Graduate Student Experiences in a Geoscience Teaching and Learning Research Seminar

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Study Objectives

We document the transformations in teaching methods and strategies that came from taking a semester-long geoscience education research course. This course can serve as an example of an effective approach to training future educators in STEM fields.

Course Objectives and Topics

1) Explain the conditions necessary for learning to occur in college geoscience classes and how they differ from other science disciplines
2) Generate lessons that incorporate a range of exercises and assessments that feature multiple levels of Bloom's taxonomy
3) Explain how you would incorporate student affect and self-regulation in learning
4) Analyze the teaching of others using validated instruments and provide constructive feedback

Week	Topic	Week	Topic
1	Introduction	9	Learning and the Affective Domain
2	Research on Geoscience Learning	10	Self-Regulation and Metacognition
3	How (Little) Students Learn in Science	11	Analysis of College Science Teaching
4	Building Geoscience Expertise I	12	Designing Effective Learning Environments
5	Geoscience Literacy Themes	13	Gender & Ethnicity in STEM Classrooms
6	Building Geoscience Expertise II	14	Geoscience Research/Design Project
7	Inquiry in the Classroom	15	Geoscience Research/Design Project
8	Lesson Plan Outlines		

Table 1: Outline of course topics by week.

Student Population

Geoeducation	In-service K-12	Geoscience
1	6	8

Table 2: Types of graduate students in the course based on their previous education experience.

Classroom Activities

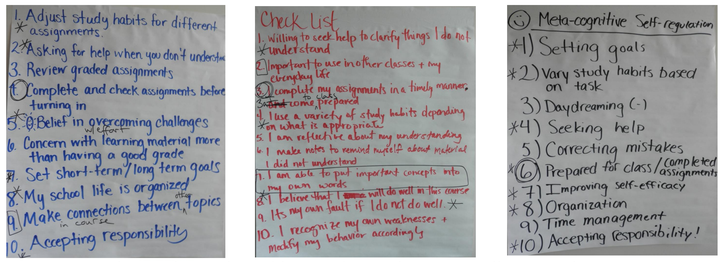

Fig. 1: Sample work produced by students during small group discussions.

The majority of class time was spent in discussion about the reading assignments for that week. Discussion often began in small groups, with each group completing a task and summarizing their discussion on large sheets of paper (Fig. 1).

Semester Projects

- *Lesson Plan:* Design three 50-minute lectures based on best practices advocated in the course readings
  - Align teaching plans and assessments to be consistent with student learning goals

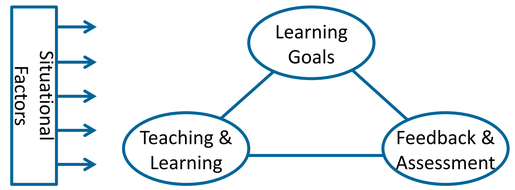

Fig. 2: Elements of an effective lesson plan (adapted from Fink, 2003).

- *Final Project*: Design a course or write a geoscience education research proposal

Course Design

  - Design a two-week summer course entitled "The Geology of North Carolina for Teachers." (Course was actually taught during Summer 2011 based on the course objectives and activities proposed by the students)

Research proposal

  - Write an NSF-style proposal in response to the solicitation for the Transforming Undergraduate Education in Science, Technology, Engineering, and Mathematics (TUES) program
  - Two projects were proposed:
    - A longitudinal study comparing self-regulation practices among undergraduate and graduate students in atmospheric science
    - A study of the impact of short tutorial videos on conceptual understanding in students in a general-education geology course

Reformed Teaching Methods

Students taking the class expressed a desire to change their approach to teaching based on material covered in this course. Some of the specific changes we have noticed are:

Before	After
• Lecture-based instruction	• Student-centered active learning
• Large amount of course material covered	• Less course material covered in more depth
• Before class reading without follow-up	• Just-in-time teaching (JiTT)
• Assessments testing lower levels of understanding via Bloom's taxonomy (Fig. 3)	• Assessments testing higher levels of understanding via Bloom's taxonomy
• Assessing students only through a midterm and a final exam	• More frequent assessments via clicker questions, weekly quizzes, minute papers, etc.
• Minimal student reflection on learning and understanding	• Student reflection on learning via exam wrappers, MSLQ assessments, etc.

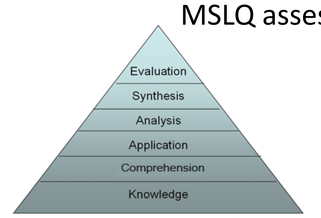

Fig. 3: Bloom's taxonomy, providing a basis for student assessments.

Recommendations

Based upon our experiences in the Geoscience Teaching and Learning Research Seminar course, we recommend:

1) All incoming graduate students attend a workshop which demonstrates effective reformed teaching methods before beginning to TA.
2) The experience of in-service K-12 teachers added to the value of the class and their inclusion in future STEM education preparatory courses is beneficial to the non-education students.
3) Seeing first-hand what reformed teaching looks like in a college classroom provides the most benefit – classes from research faculty with education specialties can be used to demonstrate active learning techniques.
4) Graduate students planning on an academic career would benefit greatly from a semester-long course that examines all aspects of teaching and learning.

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