SECTION A

CHANGING THE WAY WE TEACH MATHEMATICS AND STATISTICS

Eugene L. Round

Embry-Riddle Aeronautical University Worldwide

ABSTRACT

This paper discusses the characteristics of adult learners of mathematics and of the typical Embry-Riddle Aeronautical University (ERAU) Worldwide Campus student taking a mathematics or statistics course. It describes how mathematics and statistics courses are normally taught at ERAU Worldwide at present and some shortcomings of that approach. It discusses a software system called MyMathLab developed by Pearson Education, makes a proposal for using MyMathLab in ERAU Worldwide mathematics and statistics courses that are taught in the classroom, and describes how implementation of that proposal would help the campus meet its goals and comply with the Aviation Accreditation Board International guideline for mathematics and science.

The Scenario

Your alarm went off at 3:30 this morning so that you could get up and get to your job at a local aerospace company. Due in part to the high cost of gasoline and the long commute that many of its employees face, the company is letting you work four 10-hour days per week. That means your work hours today are 5:30AM to 4:30PM with an hour for lunch. Even at this hour in the morning, traffic can be a nightmare so you have to leave home by no later than 4:30AM to be sure you can get to work on time.

You want to move up in the company and improve your chances of promotion, so you are also going to college part-time working on earning a Bachelor of Science in Professional Aeronautics Degree from the Embry-Riddle Aeronautical University (ERAU) Worldwide Campus. This works well for you because an ERAU Worldwide campus is located fairly close to where you work. This term you are taking two courses and one of those is College Mathematics for Aviation I. You haven't taken a math course in about 15 years so you are somewhat apprehensive about taking math again. Math has never been your "thing" and you don't see where you will ever use it once you get past the math courses you have to take—but they are a requirement for the degree you want. You barely managed to score high enough on the math placement exam to get into this course. Otherwise you would have had to take a lower level course and that would delay your graduation.

You get through your work day in good shape and leave work promptly at 4:30PM. You should have just enough time to swing by McDonalds and get to class by the time it starts at 5:00PM. You aren't really looking forward to sitting in a mathematics class from 5:00 to 10:00PM and then getting up again tomorrow morning at 3:30AM.

You hope that the instructor will give a half-hour break somewhere so that you can eat the super-sized Big Mac meal that you grabbed on the way to class.

Things really start to drag about 8:00PM and you hope that you can stay awake enough to at least retain some of the material that the instructor covers between then and 10:00PM. The other class you are taking meets tomorrow night so you face the same schedule tomorrow. Fortunately the other class is more aviation-related—something you are really interested in—and allows for more interaction and discussion among students, so it is easier to stay interested and stay awake!

Background

Embry-Riddle Aeronautical University (ERAU) Worldwide offers undergraduate and graduate degree programs to over 27,000 students through a system of approximately 130 campuses located in the United States, Canada, Europe and the Middle East (ERAU, 2008). One of ERAU Worldwide's three basic principles as stated by Chancellor Marty Smith is to, "Provide an exemplary teaching and learning experience" (ERAU, p. 11). A high percentage of ERAU Worldwide students are working adults who attend classes either in the evening or through Worldwide Online. Chancellor Smith goes on to say that the vision of ERAU Worldwide includes, "Flexible delivery of education, both online and in the classroom, that is convenient to working adults of all ages" (ERAU, p. 11).

At its April 2007 meeting, the ERAU Worldwide Faculty Senate recommended that the campus apply to become a member of the Aviation Accreditation Board International (AABI) and seek accreditation through that organization of appropriate degree programs. Accordingly, ERAU Worldwide is now seeking accreditation of its Bachelor of Science in Technical Management (BSTM) and Bachelor of Science in

Professional Aeronautics (BSPA) degree programs. The AABI Accreditation Criteria Manual (AABI, 2007) section on general outcomes for baccalaureate degree programs states that, "Aviation programs MUST demonstrate that graduates have an ability to apply knowledge of mathematics..." (p. 6). Both the BSTM and BSPA degree programs require students to take at least six credit hours of mathematics and three credit hours of statistics (ERAU, 2008).

As stated earlier, the majority of ERAU Worldwide students are working adults who take classes in the evening or through ERAU Worldwide Online. Many students do both. ERAU Worldwide classroom-based courses are operated primarily on nine-week terms with each class meeting one night per week for approximately five hours. This means that working students taking ERAU Worldwide classroom-based courses often get up early in the morning, work a full day on the job, and then attend five hours of class in the evening. For Worldwide students taking mathematics or statistics, this schedule can be particularly challenging. Based on my experience teaching mathematics and statistics at ERAU Worldwide for approximately 10 years, many Worldwide students have not taken a mathematics or statistics course in a number of years and a high percentage didn't do well in those subjects in previous high school or college courses that they took. Many approach the subjects with at least some degree of anxiety and this often causes them to delay taking mathematics or statistics courses until late in their academic programs thus eliminating any possible benefit that knowledge gained in these courses could provide in later courses.

The Worldwide Campus Arts and Sciences Department and Worldwide mathematics instructors have explored other alternatives for teaching mathematics and

statistics in the classroom. Many of these courses are also offered through Worldwide Online so students could take them online over a twelve-week term rather than in the classroom in a nine-week term. However, many students, especially those who haven't taken mathematics or statistics in some time or who were not particularly successful in mathematics or statistics courses they have taken in the past, hesitate to take a quantitative course online. They prefer to have a "live" instructor that they can meet with, ask questions of, and turn to for support. Some Worldwide campuses have tried offering mathematics and statistics two nights per week for 2.5 hours per night rather than one night per week for 5 hours. This approach has not met with a great degree of success as students often don't want to "tie up" two nights each week for the same course. This may be because they don't want to travel to the campus two nights per week or because taking one course on a two-night per week format limits the number of courses they can take during a given term. Also, from the perspective of the ERAU campus, offering a mathematics or statistics course on a two-night per week format may not be desirable because it ties up a classroom two nights per week for one course thus preventing the campus from offering another course during that term. Where classes are offered on a military installation using military classrooms that are shared with other colleges and universities, it may not be possible from a scheduling perspective to offer one class two nights per week.

Adults and Mathematics

In 2006, the American Mathematical Association of Two-Year Colleges (AMATYC) published a booklet titled *Beyond Crossroads: Implementing Mathematics Standards in the First Two Years of College* (Blair, 2006). The stated purpose of the

document is to, "stimulate faculty, departments, and institutions to examine, assess, and improve every component of mathematics education in the first two years of college" (p. 1). Even though ERAU Worldwide offers four-year degree programs, the mathematics courses offered are what students would normally take in their first two years of college. The characteristics of the two-year college student are also very similar to those of ERAU Worldwide students. The *Beyond Crossroads* document lists the following characteristics of two-year college students in 2001-2002:

> -the average age was 29; 36 percent were 18-21 years old; 15 percent were 40 years or older
>
> -61 percent of all students took a part-time course load
>
> -80 percent were employed with 41 percent employed full-time
>
> -many two-year college students were involved in a career change, had not attended school in several years, and were commuters. (p. 3)

According to data provided by ERAU Institutional Research, the average age of ERAU Worldwide students is 33 and 91 percent work full-time (P.A. Tagert, personal communication, July 14, 2008). Because the ERAU Worldwide mathematics program and students are similar to those of a two-year college, ERAU Worldwide could learn from and benefit from the recommendations in *Beyond Crossroads*.

Beyond Crossroads (Blair, 2006) lists several guiding principles for two-year mathematics programs. Among these are the following:

> Innovation: Mathematics programs should be thoughtfully constructed to approach content and instruction with appropriate use of traditional and innovative methods.

> Inquiry: Effective mathematics instruction should require students to be active participants.
>
> Technology: Technology should be integral to the teaching and learning of mathematics. (pp. 10-11)

In implementing these principles, the document goes on to say that it is essential for the college to provide a supportive learning environment to the diverse student population including such facilities as mathematics tutoring labs and learning centers. Because of its widely dispersed small campuses, it is difficult for ERAU Worldwide to provide these services to its students.

Math anxiety is described as "a feeling of dread that is experienced when a person attempts to understand and solve mathematics problems" (Blair, 2006, p. 23). In *Math: Facing an American Phobia*, Marilyn Burns (1998) writes, "Math phobia is a widespread national problem. The negative attitudes and beliefs that people hold about mathematics have seriously limited them, both in their daily lives and in their long-term options" (p. x). This idea is echoed by Tobias (1993). Math anxiety is of particular concern for adult students, women students, students who haven't taken mathematics courses in sometime, and those with weak mathematics backgrounds (Tobias). O'Donoghue (2000a) states, "Adults with prior experience of mathematics often express negative feelings toward mathematics including fear, anxiety, inadequacy and even guilt" (p. 102). He also states:

> As regards mathematics, it is more often than not that adult learners bring with them poor perceptions of mathematics reinforced by negative attitudes arising out of their experience of school mathematics and associated pedagogical practices....Mathematics for these learners is difficult to learn; evokes negative

> emotions; is associated with failure; presents an obstacle to job promotion; constitutes a bar to further education; and perpetuates inequality in society. Already the educational die is loaded against success for a significant proportion of adult learners of mathematics. (O'Donoghue, 2000b, pp. 229-230.)

Fitzsimons and Godden (2000) echo the idea that mathematics is often viewed as an obstacle by adult learners. They go on to say that many adults coming from a background of traditional mathematics education also do not see the relevance of mathematics to any subject other than itself.

O'Donoghue (2000b) states that the adults who either returned to college after a break of several years or who decided to pursue a degree while working full-time have largely been treated the same as the traditional-age college students insofar as the teaching of mathematics is concerned. He goes on to say that, "the challenge for mathematics educators is to find effective ways to teach mathematics to a diverse population of adult learners with mixed attitudes towards mathematics and different aspirations, who are underprepared for post-secondary education in mathematics" (p. 231).

Ways that colleges and universities can help adult students learn mathematics and overcome math anxiety include providing the math tutoring labs and learning centers mentioned previously (Blair, 2006). Benn (2000) indicates that removing the "often difficult and disabling pressures of time" (p. 116) can help students overcome math anxiety. She goes on to say:

> There is an urgent need to build confidence by showing that it is acceptable to be wrong and by placing the emphasis on methods rather than answers; to develop a

> positive attitude to mathematics by encouraging students to take ownership of mathematics by "messing around" with, exploring, and enjoying numbers. (p. 117)

Time constraints often arise in teaching mathematics. For many students who grew up with technology, "learning is participatory—knowing depends on practice and participation" (Blair, 2006, p. 53), but practice and participation take up valuable class time. In teaching problem solving skills, giving students adequate time to solve problems is important, but often difficult in a classroom situation where the teacher feels obligated to cover a certain amount of material. Similarly, in the mathematics classroom, the teacher will often ask a question and not give students who are just learning the material time to respond. When students struggle with a particular type problem, additional questions of the same type may be necessary to facilitate knowledge construction (Blair, 2006). Proper integration of technology is also important.

> The integration of appropriately used technology can enhance student understanding of mathematics through pattern recognition, connections, and dynamic visualizations. Electronic teaching activities can attract attention to the mathematics to be learned and promote the use of multiple methods. Learning can be enhanced with electronic questioning that engages students with technology in small groups and facilitates skills development through guided-discovery exercise sets. (Blair, p. 56)

The above outlines some of the characteristics of students taking mathematics and statistics classes at ERAU Worldwide campuses and some of the obstacles to learning mathematics and statistics they face. Yet we continue, either through our own doing or

because the "system" won't allow a change, to force these students to take mathematics and statistics classes in compressed nine-week terms, for five-hours a night after they have worked a full day.

An Alternative Approach

I would like to outline an alternative approach to teaching mathematics and statistics at ERAU Worldwide that I think would provide the support that our students need to learn mathematics and overcome their fear of the subject.

MyMathLab

MyMathLab (MML) is a software system produced by Pearson Higher Education that is designed to work with a number of mathematics and statistics texts published by Pearson Addison-Wesley and Pearson Prentice Hall. Speckler (2007) states:

> MML is modularized, self-paced, customizable, deliverable anywhere with Web access, and adaptable to each student's level of knowledge. Unlike the traditional, lecture-based model of course delivery, wherein students are passive recipients of information, MML enhances course delivery by engaging students in active learning. They learn at the time, in the place, and according to the style and pace that best suits them. (p. 2)

I will briefly discuss three features of MML that I think make it appealing for use with ERAU Worldwide students. These three features are homework assignments, tests and quizzes, and the student study plan. I will illustrate these with examples from the current Math 211, Statistics with Aviation Applications, text. This text, *Elementary Statistics* (10^{th} ed.) by Mario Triola (2007), is used in classroom-based and online sections of Math 211. Portions of MML are being used in online sections and I am now

teaching a Math 211 class at the Phoenix-Chandler campus using portions of MML. The text can be purchased with MML access included at an additional cost of about five dollars. Portions of MML are also being used with the online versions of Math 250, Calculus and Analytic Geometry, and Math 111, College Mathematics for Aviation I.

Homework

For texts fully supported by the system, MML comes "loaded" with problems taken from the text. The instructor can create a homework assignment by first looking at the problems in the text and selecting the ones that he or she wants to assign. The instructor would then go to the assignment screen in the course MML site to create the assignment in MML. Creating the assignment involves checking the box beside the desired problem and then clicking on the Add button. See Figure 1.

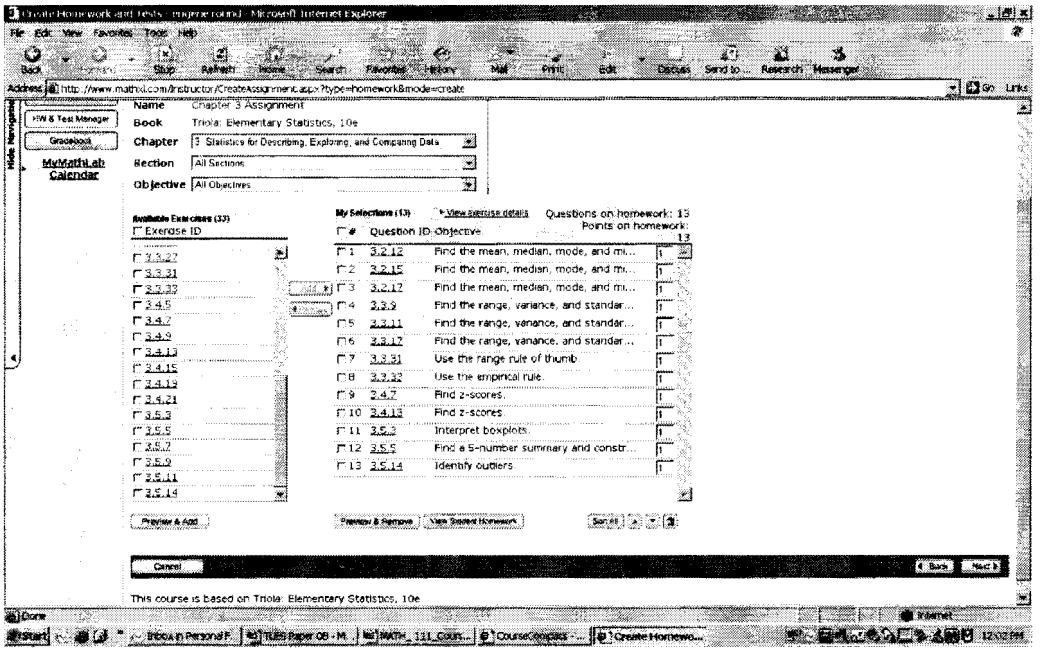


Figure 1: MyMathLab homework screen. *Note:* Copyright 2008 by Pearson Education. Used by permission.

A student would work on an assignment by opening it in MML and selecting the desired problem. A screen such as that in Figure 2 would be visible. The student would answer the question and click "Check Answer." MML would then immediately tell the student whether the answer is correct or not. Once all parts of a question are answered, the student can continue to the next problem in the assignment. Notice that on the left side of the screen, there are buttons for student use in formatting and inputting their answers.

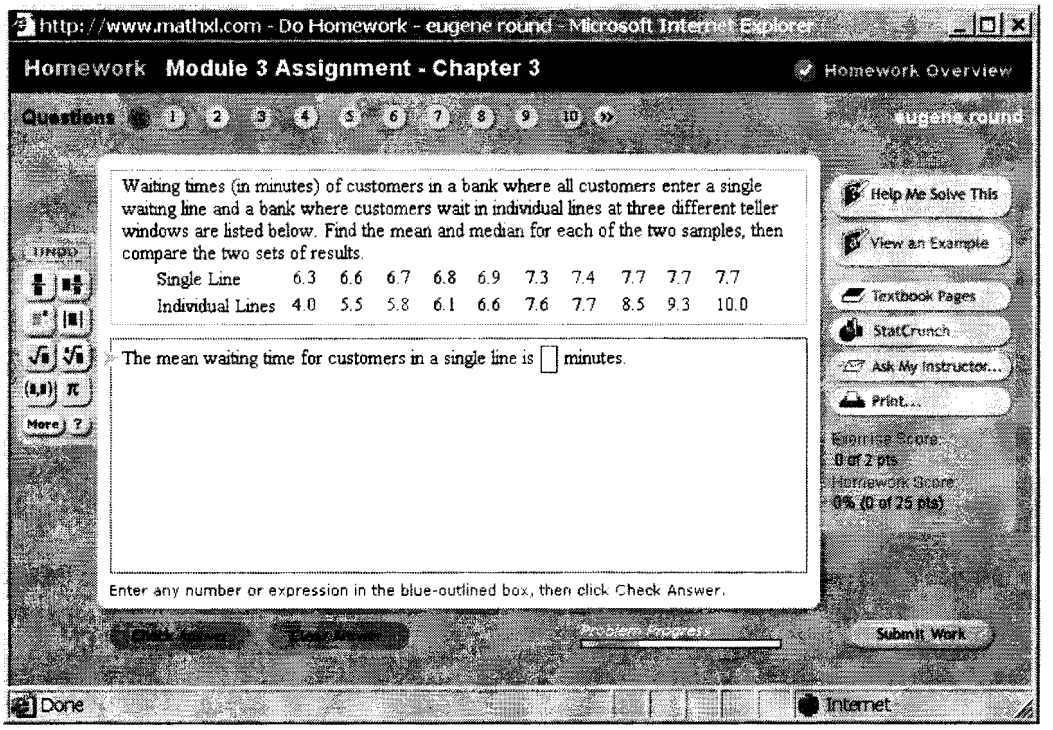


Figure 2: MyMathLab homework problem. *Note:* Copyright 2008 by Pearson Education. Used by permission.

If a student gets stuck when working a problem, there are several aids immediately available in MML. These are shown on the right side of Figure 2. The "Help Me Solve This" button walks the student step-by-step through the problem. The student must provide answers to each intermediate step in the solution before the system will

allow the student to proceed to the next step. At each step in the solution process, additional help is available if the student gets stuck. After MML takes the student step-by-step through the problem and the student provides the correct answers at each step, the student is taken to a similar problem that must be completed in order to receive credit for that problem on the assignment.

If a student clicks on the "View an Example" button, MML immediately takes the student through the steps of a completely solved problem that is very similar to the one in the assignment. In this case, MML provides the interim answers at each step. After using this tool and viewing the solution to a similar problem, the student is taken back to the original problem which he/she must solve to get credit for that problem on the assignment.

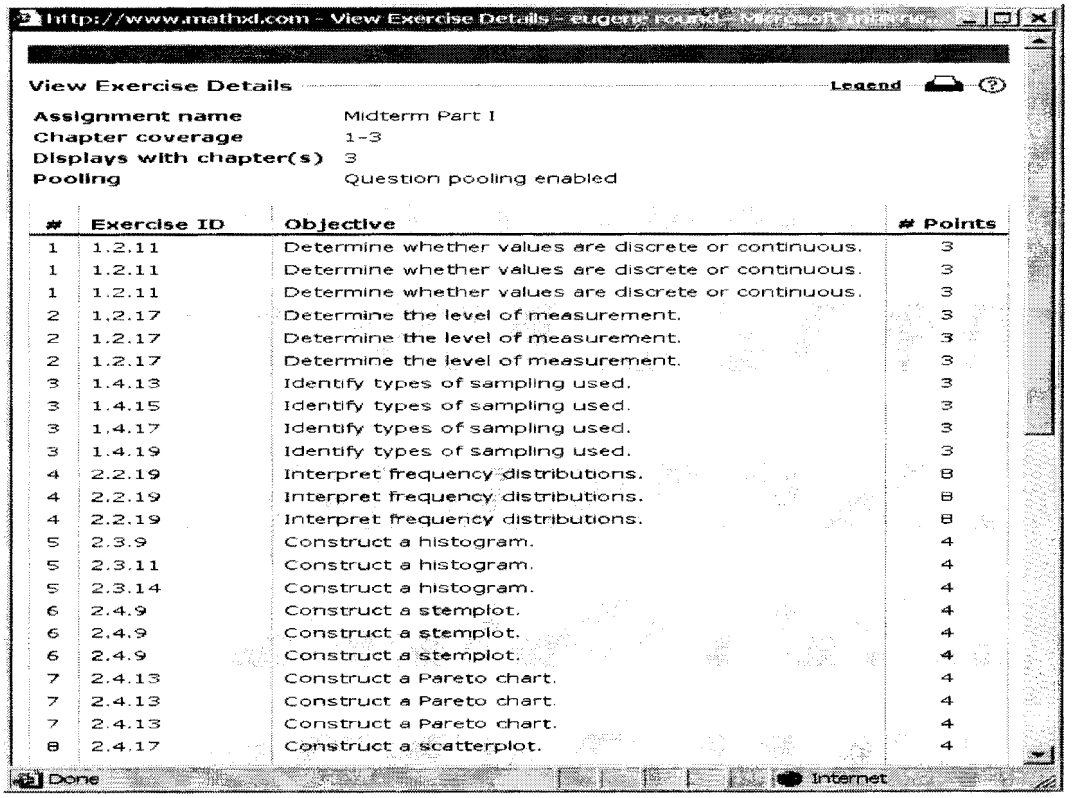
The "Textbook Pages" button takes the student to an online version of the text where he or she can read about solving that type problem. By clicking the "Ask My Instructor" button, the student can send an email to the instructor asking for help. Although not available on this particular problem, another help that is available in some cases is "View a Video" which allows a student to view a video discussing the concepts and solutions steps for the type problem under consideration. When a student completes a homework assignment, it is automatically graded and the score is shown in the MML gradebook.

In MML, students can continue to work on a problem until they get it right. They have the opportunity to try the same type problem multiple times before they have to submit the assignment. Instructors can establish minimum grades that students must achieve before they can move on to the next assignment. Instructors using MML report

that, even though they allow students to move on once they achieve a grade of 80% on an assignment, many student aren't satisfied with that and continue to work on the assignment until they achieve a much higher grade (Speckler, 2007).

Exams and Quizzes

MML also enables instructors to easily set up exams and quizzes for students to take online. The setup procedure is similar to homework assignments in that the instructor is given a set of problems to choose from or he/she can make up problems. See Figure 3. There is a Question Pooling option that allows the instructor to select several problems of the same type or to select the same problem multiple times. When the same problem is selected multiple times, students see different versions of the same type problem. By using the pooling option, different students get different versions of the quiz or exam. Students would take the exam in a manner similar to the homework assignments except that the aids that are available on homework assignments are not available on tests or quizzes. As in homework assignments, quizzes and tests are automatically graded by the MML system and grades are transferred to the gradebook. The instructor can set up the exam options so that students get immediate feedback on their score on the exam and on each individual problem.



View Exercise Details — Legend

Assignment name	Midterm Part I
Chapter coverage	1-3
Displays with chapter(s)	3
Pooling	Question pooling enabled

#	Exercise ID	Objective	# Points
1	1.2.11	Determine whether values are discrete or continuous.	3
1	1.2.11	Determine whether values are discrete or continuous.	3
1	1.2.11	Determine whether values are discrete or continuous.	3
2	1.2.17	Determine the level of measurement.	3
2	1.2.17	Determine the level of measurement.	3
2	1.2.17	Determine the level of measurement.	3
3	1.4.13	Identify types of sampling used.	3
3	1.4.15	Identify types of sampling used.	3
3	1.4.17	Identify types of sampling used.	3
3	1.4.19	Identify types of sampling used.	3
4	2.2.19	Interpret frequency distributions.	8
4	2.2.19	Interpret frequency distributions.	8
4	2.2.19	Interpret frequency distributions.	8
5	2.3.9	Construct a histogram.	4
5	2.3.11	Construct a histogram.	4
5	2.3.14	Construct a histogram.	4
6	2.4.9	Construct a stemplot.	4
6	2.4.9	Construct a stemplot.	4
6	2.4.9	Construct a stemplot.	4
7	2.4.13	Construct a Pareto chart.	4
7	2.4.13	Construct a Pareto chart.	4
7	2.4.13	Construct a Pareto chart.	4
8	2.4.17	Construct a scatterplot.	4

Figure 3: MyMathLab test creation screen. *Note:* Copyright 2008 by Pearson Education. Used by permission.

Problems offered through both the MML Homework and Exams modules are not merely true/false, multiple choice, or short answer. Many have multiple parts and require students to work with data sets. See Figures 4 through 7 for an example of a four-part MML hypothesis test problem.

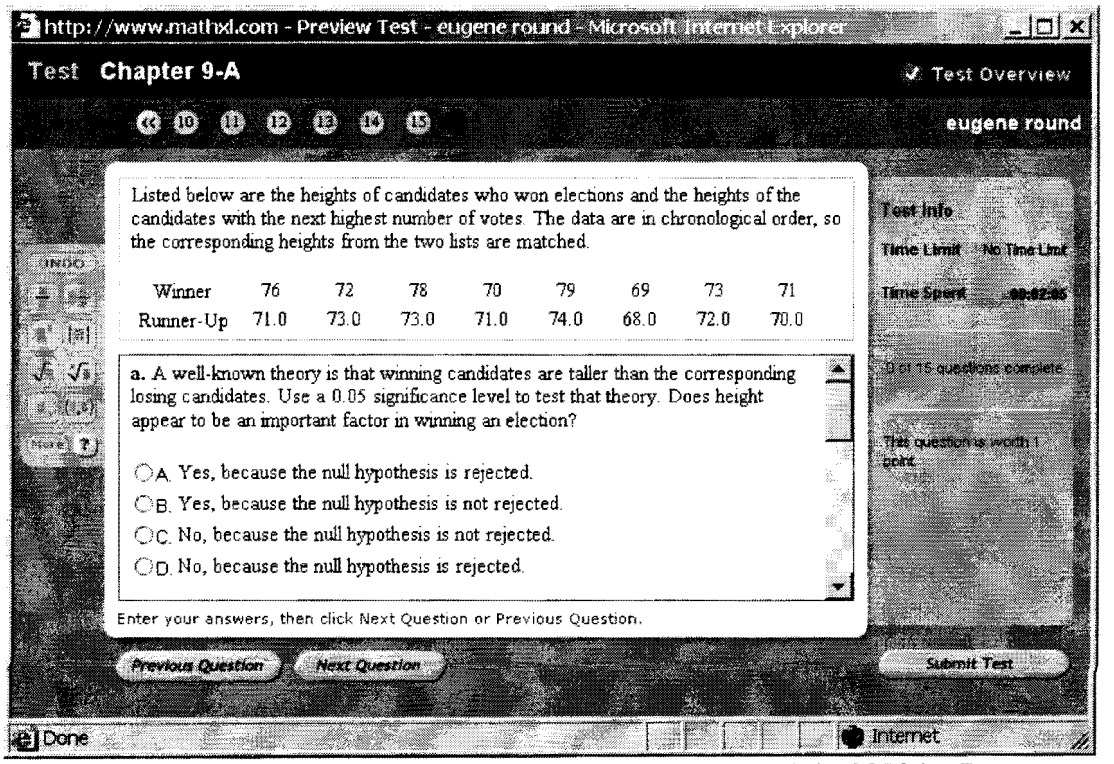


Figure 4: MyMathLab problem example, part a. *Note:* Copyright 2008 by Pearson Education. Used by permission.

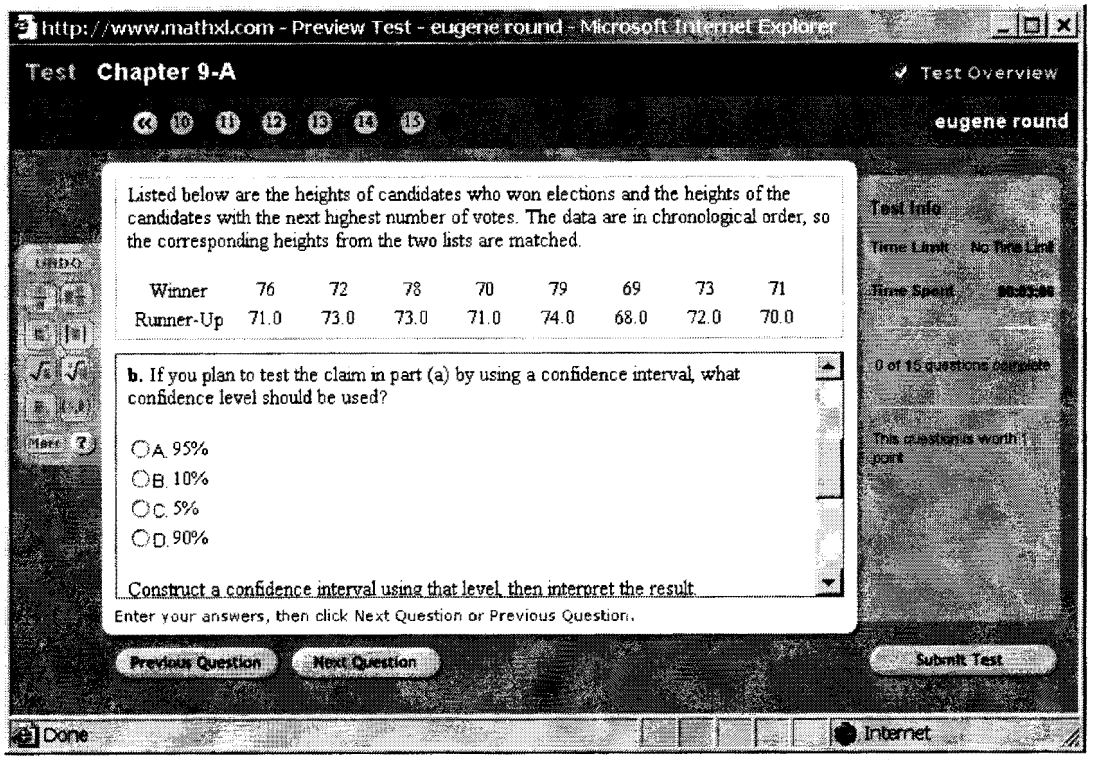


Figure 5: MyMathLab problem example, part b. *Note:* Copyright 2008 by Pearson Education. Used by permission.

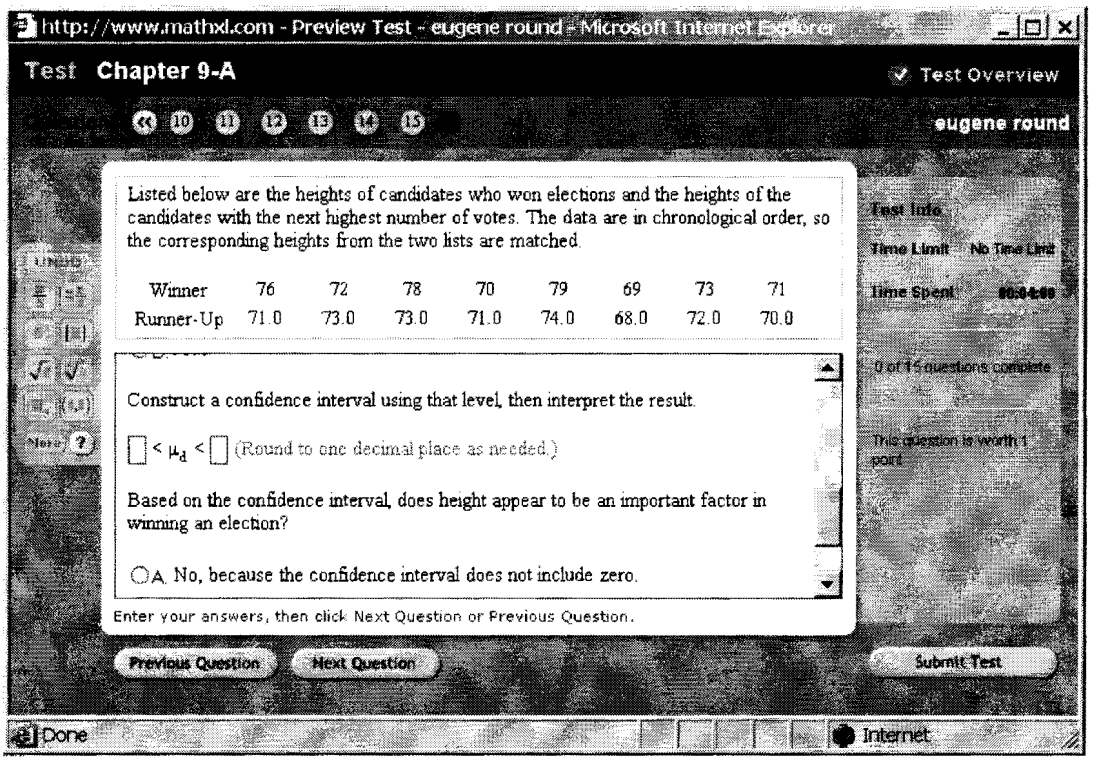


Figure 6: MyMathLab problem example, part c. *Note:* Copyright 2008 by Pearson Education. Used by permission.

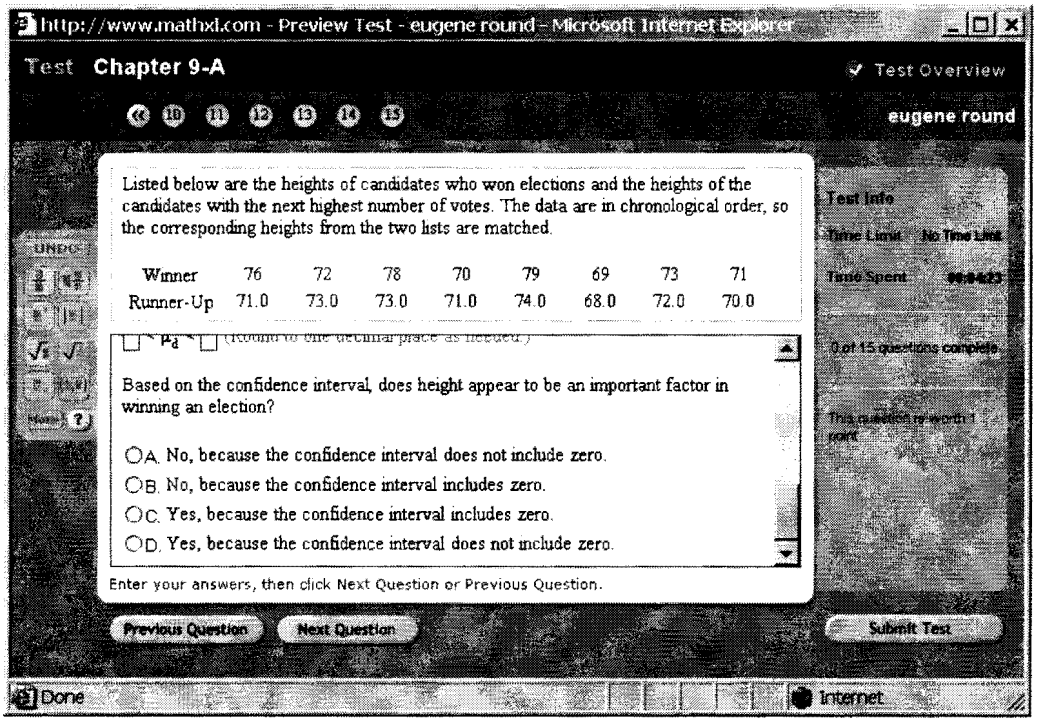


Figure 7: MyMathLab problem example, part d. *Note:* Copyright 2008 by Pearson Education. Used by permission.

Student Study Plan

Another feature of MML tracks student progress as the student works through various homework assignments and quizzes. By doing this, MML can build a study plan tailored to the individual student. By going to his or her study plan, a student will be given additional problems of types he or she has had difficulty with on past homework assignments or quizzes. This feature gives the student the opportunity to work on concepts that are causing problems and gain better understanding of those concepts. Figure 8 shows the Study Plan page in MML.

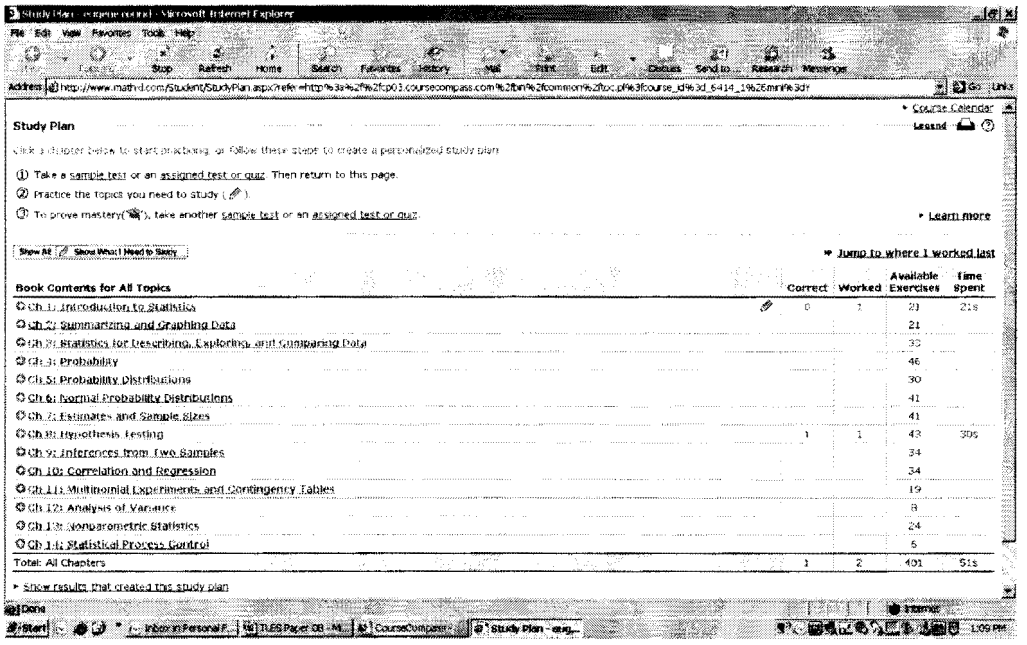


Figure 8: MyMathLab study plan screen. *Note:* Copyright 2008 by Pearson Education. Used by permission.

MML Results

Speckler (2007) summarizes the results that other colleges and universities have had when using MML. The system is used by more than 1600 colleges and universities. In 2006, Pearson Education hired Gatti Evaluation to evaluate MML. The question of

interest was whether students using MML demonstrated higher levels of achievement and better mastery of skills than their peers who were not using MML. The study involved four college systems and 17 instructors. Results of the study showed significantly better achievement in elementary, intermediate, and college algebra for students using MML.

DeVry University studies showed that for students using MML, the percentage receiving A or B grades increased by an average of 57% in introductory algebra, basic algebra, and college algebra. The percentage of students receiving C, D, F, or I grades decreased by 49% and the number of students withdrawing from the courses decreased by 24% (Speckler, 2007). Similar results are reported by Louisiana State University, Gadsden State Community College, Hillsborough Community College, Youngstown State University, and others. Studies from Wayne State University and the University of Alabama showed that MML serves the needs of "our country's most underserved students—those of color, of low income, and of remedial skills, as well as those returning to school" (Speckler, p. 11).

In regard to faculty, Speckler (2007) states, "Faculty also benefit from MML. By transferring the tasks of content delivery, student assessment, and grading to a powerful suite of course management tools, MML enables faculty to spend more time with students doing what they do best—teaching" (p. 2).

MML can also be used as a tool in outcomes assessment. Speckler (2007) gives examples of how this has been done at Florence-Darlington Technical College in South Carolina to set up a Quality Enhancement Plan for the mathematics department to help prepare for a SACS accreditation visit, and at Montgomery College in Conroe, Texas, in setting up what they call the Mathematics Learning Outcomes Assessment Laboratory

program. Items on an exam or homework assignment created in MML can easily be linked to course learning objectives and to program objectives. Student performance on these items can then be tracked and monitored and changes in methods of presenting the concepts can be made when student performance indicates a necessity to do so.

Finally—A Proposal for ERAU Worldwide

Let's go back to the scenario that began this paper. Based on my experience teaching ERAU Worldwide students it isn't unrealistic at all. Suppose we could modify it by requiring the student to be in math class only 2 to 2.5 hours that evening. That would mean the student could be more attentive and gain more from what goes on in class. The student could "make up" the missed 2.5 to 3 hours of class using MML at a time when he or she is fresher and more apt to retain the material that is covered and when time isn't a constraint—perhaps during the day they have off as a result of working four 10-hour days. The student could get home in time to attend to some personal items—like family matters, and not be exhausted at the beginning of the next day. I think this is possible and Speckler (2007) states that it has been done in other schools. One approach would be for the instructor to spend those 2 to 2.5 class hours each week answering student questions and briefly covering new material. Sufficient MML homework assignments, quizzes, and discussion items could be given to make up the missed class time and, in this case, students would have to do the homework. Yes, I did say discussion item in a math or statistics class. Surman and Galligan (as cited in FitzSimons and Godden, 2000) conclude that, "adult students require the opportunity for careful reflection, analysis, and reporting on mathematical knowledge and behaviours in order to develop deep approaches to learning, personal construction of knowledge, and explicit metacognition strategies" (p.

19). Tobias (1993) believes that students talking among themselves about their feeling toward mathematics is key to their overcoming math anxiety. She says:

> It helps some people to know that they are not the only ones to suffer from fears of inadequacy about math or science. Moreover, the process of recollection...can remove old obstacles to learning and provide insight into what is blocking learning now. (p. 241)

Obviously, to use MML, the course would have to use a Pearson Addison-Wesley or Pearson Prentice Hall text that is supported by MML. All but three of 11 ERAU Worldwide mathematics courses already use Pearson texts. The remaining three, College Algebra, Trigonometry, and Decision Mathematics could easily be converted to Pearson texts.

An approach to this process would be to have a lead instructor responsible for each course. That could be the same instructor who develops the course for online delivery. The lead instructor would set up the homework, quizzes, and tests in MML and would respond to questions and concerns from other instructors who are teaching the course. The lead instructor should be compensated for these duties. Other instructors teaching the course would be required to use the assignments and quizzes specified by the lead instructor, but could otherwise run the course as they desire. The ERAU Worldwide Arts and Sciences Department is working toward a goal of developing a packet of instructional materials for each course in the department. These materials would be provided to each instructor teaching the course for their use. Homework assignments, quizzes, and tests developed by a lead instructor using MML could become part of that packet of materials. Having a lead instructor design the homework assignments, quizzes,

and tests has an additional benefit of helping to standardize the material that is covered in specific courses throughout the Worldwide campus.

Back to AABI

Using MML, exams can be untimed and students can take them at home in an unthreatening, more relaxed environment. This can relieve the pressures of time felt by students suffering from math anxiety (Benn, 2000). The MML homework assignments present students with multiple problems of the same type that they can play around with and continue to work until they feel they understand a concept. By presenting multiple problems of the same type, MML allows students to be wrong without penalty—as long as they are willing to continue until they get it right (Benn, 2000; Blair, 2006).

MML gives students time to work problems (Blair, 2006)—time that is usually not available in class. When an instructor gives students a problem to work on in class, he or she is always presented with the dilemma of determining how much valuable class time to give students to work on the problem. Should I wait until the slowest student has finished? But then other students will be bored. I could wait until most have finished, but then the ones who are struggling most with the problem don't get time to finish it. By using MML, a student can work at his or her own pace and have time to respond. Students who understand the concept can move on; those who don't can spend more time on it and work problems until they are comfortable that they understand it.

MML forces students to "do the homework." When I taught high school mathematics, I had a banner across the front of my classroom that said, "Math is not a spectator sport!" Students can't learn math by watching the instructor work problems—they must work them themselves to discover what they don't understand. In the

traditional mathematics class, instructors usually assign homework after every class and expect—or at least hope—that students will do the assigned problems. Sometimes homework assignments are graded, but very often they are not as it can be an overwhelming workload in a large class to grade the number of problems that each student should be working and to provide them constructive feedback. A benefit of MML cited by instructors and students is that it forces students to do homework (Speckler, 2007) and it provides immediate feedback on how they are doing. Some students made comments to the effect that in the past, they never did homework in a math class, but with MML they can't get by without doing it.

Using MML in ERAU Worldwide mathematics and statistics classrooms would help to implement the principle of providing "an exemplary teaching and learning experience," and the vision of "flexible delivery of education, both online and in the classroom, that is convenient to working adults of all ages" (ERAU, 2008, p. 11) as stated by Chancellor Smith. It would also comply with the Innovation, Inquiry, and Technology principles stated by AMATYC (Blair, 2006) . Although ERAU Worldwide is not in a position to provide mathematics tutoring labs and learning centers at each of it's over 130 locations, using MML can provide a similar service to students that is available anytime and anywhere that they have access to a computer and the internet.

> The following are student comments regarding MML cited by Speckler (2007):
>
> This class completely changed my views on math. Before this class I hated math and never wanted to do it. After this course I LOVE math and am considering a math minor. I'm even thinking of being a tutor in the Math TLC next year. I would never have imagined ME teaching and helping others with math. (p. 4)

I really enjoyed using the math site because I was enjoying my homework and actually doing my homework. I was never one to do my homework, but with this I had no choice and it was fun. I also like that it had guided solutions for everything. So if I got stuck I was easily pulled out with the help. (p. 4)

It's Saturday night and I'm...sitting at home, doing math homework. I have to say, math instruction has improved a LOT since 1994. I am deeply impressed with the online service MathXL [MML]. All my homework is on the internet. If I don't understand a problem, the system will walk me through it step-by-step, then give me a new problem (for credit) based on the same principles. One out of every 10 problems comes with a five-minute QuickTime video of a teacher working it out on a blackboard—then you get to try at home. Best of all, you have INSTANT feedback. That's the thing that killed me back in the day. There were plenty of times I thought I understood the principles. When I got my homework back two weeks later, I was genuinely surprised to see I'd failed miserably. The teacher had already moved on to new material by the time we had feedback on the old stuff, so if you misunderstood one of the building blocks, you were out of luck. With this, if the walk-through and book and videos aren't enough to explain the homework, you know EXACTLY what to ask the teacher in class. Instead of coasting through for the sake of a grade, I'm actually learning some math for the first time in my life. Wow. I can't believe how optimistic I feel about a subject that has repeatedly kicked me in the [expletive deleted]. This is awesome. (p. 9)

Is it possible for students to actually enjoy math? Can we really expect an ERAU Worldwide student who has struggled with math in the past to "love" the subject?

Perhaps not, but I think we can provide them with a tool that will help diminish their fear of the subject, encourage them to take required math and statistics earlier in their academic careers, and thus allow them to use what they have learned in later courses.

As stated early in this paper, the Aviation Accreditation Board International states that, "Aviation programs MUST demonstrate that graduates have an ability to apply knowledge of mathematics..." (AABI, 2007, p. 6). I believe that the approach to teaching mathematics and statistics using MML as outlined above will enable us to demonstrate that we have achieved this objective—something that would be extremely difficult using our current approach to teaching these subjects.

References

Aviation Accreditation Board International (AABI). (2007, July). *Accreditation criteria manual: Form 201.* Auburn, AL: Author.

Benn, R. (2000). Mathematics: Certainty in an uncertain world. In D. Coben, J. O'Donoghue, G.E. FitzSimons (Eds.), *Perspectives on adults learning mathematics* (pp. 101-107). Hingham, MA: Kluwer Academic Publishers.

Blair, R. (Ed.). (2006). *Beyond crossroads: Implementing mathematics standards in the first two years of college.* Memphis, TN: American Mathematical Association of Two-Year Colleges (AMATYC).

Burns, M.(1998). *Math: Facing an American phobia.* Sausalito, CA: Math Solutions Publications.

Embry-Riddle Aeronautical University (ERAU). (2008). *2008-2010 Worldwide catalog.* Daytona Beach, FL: Author.

FitzSimons, G.E, & Goden, G.L.. (2000). Review of research on adults learning mathematics. In D. Coben, J. O'Donoghue, G.E. FitzSimons (Eds.), *Perspectives on adults learning mathematics* (pp. 13-45). Hingham, MA: Kluwer Academic Publishers.

O'Donoghue, J. (2000a). Section II: Adults, mathematics, culture, and society: Introduction. In D. Coben, J. O'Donoghue, G.E. FitzSimons (Eds.), *Perspectives on adults learning mathematics* (pp. 101-107). Hingham, MA: Kluwer Academic Publishers.

O'Donoghue, J. (2000b). Section IV: Perspectives in teaching adults mathematics: Introduction. In D. Coben, J. O'Donoghue, G.E. FitzSimons (Eds.), *Perspectives*

on adults learning mathematics (pp. 229-234). Hingham, MA: Kluwer Academic Publishers.

Triola, M.F. (2007). *Elementary statistics* (10th ed.). Boston: Pearson Addison-Wesley.

Speckler, M.D. (2007). *Making the grade, version 2.0: A report on the success of MyMathLab in higher education math instruction* [Brochure]. Boston, MA: Pearson Education.

Tobias, S. (1993) *Overcoming math anxiety.* New York: W.H. Norton & Company