Using Blackboard© and Turningpoint© Software in a Non-Majors Science Class

Science 100: Water- An Interdisciplinary Study is a science class intended for non-science majors which has been in existence since 1998 at the University of Maryland Baltimore County (UMBC). It was created in response to a Maryland state mandate that all college students in the University System must have a lab science in order to graduate. Colleges throughout the state dealt with this mandate in many ways including adapting current courses to accommodate all non-majors and fitting labs into courses where there were none. UMBC created an Interdisciplinary Science Program and developed a course on water that was interdisciplinary in nature.

Currently, approximately 300 students register for the course each semester, in addition to 80-100 during the summer sessions. The course includes field work, data analysis, scientific methods, interdisciplinary content and independent research. The majority of the students come from disciplines primarily in the arts and humanities, although computer science and information systems students enroll in high numbers as well. Currently, the description of Science 100: Water – An Interdisciplinary Study is

> "An interdisciplinary lab science experience that integrates biology, chemistry, earth sciences, and physics into a single, three-credit course with a unifying theme of water. Five modules are identified, each occupying 2-4weeks: Water Quality, Unique Physical and Chemical properties of Water, Water and Life, Water in the Earth's Environment, Water and Policy. The course consists of one 90-minute lecture/discussion session each week and one 110-minute lab/discussion period. This course is intended for nonscience majors and it satisfies the GFR graduation requirement for a laboratory-based science course" (http://www.umbc.edu/AboutUMBC/Schedule/fall2005/SCI.html.).

A grade of C or better is required in the course and grades are based on 2 exams (15% and 20%), 2 lecture papers submitted online (15%), 2 lab papers (12.5%), a group final project (22.5%), 'other' assignments and participation (10%) and lab attendance (5%). Generally, approximately 80% of students receive A's or B's in the class. Labs are taught by either one of the two instructors, me or Ms. Karin Readel, or graduate teaching assistants (TAs). Interestingly, current teaching assistants are from the history department and education department. Because there is only one course in the Interdisciplinary Science Program there are obviously no departmental graduate students available. Next year, graduate students will be recruited from the Geography and Environmental Systems department.

Technology is infused throughout the curriculum of Science 100. BlackBoard™ (BB) is used extensively throughout the semester. BB is referred to as a Networked Learning Environment or NLE. An NLE, "Applies new technology to a very old concept – that learning is much more than classes and grades. It is the interaction between learners, educators and a vast community of people…"(BlackBoard Academic Suite Brochure, 2005). Other NLEs are WebCT™, eCollege™ and Prometheus™, and Angel™, of which WebCT and BB are the most popular. Apparently, BB is used in approximately 45% of all of the post-secondary schools that use course management systems in the U.S. (BlackBoard Academic Suite Brochure, 2005).

NLE's, also known as eLearning systems or course management systems, have actually been around for many years, but only recently have become more noteworthy and globally deployed. While WebCT, created in 1996, is a privately held company with investors such as BancBoston Ventures, JP Morgan Partners and Duke University Endowment ("WebCT - About Us", 2005), BlackBoard, created in 1997, is a publicly held company and is listed on the NYSE as BBBB ("About Us", 2005). Together, they are the major suppliers of course management software in the world.

Using BB in Science 100, students submit several assignments online including 3-page lecture papers twice during the semester, Turnitin.com submissions for all digital or paper assignments and laboratory results and proposals. Additionally, students acquire posted lecture readings (as no textbook is used), laboratory handouts to bring to lab, pertinent announcements, as well as staff and TA information. They also complete online quizzes prior to attending labs.

Spires and Jaeger report several challenges associated with these web-based course management systems:

- Having the appropriate resources of hardware and software
- Training and maintaining key personnel that know and understand the tools
- Defining access and addressing the elements of the digital divide
- Engaging faculty and providing training to both faculty and students, and
- Implementing instructional design appropriate for Web-based courses (2002).

Currently, I believe that the use of BlackBoard in Science 100 adequately meets these challenges. The majority of students have had experience with BB before enrolling in Science 100. Every student has access- whether at home, in the dorms or at the library thus eliminating the digital divide at this institution. Training is constant and open to faculty and students. The course design is open and customizable. BB actually offers various "cartridges" to allow ease of adaptation ("Blackboard Academic Suite", 2005). While no formal survey of the course's organization has been taken to assess ease of use and functionality, generally problems are rare. Anecdotally, BB reports that so-called 'help' emails in one course in the first two weeks went down from over 100 to less than 20 when switching to the BB from another course management system (Blackboard Academic Suite Brochure, 2005).

Besides BlackBoard, many other technologies are used in the course. These technologies include Global Positioning System (GPS) units, LabPros™ with TI-83's and various probe ware. Students also create individual & group web pages to assist in presenting group science projects on an LCD projector. Additionally, students plot and use lines of regression in Excel™ following the completion of a lab based on generating standard curves. Two assignments using Ecobeaker™ simulation software are also completed as homework assignments. Lectures are presented with Powerpoint™ while students use Turningpoint™ audience response system software and keypads to interact with the discussion.

GPS units are utilized in one laboratory session designed to increase observation skills. Students are assigned a GPS unit and a special location, which is a preset location selected by the instructors. These locations are selected in order to provide students with both terrestrial and aquatic habitats for observation. Using the electronic compass on the GPS unit, they trek to their unnamed location. Students then collectively make observations in diagrammatic and written form. This is partly in preparation for their final group project in which lab groups select two bodies of water, make predictions about their water quality, conduct tests and then evaluate their results.

LabPros™ with TI-83's are used with probe ware to determine various water quality parameters. Conductivity probes are used to determine conductivity or indirectly salinity or total dissolved solids. Turbidity is measured to determine the clarity of the water. In essence, this equipment is a specialized colorimeter. Additionally, students might use Dissolved Oxygen, pH, nitrate and phosphate probes, although generally they utilize LaMotte chemical test kits which sometimes produce faster results and are generally more reliable. Some students may actually use an enzyme linked immunosorbent assay (ELISA) to determine amounts of petroleum hydrocarbons in water. These hydrocarbons referred to as BTEX (for benzene, toluene, ethylbenzene and xylenes) are sometimes the result of leaking storage tanks and fuel spills. This technological application is usually only used in advanced biology and/or chemistry labs.

Leading up to the apex of the course, students develop and implement a scientific investigation of water quality of natural bodies of water of their choosing. Students often select the parameters that can be tested by the methods stated above. When completed, students design a web page to present their information. Following the completion of their web page and submitted individual lab report of their project, they present their project to members of their lab section. This is conducted in lab using the group's web page and a laptop and LCD projector. An example of one lab group's site can be seen at http://fp1.ad.umbc.edu/sci100/f11group1/.

In one laboratory session, students are asked to determine the salinity of a local estuary that may be impacted by recent construction. Students generate a standard curve by measuring conductivity of various concentrations of salt solutions using the probe ware mentioned above. This curve is generated during lab using an Excel scatter plot and linear regression line (line of best-fit). Then, they test an unknown sample of water from their estuary and determine its salinity by using the equation from their linear regression line. This allows students to make a decision regarding the impact of the construction on the local estuary.

Ecobeaker™ simulation software is assigned for homework twice during the semester. This software designed by SimBiotic software, uses various features to simulate real ecological interactions.

> "EcoBeaker is the most popular ecology teaching program in the world, used by tens of thousands of students each year in hundreds of universities. The 20+ laboratories have students perform experiments where they observe or discover important biological concepts while learning how to collect and analyze data. Students watch creatures that eat, reproduce, move around, die, and do all the other things that creatures normally do, while graphs, statistics, and a variety of common sampling techniques let students get more quantitative. The labs are written to promote thinking. Most start with a structured set of exercises that introduce ideas and experimental techniques, then finish with a more open-ended inquiry-based section where students design their own experiments. Each lab comes with a workbook containing instructions and space for the students to record their observations, predictions, and data. Those in our 101 collection are especially designed for large introductory and non-majors courses, and are more structured and shorter than the others" (Ecobeaker, 2005).

Specifically, we use two simulation programs: Lake Sewage and Keystone Predator. Both significantly promote quantitative data analysis in students by addressing real world issues. Each takes students approximately one hour to complete and students have commented that they are interesting and informative.

TurningPoint™ audience response system software and keypads are used during many of the PowerPoint™ lectures throughout the course. This software allows students to interact with the material covered throughout a discussion or lecture. This is completed through the use of infrared wireless keypads that students are assigned, and software that incorporates special slides into PowerPoint lectures. Additionally, infrared remote sensors are placed in two highly visible places in the front of the lecture hall. These sensors communicate wirelessly with a base unit that is plugged into a laptop via a USB or serial cable. Other similar audience response systems include Learnstar, ClassTalk, Classroom Performance System (CPS), and Personal Response System (PRS) (Finch, 2004).

Turningpoint response slides are incorporated into the PowerPoint lecture and are used to assess student understanding or to evaluate student positions on certain issues. Various types of questions can be incorporated such as multiple choice, true/false, Likert-type questions and even fill-in-the-blank. Many other types of questions are available, but are not currently used in Science 100. When students need to respond to questions during lecture, they simply point their keypad towards one of the two sensors to register their choice. On the slide displayed, they see a rotating response chart that indicates whether their answer registered or not. Additionally, a small timer counts down from ten (10). Sometimes this is problematic in that students do not think their response was recorded, but many times it is just that they just did not see it register. For example, I might ask a question with a diagram that states, “Which direction will water flow.” The answer choices would be A) into the dialysis bag, B) out of the dialysis bag C) into and out of the dialysis bag at equal rates. I would then see the results after ten seconds.

Immediately following the countdown, a bar graph indicating the responses for each choice is generated and displayed. This enables either a positive, supportive affirmation from the instructor or a reassessment and re-teaching session of misconceptions. Either way, instruction significantly benefits from determining whether or not students appropriately acquired the important concepts.

Immediately following the lecture, Turningpoint asks if data should be saved. Data from each keypad (which is assigned to each student in the first lecture using Turningpoint) is stored and can then be downloaded into a spreadsheet file. Additionally, other types of data output can be used to analyze student responses, such as individual student responses and responses per answer choice per question.

In my lectures, I assign the keypads according to each student’s lab group, in order to keep close track of them. For example, lab groups one and two (10 students total) of the Tuesday, 9am lab will get keypads number 1-10. With approximately 90 students per lecture, the most troubling aspect of implementation of this courseware is this distribution and collection of materials. It takes approximately 5 minutes to distribute the materials each lecture, and slightly more the first time they are assigned and distributed to students. Collection of materials takes another 5 minutes.

Others using this or similar keypads and software (such as eInstructions Class Performance System) actually have students buy the keypads for approximately 3-4$.

They then register their keypad for each course that uses the keypad, for a cost of $15 (CPSurf Higher Ed, 2005).

It is possible, perhaps, that these types of audience response systems significantly impact student achievement. At this point, evidence does not suggest this although more research needs to be completed. However, students do generally feel positive about audience response system use in their classes. James L. Finch surveyed students following a pilot study of Learnstar, a similar system to Turningpoint. He decided to use this software because of its increase in student interaction, which evidence suggests is critical to any form of technology-based learning (Finch, 2004).

In his study, Finch introduced students to the Learnstar software in one lower level college class and one higher level college class in Communications. He found that students were positive towards the use of the technology, although there were some drawbacks. Overall, Finch found 1) that students enjoyed using it and believed other students enjoyed using it, 2) Learnstar added interest to the class, 3) helped them learn the material better, 4) helped focus the class, and 5) involved the class more in the discussion (2004). Students also believed that Learnstar should continue to be used in the class and wanted it to be used in some of their other classes (2004). However, students, especially in the lower level class, did not seem to prepare more for class nor did they go out of their way to tell their friends about Learnstar (Finch, 2004). James Finch does state however that "Analysis by the instructor suggested that there was not a significant difference in the grades of classes using LearnStar" (2004). So obviously, there is a need for further research in this area.

Anecdotally, professors and teachers alike have varying views and many of them believe that they have simply revolutionized their lectures by incorporating this type of software. Professor Tietz of Kent State in Ohio uses this type of software in her managerial accounting classes. In a survey, using the keypads of course, she found that 71% of the students in her class liked using the response system (Hafner, 2004). "Empowerment" is what many students say about the ability to participate without feeling threatened, provoked or uncomfortable. As Hafner states,

> "Although some skeptics dismiss the devices as novelties more suited to a TV game show than a lecture hall, educators who use them say their classrooms come alive as never before. Shy students have no choice but to participate, the instructors say, and the know-it-alls lose their monopoly on the classroom dialogue" (Hafner, 2004).

The skeptics do seem to have a basis for their cynicism. Dr. Larry Cuban, professor emeritus of education at Stanford University suggests that the software and keypads are not actually responsible for the increase in student empowerment. Perhaps, he says, teachers using the technology are making their lectures more interesting and organized. "Dr. Cuban recalled an experiment at Stanford 30 years ago when similar remote control devices were installed at desks in an engineering building. Professors teaching in that building used the devices a few times then abandoned them. Eventually the devices were removed" (Hafner, 2004).

There may in fact be some indirect benefits that result from using this technology. Victor Edmunds observed that, "The instructor prepares class thinking about what the students know, what kinds of questions might be asked, what kinds of results might be shown. It is a perfect example of technology encouraging better teaching." (2005). During his use of the technology, he actually noticed that he was able to get through more material in a shorter amount of time. While he notices that there are many more features that he does not use, he notes, he is comfortable using just the basics and the response from his students is overwhelmingly positive (Edmunds, 2005).

Other issues surrounding the implementation of this technology include gathering sociological data and using it to conduct surveys. Research conducted by Ulla Bunz suggests that audience response systems are just as good as other methods like scan-tron at obtaining survey data (2004). Specifically, the research indicated that the technology was just as easy to use, had no effect on time pressure, was more fun than traditional methods and was equally valid (Bunz, 2004). However, student's perception of the validity of the surveys was less positive than with the use of traditional scan-tron surveys (Bunz, 2004). The author suggest that more research should focus on the negative perceptions of validity when using technological tools, as it has been observed in other studies of educational technology (Bunz, 2004).

In the future, research perhaps should focus on the differences in achievement, attitudes about technology and content in relation to the uses of these various forms of technology. Of particular interest is the use of online learning systems and audience response systems. Students taking Science 100 certainly get an adequate taste of current technology. Whether it is probe ware, computer graphing programs, BlackBoard or even the lecture – based audience response system, students in Science 100 experience technology that will probably one day be significantly infused into their lives.

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