9.10 LEVERAGING THE INTERNET TO ENHANCE THE SKILLS OF ENTRY LEVEL METEOROLOGY MAJORS

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1.0 INTRODUCTION

During the Spring Semester, 2001, the OU School of Meteorology's Introduction to Synoptic Meteorology class was redesigned to integrate computer applications with traditional undergraduate synoptic topics. The authors focused on data archival and distribution, programming and scripting, and data analysis and display. The students were required to perform these tasks in both unix and pc workstation environments. The Unidata Gempak and N-AWIPS software packages were used, as well as numerous University-based web sites with on-line meteorological modules. Effective graphical presentation methods, including the use of web sites and MS PowerPoint™ were featured and assigned as term projects. The goal was to provide students with practice in applying technology and interactive processing systems to achieve a working knowledge of the tools used in both operations and research.

2.0 THE NEED

The Williams Energy Group (a Tulsa-based subsidiary of the Williams Company) has entered into a $10 million strategic alliance with the University of Oklahoma to enhance weather and climate research, technology development, and undergraduate and graduate meteorology education.

This commercial arrangement, the largest of its kind in the U.S. between a private corporation and a university meteorology program, is a mutually beneficial agreement that allows OU to expand its top-tier meteorology programs. This partnership will provide enhanced educational and research activities with the goal of providing the nation's most qualified meteorologists and weather impact decision makers.

In order to better prepare OU Undergraduate students to reach these lofty goals, it was evident that the traditional Introduction to Synoptic Meteorology class needed to be overhauled in favor of a more technologically challenging curriculum.

3.0 THE ORIGINAL COURSE

The current American Meteorological Society guidelines for undergradute programs are very broad where the use of advanced technology and meteorological applications are concerned. The Bachelor's Degree in Atmospheric Science or Meteorology — (Adopted by the Council 10 January) suggests that" any B.S. program should be encouraged to supplement minimum requirements with additional course work in the major and supporting areas. This supplemental course work may include courses designed to broaden the student's perspective on the earth system and the environmental sciences (e.g., hydrology, oceanography, and solid earth sciences) and science administration and policy making, as well as additional courses in the basic sciences, mathematics, and engineering. Also, students should be strongly urged to give considerable attention to additional course work or other activities designed to develop effective communications skills, both written and oral." No mention is given to computer applications as it applies to meteorology.

The sophomore level METR 2413, Introduction to Synoptic Meteorology at OU, carries prerequisites of Calculus IV and Physics II. Computer Programming is taken as a co-requisite. The METR 2413 course description is listed as: "Introduction to atmospheric structure and synoptic meteorology. Laboratory exercises in weather analysis and forecasting, and in using departmental computer systems to display and analyze meteorological data. Laboratory."

Unfortunately, the way this course was taught in the past was markedly segmented. One instructor would teach computer skills for five weeks, a second instructor would teach synoptic topics for 5 weeks, and a third instructor would teach thermodynamic topics for 5 weeks. Although the course was team taught, there was little integration of topics. Consequently, students were unable to make connections between the three subject areas. In addition, 5 weeks is not nearly long enough to adequately prepare students to use computer tools and applications. Each course meeting was one hour, meaning that each student received 15 hours of computer tools, 15 hours of synoptic, and 15 hours of thermo. lecture material. Homeworks and labs were up to the individual instructor, and were not coordinated with material from the other instructors.

3.0 PARADIGM SHIFT

As computers become the means with which we obtain, evaluate, analyze and communicate meteorological data, it is imperative that undergraduate curricula integrate interactive processing systems in all facets of the classroom environment (programming, exams, laboratory, evaluation). Koval and Young (2001) provided inspiration in the way that courses at Penn State are being revamped to include applications for "entrepreneurial meteorologists" at the undergraduate level.

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The Spring 2001 version of METR 2413 was taught by the authors, but the computer, synoptic and thermodynamic topics were completely integrated throughout the semester. Each assignment had components that required data acquisition, hand analysis, objective analysis and a communications component. Mastery of computer applications was essential to complete each task.

4.0 THE ASSIGNMENTS

Koval and Young (2001) reported that for graduates able to take advantage of the on-going technological revolution, there is an "extremely lucrative market". Their paper documents numerous examples of CEOs reporting that a strong combination or programming (including the web) skills and scientific content is now required to succeed in the science-related job market. In order to take better advantage of the Williams alliance, and the trends in the field, a new set of assignments were constructed for OU's Intro to Synoptic course.

•There was an assignment due every class period (three times per week for 15 weeks). This strategy was implemented to provide the students with a similar time management challenge to that in private industry. A challenge where weather information is deemed perishable, and where missed deadlines can mean millions of dollars in losses.

During each week, the Instructors would develop a topic, beginning with the theoretical, then the observational. The observational analysis would begin with traditional hand analysis, then move to the use of computers for data acquisition, display and objective analysis. Students then communicated the similarities/differences between the hand-analyzed and computer analyzed maps. Each week was structured identically.

[It is amazing what this 'due every day' strategy did for class attendance. Even on obvious storm-chase days, our class was full!]

*Each assignment involved traditional (hand analysis), objective analysis and communications components.

*Each assignment required use of unix, web programming, scripting, the creation of graphical output, and a write-up.

*Each assignment focused on a graphical tool available to meteorologists (Gempak, N-AWIPS, GARP, NSHARP, etc.)

•Each student was reguired to design a web site to graphically present each assignment. Many used multiple developer techniques such as javascript.

•A term project was required on a meteorological topic that required research, then the creation of a MS PowerPoint™ Presentation to share with the class.

In addition to the 40+ external lab assignments, we assigned in-class labs and quizzes designed to evaluate the students' progress in the theroetical meteorological topics.

The instructors also developed a web page with numerous links to sample scripts, user manuals for software, etc. A "Computing Corner" site was also developed to help students navigate around the OU School of Meteorology and University computing infrastucture (unix help , data archives, troubleshooting, secure shell, etc.). When the local cable internet provider had difficulties with their name servers, our class was able to help fix the problem, restoring service not only to our students, but to many other OU users of the cable modem service.

5.0 EVALUATIONS AND FEEDBACK

The response of the students in the post-course evaluation was overwhelimgly positive. When compared against the last five years of evaluations for this course, the approval rating from the students was significantly higher. Consistently, the students provided comments like the following:

"*Increased my personal critical thinking & awareness. Very relevant course in our field. Topics covered greatly enhanced my knowledge & interest in field*." and "*Very strong course. This course has set the bar for all others to follow.*"

Even when students found the course material and pace not to their liking, the comments were still positive.

"*As much as I disliked the computer assignments, I believe that they were a very strong point because we learned skills that will help us throughout our academic careers and beyond*."

A final endorsement comes from these students:

"*Teachers know their stuff and were confident teachers. This is the second time I have taken this course and it left the last one in the dust*." and "*This course was great. They need to teach it this way from now on.*"

Another benefit of the class format was that our upper division students began hearing about the course from their sophomore colleagues. Many of the upper classmen began participating in the course via the course web site. Some of them even purchased the textbook so that they could follow along with the assignments (Djuric's *Weather Analysis* text was used.) The online presence allowed many students who had taken the course previously (under the different format) to retake the course, even though no credit could be obtained for doing so.

6.0 LESSONS LEARNED

Given the positive feedback from the students, the class will be taught the same way during the spring semester of 2002. The students did present some unique challenges to the instructors (students ftp-ing maps to each other to turn in, sharing code, etc.), but we adapted the assignments to eliminate the use of shared resources. We also learned that the students were not used to working this hard for a single class. Note the

following feedback:

"*The in-class labs- we weren't able to finish due to time.*"

"*You required a Big project at the end while assigning other work the week before it was due*."

Regarding applied meteorology, the instructors realize that weather-impacted crises require accuracy and efficiency where analysis and forecasts are concerned. You don't typically get extra time to produce the perfect tornado warning, for example. The students ultimately realized this. Those students that did not do well in the course were not good time managers. Therefore, the next course sequence will likely provide some instruction on time management strategies.

7.0 THE FUTURE

As mentioned previously, the Spring Semester, 2002 course will use the same format as Spring 2000 . Many of the students that completed the class have been wonderful ambassadors to those following in their footsteps. They have shared their trials and tribulations with them, and warned them of their need for good time management skills. Unfortunately, they have also shared their assignments and code with them. Therefore, the instructors will need to constantly create new wrinkles and new assignments. One strategy is to use current data for each activity. This was done in many cases during Spring, 2000. The instructors will have to continue to work to provide new coding assignments (or variations of the previous ones) to keep the course fresh and challenging.

8.0 REFERENCES

AMS Council, 1999: The Bachelor's Degree in Atmospheric Science or Meteorology. *Bull. Amer. Met.Soc.*, **80**, 475—478.

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