

USING BLACKBOARD AND THE WORLD WIDE WEB IN A QUANTITATIVE LITERACY COURSE

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During the summer of 2003, I received a CTW Mellon grant to develop and integrate into Mathematics 101, the introductory Quantitative Literacy course at Trinity College, eight application web-based modules. The terms of the grant required that I also address enhancing students' information literacy skills. These modules were available through Blackboard for individual use and group use by students. Each module would consist of an introduction linked to two application case studies. Each case study consisted of background information, cited references and a short electronic self-assessment quiz. Each module concluded with an exercise set for both case studies and involved both quantitative literacy and information literacy skills.

The topics the eight modules covered are as follows:

Module 1: Percentages and Proportions in Nature

Module 2: Generation to Generation: Using Proportions and the Consumer Price Index

Module 3: Mega Cities and Descriptive Statistics

Module 4: The Gallup Poll and Probability

Module 5: Energy Availability and the Average Rate of Change

Module 6: Taxi Fares and Linear Functions

Module 7: Growth of Developing Nations and Exponential Functions

Module 8: Decay of Radioactive Materials and Exponential Functions

The general goal of Mathematics 101 is that of any Quantitative Literacy course; namely, to equip students with the quantitative tools required to understand our increasingly complex society. For example: How do we determine the rate of inflation of consumer prices? How do we choose among different algebraic models to predict world and national population sizes? How do we decide whether graphs from media sources distort information? It is desirable that at the end of a quantitative literacy course students can judge the validity of logical arguments, determine percent change for time series data, statistically summarize data, find the probability of certain events, fit curves to data and evaluate the reliability of different mathematical models and analyze tables, graphs, and charts.

Information Literacy stresses competency in five areas: students should be able to analyze information, locate information, evaluate information, present information, and use information ethically. The eight modules I developed stressed these competencies. The modules had numerous exercises where students had to locate data, cite sources according to a specified reference style, present, evaluate and analyze this data.

The eight modules were web-based for a variety of reasons. The World Wide Web is a dynamic medium whereas textbooks are a static medium. The World Wide Web appeals to students who are digital-savvy having been exposed to computers and other forms of technology since they were infants. The World Wide Web has numerous reputable government and non-government sites which contain interesting, reliable and current information. Consequently, these modules can engage and motivate students to learn quantitative literacy since they are more relevant, use actual data and are more interactive than traditional methods of learning utilizing only classroom instruction and textbooks.

Students accessed these modules through the Course Document area of their Mathematics 101 section of Blackboard. Blackboard version 6.3 was selected due to its ease for creating web-based instruction in comparison to Microsoft Frontpage or WebCT. Blackboard has an online communication forum for the posting of questions and for stimulating virtual class discussion. It also has versatile test features for presentation, feedback and grading.

The modules were assigned at appropriate times throughout the course to dovetail with the topics presented in class. Students were required to review the prerequisite as well as the case study material for each module. Students had to complete the self-assessment quizzes and also the accompanying exercises. Answers were provided for all exercises so students received immediate feedback on their progress. Students reported that the modules particularly were helpful when they were preparing for quizzes and exams.

The accompanying exercises were written in a manner not only to engage students but also to require them to search for information needed to solve the posed problem. For example, the following accompanying exercise from Module 4 is based on the results of the latest presidential job approval rating poll.

Module 4 - Accompanying Exercise 1: Find the most recent United States Presidential Approval poll. Cite the sources using the style guide posted on the Trinity College Raether Library's web site specifically at the Bedford/St. Martin's On-Line Reference section. Using the approval rating from the poll you just cited, answer the following questions:

- a. Suppose five Americans are chosen at random, what is the probability all of them approve of the President of the United States' performance?
- b. Suppose five Americans are chosen at random, what is the probability at least one of them approves of the President of the United States' performance?

Not all exercises found in the modules are mathematical in nature. Since one major goal of the grant was to strengthen the information literacy skills of students, many exercises required students to gather information to solve problems and also evaluate whether this information provided an effective solution. For example, in Module 5, using official web sites such as the Energy Information Administration of the United States Department of Energy, students had to research the advantages and disadvantages of using different energy resources such as natural gas, coal, or nuclear energy, and to discuss the ramifications of using these energy resources on the environment and on national security. Students were then directed to repeat this exercise using alternative energy sources: solar, ocean or geothermal energy.

The modules exposed students to linear and exponential models for the purposes of forecasting future trends in both the use of natural resources and population growth. Students were required at times to assess their predictions. For example, the following accompanying exercise from Module 5 is based on the average rate of change based on a linear model.

Module 5 - Accompanying Exercise 3: Using an appropriate source, find both the world and China's consumption of petroleum in 2000 and 2003 in millions of barrels a day. Using the average rate of change analysis discussed in this module, predict the world and China's consumption of petroleum in 2013 in millions of barrels a day. Will there be any change in China's consumption of petroleum in 2003 versus 2013? What may or may not account for this change? China's consumption of oil will be what estimated percent of the world's consumption of oil in 2013? Cite your source using the APA citation style by following examples at <http://www.wisc.edu/writing/Handbook/DocAPA.html>.

The following accompanying exercises from Module 7 are based on the exponential growth module.

Module 7 - Accompanying Exercises 1 and 2: 1. Choose a developing country other than Egypt, Thailand and Ecuador. (Note these three developing countries were already discussed in earlier exercises found in this module.) Find the population size and population growth rate in 2000 and use this rate to estimate the approximate population of this nation in 2020. Compare your 2020 estimate to an official estimate. Cite the sources that support your data using the APA citation style found at <http://www.bedfordstmartins.com/online/cite6.html#1>

2. Referring to question 1, in how many years will the population size of the nation you chose double the size it was in 2000?

In addition, each module provides students with an informal opportunity to evaluate their progress. This informal mechanism is a short self-assessment quiz available through Blackboard. Blackboard allows a variety of different test questions: multiple choice, true/false, fill in the blank, multiple answer, matching, ordering, essay and random block.

I found essay questions to be the best form of evaluation since it allowed input of detailed solutions. The problem with short answers is that each variation of an answer must be included and this is extremely tedious to input. Suppose the correct answer to a question is $\frac{3}{4}$. Unless the question is specifically worded that the answer must be a fraction in reduced form, 75%, $\frac{6}{8}$, $\frac{75}{100}$ or .75 are all equivalent answers and each of these must be entered into Blackboard. Blackboard essay questions allowed me to provide detailed solutions to questions as well as detailed feedback. Detail that my students appreciated receiving since it accelerated the learning process and helped better prepare them for quizzes and exams.

Blackboard allows the course instructor to control the number of test attempts, the test completion time, the detail for answer feedback and the test presentation layout. The control panel feature allows the instructor access to a gradebook. This gradebook gives the score for each student on each self-assessment quiz, indicates the date and time each student completed each quiz and provides complete student responses for each quiz question. I found this latter feature helpful, since I could easily monitor individual assessment throughout the semester.

Did the modules impact students learning in Mathematics 101? From the fall of 2004 when the modules were first initiated through the spring of 2006, I received numerous positive comments from students on how using the modules increased their understanding of the concepts and applications found in Mathematics 101. What follows are the comments of three students out of the approximately 250 students who have used the modules at this point in time. (Student 1) "The modules were quite helpful in reinforcing the material, and showing real-world relevance to the material. I think this in and of itself made it easier to understand why we were doing certain work. This was motivating." (Student 2) "The modules were great because we could do them on our own time, and over and over as a review." (Student 3) "The explanations really helped me understand what I was missing or doing incorrectly. Thanks for taking the time to make them Professor Z-T."

Besides anecdotal evidence, I also was able to gather and analyze quantitative evidence concerning the effectiveness of these modules. During the fall of 2004, the students in all four course sections of Mathematics 101 were given a statistics/probability proficiency pretest. At the end of the semester all four course sections were given a statistics/probability proficiency posttest. One of the four course sections was not required by their instructor to use the modules. Since no student in this particular course section used the modules, this course section served as a perfect control group. This section showed no statistical change in the pretest/posttest scores. However, the three course sections where students used the modules showed significant statistical improvement from the pretest to the posttest scores.

Another added benefit to using these modules was that students were able to engage in metacognitive reflection on their learning of the course material. Students were required not only to do the self-assessment quizzes online but also to print off a hard copy of their

quizzes and write reflections on the causes of their errors on this copy. Since students had to analyze why they got certain problems wrong, a constructional approach to learning was assured. Students experienced better retention and understanding, since they constructed their own meaning of concepts rather than simply memorizing concepts by rote.

The main lesson learned in using Blackboard and the World Wide Web in a Quantitative Literacy Course is that these mediums allow students to have access to hands-on, relevant data which can be used to solve real world problems. Students can more fully appreciate the role mathematics plays in understanding an ever changing world. Rarely do students ever ask me “So what is mathematics good for?”