INFUSING TECHNOLOGY INTO A VARIETY OF MATH COURSES

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Introduction

This paper describes some of the approaches to infusing technology into a variety of math courses at our institution. The TI-73 and TI-84 calculators are utilized in our Math for Liberal Arts course in the study of the Math of Finance. In our Finite Math course, in addition to the topic Math of Finance, students are introduced to the use of the Internet to find and utilize free programs and applications to solve various problems involving matrices and linear programming. MyMathLab is employed in College Algebra to facilitate differentiated instruction. In our Math Education courses, the TI-73 calculator, MyMathLab, Web Assign, and Blackboard are used extensively to provide future teachers with tools for their own class management. Illustrative examples are included.

Math for Liberal Arts Technology Applications

In our Math for Liberal Arts course, the material on the Math of Finance is presented utilizing TI-73 or TI-84 calculators. These calculators have display capabilities that allow the students to solve, in addition to simple and compound interest and annual percentage yields, more complex problems with annuities, sinking funds, present values of annuities (e.g. the cash value option of lotteries) and amortization. The display capabilities allow the students to backtrack if an error message occurs to correct errors without the need to re-enter all of the formula into the calculator. The display also permits the students to change parameter values and do "What Ifs", without the need to re-enter the complete formula expression.

As an illustrative example, consider the following – a home purchase (amortization) with various options – e.g. here comparing a 30 year mortgage to a 15 year mortgage with fixed monthly payments. To purchase a $150,000 home by paying 20% down and financing the rest with a mortgage at 4.25% interest, compounded monthly for a 30 year mortgage the calculator formulas with keystrokes are given by:

Payment = Principal / ((1-1/ (1+R/k) ^N)/(R/K))
= 120000 / ((1-1/ (1+.0425/12) ^ (12x**30**)) / (.0425/12))
= $590.33 (For **15** years, payment = $902.73)
Total Cost = DP + Payment x N = 30000 +590.33x12x**30**
= $242,518.80 (For **15** years, Total Cost = $192,491.40)
Interest = TC – Cash Purchase Price = 242518.80-150000
= $92,518.80 (For **15** years, Interest = $42,491.40)

Note that the **15** year results are obtained by simply backspacing and replacing the **30** in the above formulas with **15**. Similar parameter changes and correction of errors is also done with the other Math of Finance formulas.

Finite Math Technology Applications

Our Finite Math course also includes the Math of Finance, so the displayed calculations in the Math for Liberal Arts discussion earlier are similarly employed in Finite Math. In addition, in the Finite Math course, students are introduced to the use of the Internet to find and utilize free programs and applications to solve various problems including calculating the inverse of a matrix and solving Linear Programming problems.

As an example, a Google search of "matrix inverse calculator" yielded tens of thousands of hits. An example of one of these, the **Oneline Matrix Calculator** by *Bluebit,* is given in Figure 1. Note all the options listed for this "**Matrix Calculator**". Many such programs include iterations of the steps to arrive at the matrix inverse.

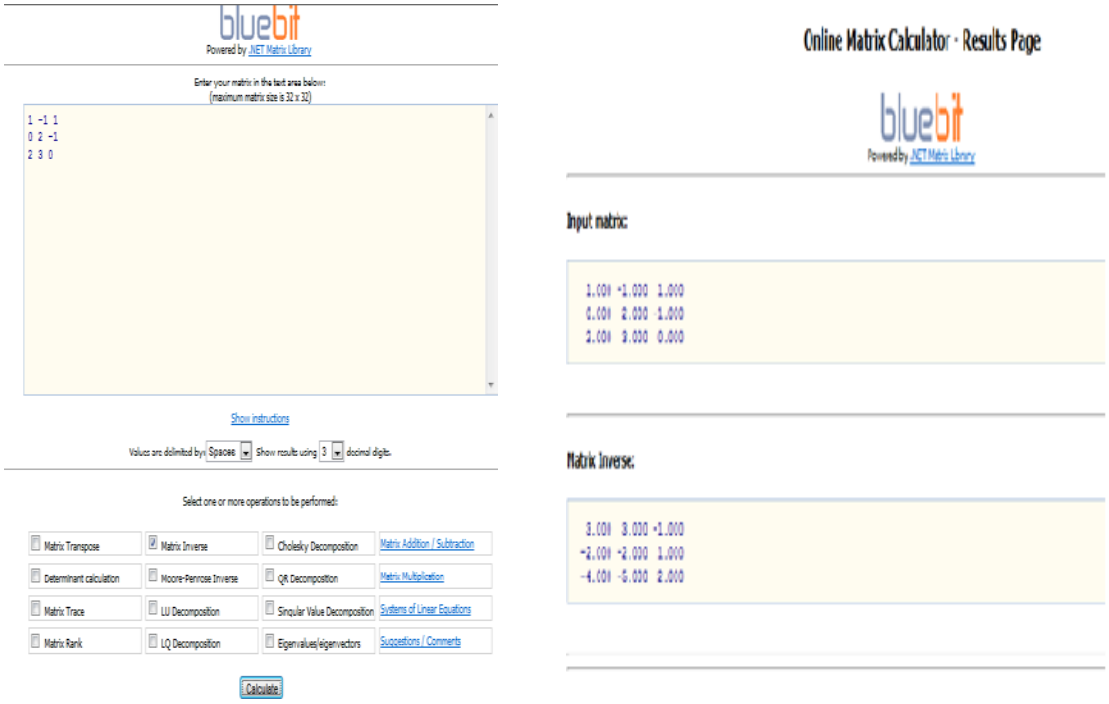

Figure 1 - Matrix Inverse Example

As a second example, a Google search of "simplex method calculator" again yielded tens of thousands of hits. An example of one of these, the use of the **Finite mathematics utility: simplex method tool** to solve a Linear Program problem, is given in Figure 2. Notice in the output that the program calculates all the intermediate tableaus, while we have just included the third and fourth (final) tableaus. Also, note all the other options in this **tool.** The dual-simplex method, the two stage method, sensitivity analysis and all the other usual LP techniques are also available at numerous other free sites.

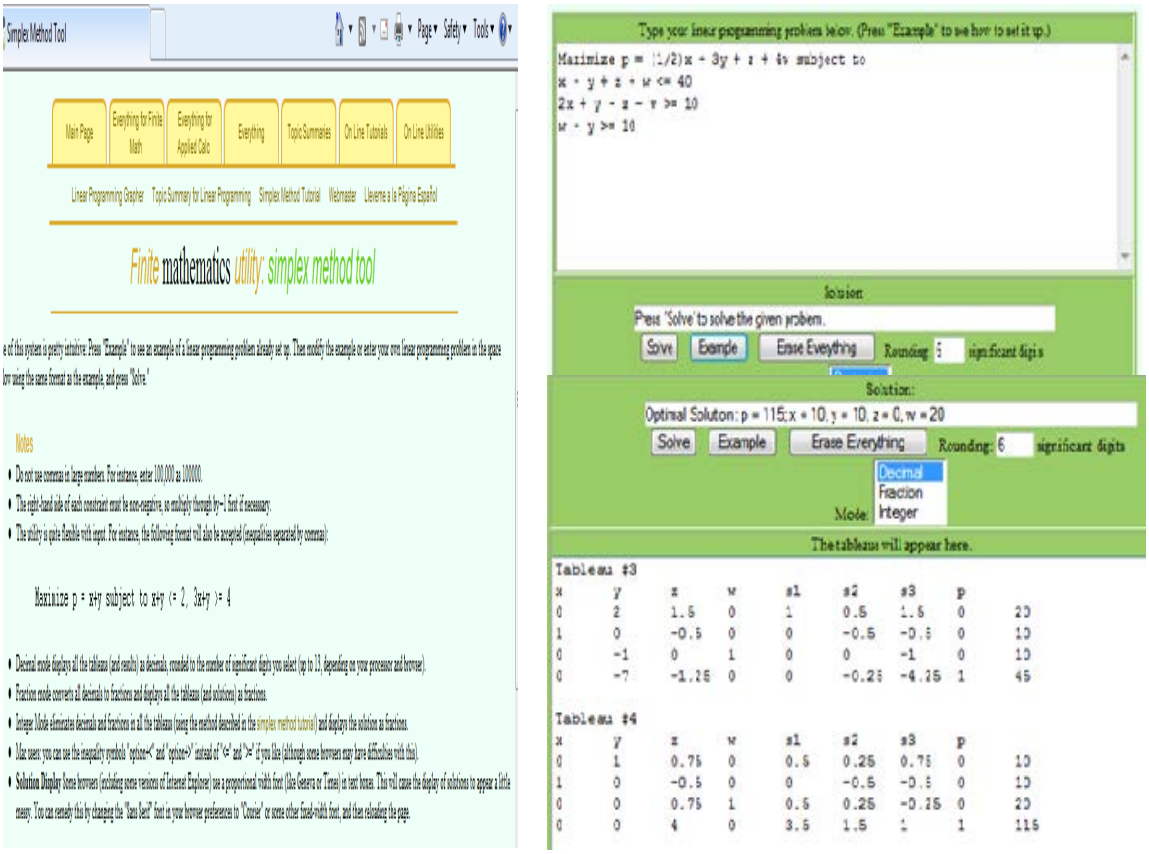

Figure 2 - Linear Programming Example

It is pointed out that the students can and should look to the Internet for free tools for problems in all their math courses and for many problems in other fields. Students in our Finite Math sections are almost exclusively Business Majors and it is noted that there are many free programs on the web to solve problems in Accounting, Finance and various other areas in Business. It is also pointed out that everything "free" is not necessarily good or even correct. So students are encouraged to input problems whose solutions are known, for example textbook examples, to first check the credibility of the "free" programs.

College Algebra Technology Applications - MyMathLab

At our institution, College Algebra is labeled as a *bottleneck course* - a large-enrollment, high-attrition core course whose learning outcomes are important for success in the broader undergraduate curriculum. There are many factors that make the course a challenge for both students and instructors. One significant factor is the wide range of skill sets and levels of understanding in mathematics that students in the course have. Another important factor is that students have different learning styles and need different learning environments to achieve success. Differentiated instruction is one instructional methodology that instructors may use to create a learning environment that addresses

both of these challenges. In this learning theory, the goal is to provide students with multiple options for learning and doing mathematics to accommodate their level of skill and learning style. The course management system MyMathLab supports differentiated instruction through its default course settings, as well as provides instructors with the ability to further customize a course, depending on the course syllabus and needs of their students.

Regular Features in MyMathLab Support Differentiated Instruction

To learn mathematics, students need sufficient explanation of the concept or method being studied, and they must have the opportunity to practice related problems as many times as they wish to achieve mastery themselves with the concept or method. MyMathLab has many default features to support these goals. The column on the right side of Figure 3 includes the following help features which students may select.

- *Exercises* – regenerate algorithmically so students have unlimited opportunity for practice and mastery.
- *Help Me Solve This* – provides a guided solution to a problem in which students must answer questions in order to proceed. The student will have to do a similar problem to receive credit.
- *View an Example* – walks the student through the solution to a problem step-by-step without asking questions of the student. The student will have to do a similar problem to receive credit.
- *Video* – provides students with a video lecture from a teacher working through the problem with an explanation of the material. The student will have to do a similar problem to receive credit.

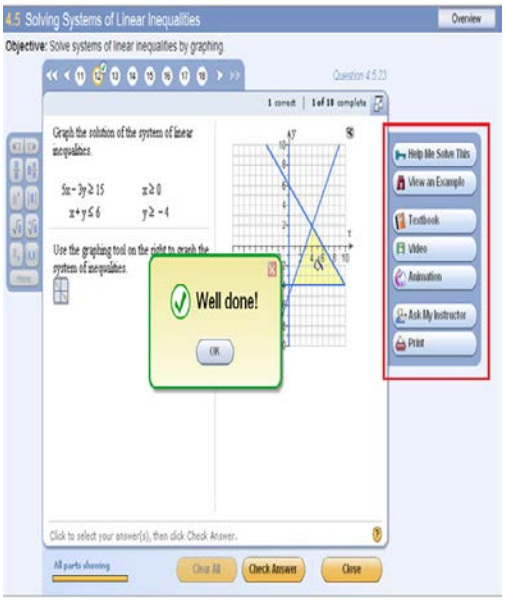

Figure 3 - Example of Default Help Features

Coordinator Course Customized Features

At our institution, we have chosen the MyMathLab option to create a master Coordinator Course for College Algebra that is then copied by all instructors for use in their section of the course. In the Coordinator Course, direct links have been added to resources outside of MyMathLab to better support student learning. These links include the following.

- UHD Student Resources (UHD Algebra Web Page; UHD Advising)
- Wolfram Alpha (free online tool that does everything a graphing calculator does)
- Khan Academy (large library of math videos for every level)
- Math TV (small library of math videos in English and Spanish)

Custom Created Questions, Video Help, and Media Assignments

Most of the algorithmically generated multiple choice questions available in MyMathLab help students achieve mastery with rote skills in mathematics, but there are fewer questions available to help students with conceptual understanding. Moreover, there is not always a perfect match between the problem types in MyMathLab and those in the textbook or course syllabus. Instructors are able to address some of these issues by creating custom questions in MyMathLab. Our Coordinator Course contains many custom questions created by our faculty that emphasize conceptual understanding and help to meet course goals. For an example, see Figure 4.

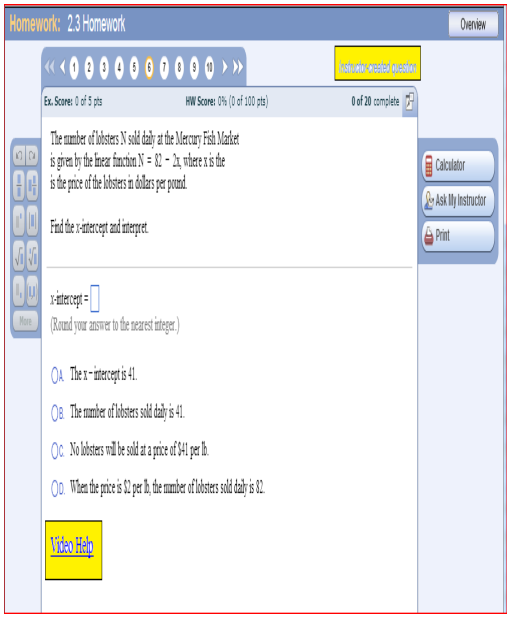

Figure 4 - Example of Custom Problem

Unfortunately, the default MyMathLab help tools are not available to students for custom questions. However, instructors may create help videos outside of MyMathLab and then link these to specific problems inside of MyMathLab to compensate for this. One of our faculty members created help videos for many of our custom questions, downloaded these to You Tube, and finally inserted the links into the custom questions in our Coordinator Course. Among our most popular videos are: Midpoint extrapolation; Using

a linear function to model data; Evaluating a function at a symbolic input; and Domain of a function formula.

Our Coordinator Course also includes Media Assignments. A Media Assignment has been added to each homework assignment in the course and it consists of related existing videos on the Internet. One of our faculty members selected these to supplement the course material. For example, the Media Assignment for Homework 2.2 Equations of Lines includes: Slope Dude; Understanding Positive, Negative, Zero and Undefined Slope; Writing Equations of Lines Examples and Direct Variation Introduction.

Student opinion of the effectiveness of MyMathLab in our College Algebra course is favorable. Of students taking the final exam in the course recently, only about 15% disagreed with the statement "Working on homework exercises in MyMathLab helped me learn the course material."

Math Education Technology Applications

Two Mathematics courses for students with a concentration in PreK-8 are offered at our institution: Math Concepts I and II. In these courses, TI-73 Calculators, MyMathLab, My Blackboard and Web Assign are used extensively to provide future teachers with tools for their own class management.

- **TI-73 Calculators**
  In these courses, students are taught to use the TI-73 because they will be expected to teach their own classes with this calculator.

- **MyMathLab**
  This course management system is extensively utilized. A typical list of online assignments in MyMathLab is given in Figure 5.

Assignment Name	Category	Assigned	Start	Due
Orientation	H	✔	01/07/13 4:53pm	02/20/13 3:00pm
8.5	H	✔	01/07/13 4:53pm	02/20/13 3:00pm
9.1	H	✔	01/07/13 4:53pm	02/20/13 3:00pm
9.2	H	✔	01/07/13 4:53pm	02/20/13 3:00pm
9.2 Spinner Statistics page 490 (MA)	H	✔	01/07/13 4:53pm	02/20/13 3:00pm
9.3	H	✔	01/07/13 4:53pm	02/20/13 3:00pm
9.4	H	✔	01/07/13 4:53pm	04/03/13 3:00pm
9.5	H	✔	01/07/13 4:53pm	04/03/13 3:00pm
Chapters 8 and 9 Test Preparation	Q	✔	06/13/12	04/03/13 3:00pm
Test I on 8.5 - 9.3	T	✔	02/20/13 3:50pm	02/20/13 5:25pm

Figure 5 –Example of Online Assignments in MyMathLab

- **Web Assign**
  In this course management system, online homework is assigned and the features of Web Assign are utilized.

- **Blackboard**
  Blackboard is used extensively to provide future teachers with tools for their own class management. A typical application in Blackboard is given in Figure 6

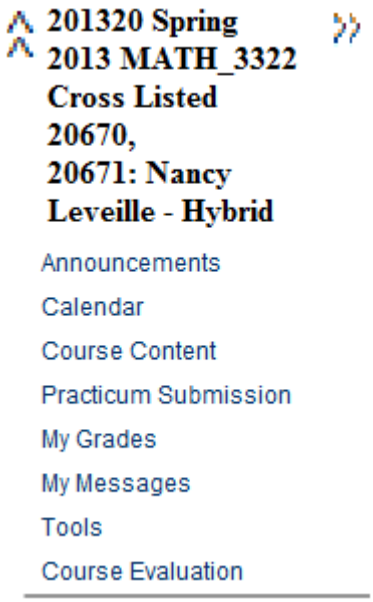

Figure 6 – Typical Application in Blackboard

Conclusion

This paper considered a variety of technology tools and how they can be integrated into general education, service, and math education environments. A number of illustrative examples were given and discussed. The technologies ranged from calculators, to course management systems and the use of free Internet programs and applications. In addition to their use in these courses, another goal was to provide the students with technology tools that they can use in other settings outside these particular courses.