Psychology Meets Technology: Examining the Ingredients of Successful Learning

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Abstract

The emphasis on technology-enhanced learning in the mathematics department at the Borough of Manhattan Community College is above and beyond what could be expected at a typical two year college. In fact, the use of technology in our developmental program has been reported as well ahead of most four-year colleges. Equally important however, is our department's student oriented approach to learning which emphasizes mathematical thinking and reasoning. Various projects involve significant writing assignments and interpretation of data. In courses ranging from developmental mathematics to statistics to calculus, innovative instructional activities are coupled with state-of- the-art technology in order to optimize student performance and satisfaction.

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Introduction

The emphasis on technology-enhanced learning in the mathematics department at the Borough of Manhattan Community College is above and beyond what could be expected at a typical two year college. In fact, the use of technology in our developmental program has been reported as well ahead of most four-year colleges. Our use of CD-ROM based software, graphing calculators and computer algebra systems, as well as web-based and multimedia portfolios is well documented. In addition to our departmental mathematics laboratory, dedicated laboratories with specialized software are used for classroom instruction in our calculus and statistics courses.

Equally important to our technological focus is our department's instructional pedagogy. We have developed various learning activities that help students use technology to maximize their mathematical thinking and reasoning skills. At all course levels, a variety of projects involve significant writing assignments and interpretation of data. For example, statistics instructors can

choose from a portfolio of class projects designed by our faculty (and custom published). Although they vary by topic, all of them focus on data analysis using a graphing calculator or spreadsheet software (such as SPSS or Microsoft Excel). The projects also require students to interpret and explain the implications of findings. Calculus students receive weekly laboratory instruction in Maple and are required to complete projects with similar goals. These projects become part of each student's portfolio. Developmental mathematics students have access to computerized instruction in algebra including an extremely popular self-paced assessment test.

Students regard these learning activities as positive enhancements to their mathematics education. Furthermore, most report that they have come to appreciate how the power of technology can "free" them from number crunching, and instead allow interpretation of more advanced sets of data.

The following statistics and calculus projects demonstrate how our department combines the psychology of education with state-of-the-art technology to optimize student learning.

Using "Live" Data From a Statistics Class

Borough of Manhattan Community College
Introduction to Statistics
Dr. Fred Peskoff

Project: Using "Live" Data From a Statistics Class

Introduction: Have you ever wondered about your fellow classmates? Have you ever asked (yourself or another student) how old your classmates are or if they have children? Curiosity is natural. Here is your opportunity to satisfy your curiosity and practice calculating statistics at the same time. The data for this project was anonymously collected from your class. You will be analyzing it and equally important, interpreting it. In addition to calculating certain statistics from a "real live" sample (of which you are a part), you will be reviewing the concepts of correlation and independence. Using the technology below will enable you to spend less time "crunching" the data and more time thinking about the meaning of the statistics.

Instructions: You may use the technology of your choice to complete this project. The TI-83+ Graphing Calculator and Microsoft Excel are two good options. Remember to show all calculations or attach printouts. Any questions requiring interpretation should be answered as clearly as possible, preferably in a few sentences.

Consider the following data collected anonymously in class. Each row represents the following information for a given student recorded in the order below:

student number, age in years, number of children.

You may wish to recopy the data as a table with seventeen rows and three columns before entering it on your computer or calculator.

1, 23, 0
2, 21, 0
3, 20, 0
4, 21, 1
5, 24, 0
6, 22, 0
7, 23, 0
8, 19, 0
9, 45, 2
10, 20, 0
11, 20, 0
12, 23,0
13, 22, 3
14, 22, 0
15, 33, 2
16, 35, 2
17, 38, 3

Questions:

1. Calculate the mean, median, and mode for the variable age.

2. Which of the above statistics (if any) most accurately describes this data set? Justify your answer.

2. Calculate the range, variance, and standard deviation.

3. Explain what the range and standard deviation tell about this data set.

4. What information does the standard deviation give that the mean does not? Why is this important?

5. Calculate the correlation coefficient r between age (x) and number of children (y).

6. Carefully explain what the value of r (its sign and its magnitude) suggests about the relationship between the two variables.

7. Is the relationship between age and number of children what you would have predicted for your class? Why or why not?

8. Construct a two by two contingency table that contains frequency counts of the number of students who have children (one or more) vs. students who do not. Your table should also

display the number of students who are at least 23 years old in comparison to those who are 22 years or less. The table should contain four cells which report joint frequencies. Use the table to answer the remaining four questions.

9. What is the probability that a randomly selected student will have no children?

10. What is the probability that a randomly selected student will be at least 23 years old and have children?

11. Are the variables age and number of children independent? Make a joint probability distribution and test its four cells to answer this question.

12. Does your answer to the previous question seem reasonable based on the correlation coefficient calculated above (in question five)? Why or why not?

Multimedia Based Calculus with E-folios

Borough of Manhattan Community College
Dr. Patricia Wilkinson
Dr. Lawrence Sher

This "proof of concept" project is developing a combination of prototype web-based and traditional educational material for electronic portfolios in calculus courses, and for presentation of student mathematics research. This subject of study integrates computer programming, art and design and video production techniques to conceptualize, design, construct, test and distribute multimedia presentations in calculus. Since multimedia is a young discipline, very little organized teaching material, especially at the undergraduate level, is available. The product in this project is intended to fill this void and help students acquire quality training in an area of expertise, which is currently in tremendous demand from the Multimedia and World Wide Web industries.

Initially, the project will develop a multimedia e-book through the use of the internet, a lab manual and instructor's guide, for enhancing calculus computer based projects and student research for internet presentation. The targeted audience is first term calculus and mathematics research students. Activities will include constructing web modules that consist of laboratory notes and research problem sets with links to appropriate sources of information and software tools. The modules will enable students to learn through a hands-on problem solving approach.

A major feature of the Borough of Manhattan Community College's calculus program is the written communication of mathematical ideas. Our style of "print calculus portfolios," where each student presents in print his or her best project coupled with a narrative explaining why that project was selected and what was learned from it, was the first of five national models featured in the American Society of Engineering Education Journal's cover story on portfolios (ASEE Prism, March 1996).

Student Views of the Borough of Manhattan Community College

Calculus Experience

An African American student's directly quoted view:

"In all my calculus experience, this semester was the greatest because I never made that advanced use of computers to solve problems. Before, everything was based on my thinking and my capabilities of solving long and tedious equations. Computer software such as Maple or Derive helped me by cutting in half the time I had to spend in order to complete a problem. It didn't take away the burden and sometime pleasure of solving a problem, but helped me in doing the calculation."

Our department is proud that the program has value beyond the students for whom it was designed. An international student's opinion follows:

"When I was a senior in high school, I got a math scholarship in Russia. Twenty other students and I were selected from all over the world for a math camp in Moscow. At the end of the camp, I ranked the third among the twenty students in writing equations for different kinds of graphs. When we got this project, I thought it would be a waste of time for me to do it, but in reality I was wrong because it mastered my speed and showed me how to avoid doing any mistakes. In conclusion, frankly I thought at the beginning of this course, that I wouldn't learn anything. Because I already finished Calculus and took more advanced courses in math, I thought it would be a waste of time to be in this class. But after I started doing the projects and using the computer software, I found myself learning something totally new and unexpected."