5.5 NEW APPROACHES TO METEOROLOGY EDUCATION: THE 2002 COMET WORKSHOP FOR UNIVERSITY FACULTY

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1. INTRODUCTION

The Cooperative Program for Operational Meteorology, Education & Training (COMET) hosted a workshop titled "New Approaches to Meteorology Education Course for University Faculty" 12-16 August 2002 in Boulder, Colorado. The goal for this workshop was to help faculty in undergraduate meteorology programs create more effective learning environments through the innovative use of technology and instructional strategies. This workshop used the improvement of undergraduate atmospheric thermodynamics courses as a focal point. Topics that were addressed included how students learn, alternative ways learning can be demonstrated, establishing course goals, and choosing instructional media. The faculty used contemporary pedagogies to create group projects that will serve as pilot versions of innovative approaches to course materials designed to help students understand principles of atmospheric thermodynamics. This workshop will be discussed in terms of a possible model for restructuring undergraduate science courses.

2. BACKGROUND

The confluence of a national call for improving undergraduate education (e.g., Scrutiny of Undergraduate Geoscience Education, Shaping the Future, and Geoscience Education: A Recommended Strategy), the rapid development of technology, and the emergence of new models of how students learn have created a climate for a reassessment of how the foundation courses in undergraduate meteorology programs are taught. Most of the required meteorology courses are currently characterized by a lecture format, which many educators have argued focuses on memorization of factual information and promotes the development of superficial understandings and inert knowledge. In response, this workshop was developed to serve as a stimulus for infusing current educational theory into practice within undergraduate meteorological instruction.

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3. THE WORKSHOP MODEL

The workshop was designed to build upon foundational discussions on how people learn, the need for active-learning methods in science education, and why we now talk in terms of learning environments, rather than simply classes and classrooms. This pedagogic foundation was then overlaid with examples from undergraduate science courses where innovators have effectively used technology to engage students in active learning situations. The eighteen participating faculty were divided into three teams of six, provided both technical and pedagogic experts as resources, and assigned the task of preparing a prototype curriculum unit or module for use in a class on thermodynamics.

Forms that provided guidance and accountability for each team aided the development process. These were submitted to workshop directors at the end of days one and two. For day one, the form asked participants to respond to the following:

<u>Possible Topics</u>

- Describe 2-3 possible topics or skill areas you might want to choose for a project.
- Tell what is problematical or promising about each of these topics?

<u>Possible Teaching Strategies</u>

For Each Topic Consider

- What are students currently learning?

- What do you want them to learn that's different than the status quo?
- What are some ideas for teaching that would lead students to your desired learning outcomes?
- What are some ideas for assessing these new learning outcomes?

At the end of day two, participants responded to these items:

Topic

- What curriculum area or topic have you decided to focus on?

Learning Goals

- What do you want students to learn?
- How is that different from present learning outcomes?

Teaching Strategy

- What teaching strategy do you plan to use?
- List some key ideas you have for implementing this strategy.
- Explain why active learning is needed in this topic area, and why your teaching strategy will work.

Questions and Concerns

- What questions do you have about your project?
- Where could you go to get answers?

4. COURSE CONTENT

The workshop used the teaching of thermodynamics as the subject to engage attendees in hands-on learning. The complete schedule of workshop activities and the links to various presentations can be found at: http://www.comet.ucar.edu/class/faculty/Aug12_2002/html/schedule.htm. The faculty that attended experienced many of the frustrations common to students that are exposed to learning situations vastly different from the traditional lecture formats that only disseminate information. In fact, comments from the feedback forms submitted at the end of the first day complained that there was too much time devoted to pedagogy and not enough directed explicitly to "sharing ideas for teaching thermodynamics". This was similar to a general attitude among students that "if you will just tell us what you want us to know we will learn it and show you on exams that we do". Nevertheless, the second day schedule was similar to the first day where pedagogic principles were presented, examples of application of these principles were given and then a significant amount of time was allocated for the attendees to work on their projects. At the start of the third day, each team reported on the progress of their project. It was evident that significant progress was being made and that the three support elements of each team, subject matter expertise, pedagogic expertise and technical expertise were interacting.

On days three and four significant time was made available to allow participants to share their ideas and experiences for teaching and to identify resources that they found particularly helpful. These comments can be found at http://dev.comet.ucar.edu/class/faculty/Aug12_2002/docs/abshire/FacultyCourseNuggets.doc

The last day was reserved for presentations of the projects. The instructions and expectations for these projects are given below. Four projects were completed and were uniformly of high quality. Each project is now at the stage where it could be handed to a java or Flash programmer to complete a test version. These projects can be accessed through links found on the last day of the workshop schedule.

Final Project Guidelines:

Assignment Overview

In teams of 5-6, prepare a prototype curriculum unit or module for use in a class on thermodynamics. The project should adhere to principles of active learning.

Prototype Materials

Design, prototype, and/or collect materials, media, and resources needed in the unit or module. These can be in any electronic format (HTML, PowerPoint, Word, etc.) or combination of formats.

Final Report

Provide a 2-page design report that includes the following items:

- Title, names of team members, and date
- Overview. Provide a 1-3 sentence description of the topic, what students will do, and where it fits within the curriculum.

- Learning Objective(s). State what students will be able to do at the end of the learning activity by listing out key objectives.

- Audience. In 2-3 sentences, describe the intended learners and their specific needs.

- Required Resources. Provide a list of required resources (e.g., computer, Web connection, software, etc.)

- Assessment Plan. In a short paragraph, describe how you will evaluate student learning.

- Learning Activities. Describe the activities students will engage in and the underlying teaching strategy. Show your reasoning that led to adopting this strategy, and how this strategy embodies active-learning principles.

- Reflections. Include a short section to include:

    - Ideas for Implementation

    - Continuing questions and concerns

    - Reflections and lessons learned

Final Project Evaluation Standards:

Design Report
Title and overview are informative and reflect the gist of the project. Objectives are specific and comprehensive, written using action verbs to describe learning outcomes. Other sections are clear and informative. Reflection section shows an awareness of the project's strengths and limitations.

LearningActivities
Students are appropriately guided, coached, or supported in their learning. Learning activities are appropriate to the audience and result in the intended learning outcomes.

Assessment
Assessment is consistent with the theory being applied, the instructional strategies, and the learners' needs.

Usability
Materials can readily be used by third-party teachers and students. Adequate support is provided to allow flexibility, adaptation, and re-use in the materials.

Active Learning
Project is an effective and appropriate implementation of active-learning principles.

5. CONCLUSIONS

Comments from the participants on the last day were overwhelmingly positive. They had experienced a sense of achievement and a confidence that they could actually use active learning methods and could also participate as part of a team in creating them. The project experience created interactions that resulted in deep and significant discussions and created bonds among team members that could provide the basis for future interactions.

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7. REFERENCES

National Science Foundation. Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology, 1996.

National Science Foundation. Geoscience Education: A Recommended Strategy, 1997.

Stout, D.L., E.W. Bierly, and J.T. Snow. Scrutiny of Undergraduate Education: Is the Viability of the Geosciences in Jeopardy? Chapman Conference Proceedings, American Geophysical Union, 1994.