critical parts of the laboratory manual available on tape and associated figures and tables in Braille.

The last meeting was arranged approximately one week prior to the start of classes. Detailed descriptions of the classroom and laboratory were provided along with a guided tour around the rooms and hallways leading up to the rooms. This allowed the student to become familiar with the layout of the furniture. Seating for the student in the classroom and laboratory were chosen close to the exits for easy access and convenience. It was also decided

Challenges	General Accomodations
Note-taking	Lecture: tape recorder, slate and stylus; Laboratory: note-taker, tape recorder, slate and stylus
Reading material	Books-on-tape, Braille handouts, ODSS personnel for exams
Drawing, maps, etc.	Exams: alternate guestions; Laboratory: reliefs maps, tactile models (3-D, with colors represented by felt, sandpaper, and other materials)
Field trips	Driver and guide, tape recorder, note-taker, Braille handouts
Slides, audiovisual presentations	Verbal descriptions

Table 1. Summary of challenges faced and how they were accommodated.

that the doors to both rooms would be shut once class or lab began to eliminate external sounds from the hallway. The student and I had a short mock-up lecture and laboratory to ensure that the student was able to hear me and make a clear audiotape for later use. The student also used an Interpocket slate and stylus to take notes during the mock-up. This familiarized me with the sound associated with note taking by the student.

DURING THE COURSE

Several techniques used during lectures, laboratories, examinations, and field trips are summarized in Table 1. Many of these aided the learning process for not only the student with visual impairment but also many students enrolled in the course. Regular meetings with ODSS personnel and the student during the semester also provided useful feedback on how things could be improved.

Lectures - All new words being introduced were spelt out and any sketches being drawn were described. Descriptive words and phrases such as "in front of you" or "to the right hand side of" rather than "over here" were used to indicate the location of demo samples or part of a sketch. I made a conscious effort not to use phrases like "as you can see" or "let me show you" to point to objects. In retrospect, I now realize that I was more concerned with this than the student. She understood what I meant if I accidentally used phrases like "see this" or "over here". If you are concerned about language usage, check with the student. I was fortunate to have a student who was friendly and open and had an excellent sense of humor.

Audio-visual presentations are an important component of many geology courses, especially those being taught at the introductory or freshman level. I frequently used educational videos to supplement my lectures. During the video presentation I sat next to the student to explain any visuals that were not accompanied by sound. The tapes were also made available in the library for the sole use of the student, if they were needed. During 35-mm slide shows I thoroughly described each slide. If a slide invoked laughter before I began to explain the content in the slide, I clarified the humor by addressing or describing it to the student in an aside or to the entire class once the laughter subsided.

In addition to audio-visual presentations, rock and mineral samples and 3-D models were employed to explain concepts such as texture and geologic structures. Passing hand samples of rocks or minerals around the room is traditionally part of lectures on rocks and minerals in an introductory geology course. To enable the student to participate in the activity, I personally handed the sample to the student, especially if the sample had sharp edges (e.g. obsidian). I held the sample in my hand and guided the student's fingers, to carefully indicate all the sharp edges before handing over the sample. If more than one sample was being passed around, I distinguished between the samples on the basis of dimension, heft or surface textures in addition to color.

Block models of folds, faults, bedding or unconformities were outfitted with strips of sandpaper, felt cloth, and other materials to illustrate bedding to the student. I often stopped lecturing and aided the student in understanding the relevance of the structure when models were being used. Just as with rock samples, I guided the student's fingers to "show" bedding and other structures. To demonstrate the types of volcanoes several items were used. A large chef-style salad bowl served to demonstrate the shape of a shield volcano while the cone of a plastic funnel wrapped in aluminum foil (to eliminate any sharp edges) became a cinder cone or a stratovolcano. The use of models and detailed commentary during slide shows not only aided the student; it also enhanced the learning process for all students.

Laboratory - A reader, whose primary role was to write answers on laboratory worksheets, was provided by the ODSS. The reader, a student who was not enrolled in the course and was chosen by ODSS, had no prior knowledge of geology so that there would be no bias while writing down answers in the worksheets during laboratory sessions. Once I graded the worksheet, the reader conveyed any incorrect answers to the student.

Some of the standard laboratory exercises had to be modified. To my surprise, laboratories on rocks and minerals turned out to be the easiest. The student used a

Braille version of standard classification charts and with the help of the reader was able to successfully identify the minerals and rocks. While the remainder of the class worked on standard topographic map exercises like drawing contours and topographic profiles and reading latitude and longitudes, I utilized relief maps and created alternate laboratories on topographic maps for the student with visual impairment. The student used several relief maps with Braille strips attached at each corner that denoted latitude and longitude. The student wrote a short paper describing the overall topographic features in each map in lieu of drawing contours. Topographic profiles were constructed with the aid of string across given lines on the map.

Commercial models portraying folds, faults, geologic cross-sections, and rule of V's were purchased and bedding was indicated with various types of materials. Appropriate questions were provided along with these models. For example, the student was asked to determine if the fold being portrayed was a syncline or anticline, symmetrical or asymmetrical, and plunging (including direction of plunge) or non-plunging. The remainder of the students in the class answered these same questions about folds portrayed as block diagrams on a handout rather than using 3D models. For models of faults, the student determined the type of fault by determining if movement had taken place in the horizontal or vertical direction and identifying the type of fault by examining the displaced rock units. As with folds, the remainder of the students in the class answered the same questions about faults portrayed as block diagrams on a handout rather than using 3D models. The student with visual impairment answered questions on relative ages of rock units of various geologic cross-sections and familiarized herself with the rule of V's with the aid of models while the rest of the class used handouts. As with the verbal slide shows and models during lecture these models on topographic maps and geologic structure helped all the tactile learners in the laboratory.

Examinations - All lecture exams were proctored at the ODSS rather than in the classroom. The student with visual impairment took the exam on the same day as the rest of the class but was allowed extra time to complete the exam. Multiple choice, true-false, and fill-in-the-blank questions required repeated reading on the part of the ODSS personnel so that the student could select an answer. The ODSS personnel indicated the answer on the exam as selected by the student. The student used a brailled keyboard to type answers to essay questions. Any examination questions pertaining to figures (e.g. requiring figures to be labeled, or sketches to be made) were replaced by appropriate essay type questions. For example, an essay question on describing the rock cycle replaced a question requiring a sketch of the rock cycle on the student's exam. Similarly, definitions of various parts of a fold replaced a question requiring labels on axial plane, hinge, and limb of an anticline.

At the beginning of each laboratory session, I distributed a quiz based on the assigned reading for that particular laboratory. The reader who assisted the student with the laboratory also proctored this quiz. During the laboratory exams, however, a reader was not necessary because ODSS personnel assisted in proctoring the two tests. The exam was administered to the student in a room apart from the rest of the class. For the rock and mineral examination, the student received the same samples for identification as did the rest of the class. The student was allowed to ask several questions about the physical appearance of the sample (is the sample dark black or a shade of gray? can you see fine lines that resemble strands of hair on the flat face of the sample? can you see specks of silvery flakes in the rock? are the grains easy to see with your eye or not?). The ODSS staff simply answered the student's question with a yes or no and recorded the final answer given by the student. For the second laboratory exam on topographic maps, structural geology, and geologic time, the student was given a separate exam. Once again 3D models of structures, geologic cross-sections, and topographic maps were used and specific questions were generated for the student.

Graded examinations for the lecture and laboratory portion of the class were returned to the student at the end of the class period. The grade and all comments regarding incorrect answers were read to the student. This turned out to be the least awkward part of the course since the student scored greater than 95% on each examination.

Field trips - Three field trips were held during the semester: one to an underground mine to study the varieties of gypsum and associated strata and their sedimentary environments, a second to a local cemetery to examine small scale mass wasting events, and a third to the downtown area to identify building stones. The students were given maps and directions, descriptive handouts, and worksheets prior to each field trip.

Arrangements were made in advance for an ODSS staff member who would drive and guide the student with visual impairment. The student was given the option of either using a tape recorder to take notes or having the laboratory reader be the note-taker. Maps, handouts, and worksheets were also supplied to the guide and note-taker. A Braille version of the handout and worksheet for each field trip were also provided to the student in advance. Exercises that required sketches to be drawn of outcrops were replaced with appropriate descriptive questions instead. The student was given extra time to complete the assignment on a word processor whereas the rest of the class turned in the worksheet at the conclusion of the field trip.

Safety and legal issues pertaining to field trips were addressed during the planning meetings with the student and the ODSS personnel. I also met with the legal advisor for the institution to discuss these issues and learn more about accessibility in general. As with all students, the student with visual impairment was also required to sign a liability release form prior to each field trip.

EVALUATING SUCCESS

My experiences, along with those of the student with visual impairment and the rest of the students enrolled in

the course are discussed in this final section of the paper. While many of the experiences of the class are related from events that occurred during the semester, others have been compiled from the standard end-of-semester course evaluations. Based on these evaluations, the use of 3D models and detailed commentary during slide shows not only aided the student with visual impairment; it also enhanced the learning process for many students.

Student with visual impairment - The student performed well in the physical geology course and had a positive attitude towards the course and me. The student connected with her peers and formed a study group with three other students who shared laboratory bench space with her. This study group was involved in peer learning and peer teaching especially during the laboratory sessions.

The student ended up enrolling in an independent study, library-based research project in geology with me for the following semester. The student provided a letter of support to the ODSS on my behalf recommending me as being "handicapped-friendly" and "willing to accommodate all types of students in her classes". The Physical Geology course played a major role in shaping the attitude of this student towards science in general. The student also ended up enrolling in a biology class to fulfill science requirements towards the core curriculum at the institution.

Instructor - This experience proved to be quite valuable for me. It helped me become a tactile and visual lecturer enabling inclusion of more hands-on activities during class. The most challenging aspect of this course proved to be the advance preparation that was required for the course. It encouraged me to think of alternate ways to present material. I came to rely on several resources that were available about making science courses accessible to all students in general and people with disabilities in particular (Dick and others, 1997, Ratliff, 1997; Davis, 1993; Travis, 1990; Jones, 1979). Communication with other instructors who had had similar experiences via a listserv and resources I found on the World Wide Web also proved to be quite valuable.

This particular course was very rewarding at many levels. The students enrolled in the course were very comfortable with giving suggestions on how I could purchase art supplies to demonstrate geologic structures. Many of the students commented that my teaching style suited their own learning styles.

Other students enrolled in the course - The auditory and kinesthetic learners in the course benefited from having the visually impaired student this course. In general, the verbal communication between the students and me increased during the semester. The quality of my slide-shows was enhanced by the increased verbal description of features being shown. The tactile learners appreciated the hands on activities in class so that they could grasp the material being covered. The students often came up with ideas and suggestions to demonstrate a concept with an alternate technique.

The students in the class were very patient when I was involved in helping the student with visual impairment and often ended up helping us both. Overall student participation increased during classes making it a truly interactive learning environment.

SUMMARY AND GENERAL SUGGESTIONS

The experience described above provided me with a challenging and exciting opportunity to develop strategies in an introductory geology course to accommodate and enrich the education of a student with visual impairment. In order to share this experience with other geoscience educators, I organized a special poster session entitled "Teaching Geology to Disabled Students" for the annual Geological Society of America meeting in October 1999. Twelve individuals submitted abstracts to this session. Of the twelve abstracts, five dealt with strategies for visual impairment whereas the remainder dealt with other accommodations. Educators are invited to read the abstracts from this session, including my own (Asher, 1999) and are encouraged to contact any of the presenters if they have questions or need further information should they need to accommodate a student with disabilities in their classroom.

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