

A VARIETY OF OPTIONS CAN HELP STUDENTS SUCCEED IN MATH

*Susan Beane
University of Houston-Downtown
One Main Street, Houston, Texas 77002
beanes@uhd.edu*

A variety of options are sometimes offered to students in algebra to help increase the likelihood of course success, such as practice tests, correction of tests, test answer keys, and make-up tests. This comparative research study examines how some slight variations on these options, when used in combination with each other, can have a favorable impact on the overall rate of success for students in mathematics. The research addresses questions such as “Which is better an individual or a group practice test?” and “When/How should a student correct a test to gain optimal remediation?” while asking questions such as “How can a course address more learning styles?” and “How can a course be more individually rewarding?” A resulting comparison was then completed using both course outcome statistics and student comment/feedback over several years as a way to validate the success of the study.

The “slight variations” stemmed from the underlying force in all course structures: The different ways teachers teach and students learn are both fundamentally based on an individual’s learning style and intelligence type. We tend to teach the way we ourselves learn, which is most likely rooted in our own unique learning style--visual utilization of content, auditory discussion of methods, and/or kinesthetic performing of actions. As a result, many different teaching styles and models that have been developed during the last several decades by many different individuals; each presents the course material to the individual learner differently, each utilizes a different teaching style, and each addresses a different learning style. Using a variety of models with some slight variations, these existing “standard” teaching options were integrated and utilized to broaden the teaching styles presented in each class which resulted in a greater variety of student learning styles being satisfied and thus an increased number of student successes.

This research utilized and incorporated ideas congruent with current research trends on the use of online MyMathLab course component, compiled by Michelle D. Specker, entitled “Making the Grade, V.4, and group theory based learning concepts by Larry K. Michaelsen and Michael Sweet presented in a chapter entitled “The Essential Elements of Team-Based Learning” from the online periodical NEW DIRECTIONS FOR TEACHING AND LEARNING. The essence of this research, the need for variations in teaching structure as well as the informational aspects of the various teaching models, is also supported by current research and nicely summarized by Dr. Selina Vázquez Mireles during a presentation entitled “Teach the Way You Were Taught to Teach” in the quote, “You each possess your own teaching style, but you may have to go out of that style to capture each individual learner.” This presentation also provided the basic concepts used to summarize some of these most recent teaching models and basic learning styles.

The historical concepts as well as their results from these various sources are therefore summarized before the research models and data are presented. Research results from the addition of online MyMathLab assignments, quizzes and testing platforms has shown that the component encouraged students to practice math skills until mastery. Students have earned consistently high homework scores, final exam scores, and final course grades as a result. Student comments also contribute their success in class because of more meaningful practice, the step-by-step examples and multitude of help resources, and instant feedback. These results are additionally supported by these future student’s success by research results conducted by the University of Houston-Downtown which reported the average ABC rate of 78.2 percent, an average mean homework score of 85.5, an average mean final exam score of 73.5, and an average mean course grade of 71.2 in a Fundamentals of Calculus with Applications course at the University of Houston-Downtown. Additionally, the research indicated that utilizing MyMathLab increased pass rates, completion rates, and retention rates. Research results from the Pathways to Algebra report “consistently shows that students who use the MSC [tutoring lab] on a regular basis are more likely to be successful” but that students in lower level math classes were less likely to utilize the tutoring center. The report showed that students who utilized the tutoring center had a mean passing rate of 65.4 percent, whereas students who did not utilized the tutoring center succeeded at a significantly lower rate of 40.5 percent. Research results shown by in the Essential Elements of Team-Based Learning (TBL) study show that “compared to a traditional curriculum, faculty members in a wide variety of contexts have observed that introducing TBL enables at-risk students to successfully complete and stay on track in their course work, probably because of the increased social support or peer tutoring.” The TBL model’s key to creating effective group assignments is a combination of individual work, then small group discussion, and completed by a total class discuss on assignments that are significant to capture students’ interest, involve repetition of the same problem throughout, discussions focusing on individuals and groups being required to make a specific choice, and simultaneous reporting of group results. To complete the historical basis for the research model, a quick overview in table form is given for various teaching models (Table 1), as well as some of the common divisions in intelligence types as they would relate to college and career characteristics (Table 2).

Instructional Method	Teaching Model	Instructional Method	Teaching Model
Direct	Teacher Active – Lecturer	Indirect	Teacher - Facilitator, Resource
Discovery	Student Engaged- Scientific Method of Experimentation	Inquiry	Student Investigates -Techniques & Understanding
Constructivist Approach	Student-Individual Learner	Instructivist Approach	Teacher-Centered Deliveries
Explicit Instruction	Teacher-Visible Delivery, Instructional Design Principle	Implicit Instruction	Teacher-Guidance Using Examples & Illustrations
Problem-Centered Instruction	Focus on Understanding vs. Result	Answer Centered Instruction	Focus on Obtaining Final Outcomes
Open-Ended Approach	Problems Posed with Multiple Possible Outcomes	Concrete-Representational	Instructional Progresses from Concrete to Abstract
Moore (Texas) Method	Teacher-Basic Theme, Student-Develops Theorem	Algorithmic Instructional Method	Teacher-Addressed Problem Solving Skills
Problem-Based Learning	Teacher-Problem Stated, Student-Develop Method	Socratic Method	
Concept Attainment		Group Work	
Cooperative Learning		Collaborative Learning	

Instructional Methods - Table 1

Type of Intelligence	Ability	Characteristics	Common Career
Logical-Mathematical	Apply logic to systems and numbers	Problem solvers, enjoy discovery, organizers	Engineers, Scientist, Mathematicians, Economists
Bodily-Kinesthetic	Possess fine motor skills, Learn by doing	Want “do” activity, enjoy sports, builders	Athletes, doctors, soldiers, dancers, actors, therapists
Visual-Spatial	Think in pictures, Re-create without physical stimuli	Draw images, grasp geometry over algebra, charts/pictures more effective, notice details	Architects, designers, artists, sculptors
Interpersonal	Empathize with people, engage in deep conversations	Extroverts, sociable, good listeners and encouragers	Politicians, teachers, managers, salespeople, social workers
Intrapersonal	Understand yourself, deep thought, breakdown complicated ideas	Introverts, strong sense of independence, self-confident, perfectionist, self-critical, Daydream	Philosophers, writers, scientists
Musical	Use and understand music, can sing, play instrument	Have music playing in background, remember old songs, use music and rhythms to memorize information	Musicians, composers, singers
Verbal-Linguistic	Easily learn languages, good readers and writers, debate and explain concepts well	Write well, funny, enjoy arguments, possess good vocabulary	Writers, journalists, politicians, poets, teachers, philosophers

Intelligence Types - Table 2

The study found that the class dynamics are already present; to increase success we only need to utilize the multiple “platforms” available to reach and satisfy the individual learner. However, the key lies in the ability to offer the right method of engagement at the right time...adapting “slight variations” and “various combinations” of instructional methods using the pre-existing wealth of learning styles and knowledge that our students possess. The research gathered in this study therefore focused on three key areas to meet the variety of needs while utilizing some common educational resources. The main components addressed by the research, along with the method utilized and/or additional benefit(s) are summarized as follows:

- Increase the “teaching methods” in our class by utilizing groups and peer-tutoring.
 - Our class already possess a great variety of teaching styles...our students.
 - Allows time for individualized instruction, when necessary
- Utilize current technology.
 - Publisher provided online programs like MyMathLab to improve mastery and provide immediate feedback.
 - University provided platforms like Blackboard Vista to provide virtual office hours, discussion boards, and chat rooms.
- Utilize math help labs on-campus.
 - Tutors can offer additional methods to focus on specific student needs.
 - Receive one-on-one instruction for correction of assignments and tests.

Teaching methods were increased by group activities which progressed from concept discussion to also include concept recall with group work in this research initially consisting of a group discussion in the form of a group bonus-point test and short quizzes called buddy checks and progressing to included concept recall activities such as concept overviews, chapter reviews, practice tests, and instant feedback answer forms during the group bonus test. Online technology usage changed from initial mastery-based platform utilization to include discussion platforms and class-based help chat rooms with technology initially consisting of a basic pre-algebra review program followed in subsequent years to the use of MyMathLab with emphasis placed on current section/lecture homework mastery, and progressing to also include practice tests and eventually quizzes. Also, as research progressed, an additional platform, “Blackboard Vista”, was added as a requirement providing a common chat room for all courses with a hosting calendar, discussion board, and virtual office hours. Utilization of the university’s math tutoring lab was increased along with lab visitation changing from optional to that of required for some students. This research initially consisted utilizing the math tutoring lab as an “optional” help center. Students were taken to the lab for an “initial” visit, and then encouraged to utilize the benefits of the lab when help was needed to insure success. As research progressed students were required to visit the lab to make test corrections when performing below the class average, and those falling below 50% were given the option to complete a remediation assignment followed by a makeup test in the lab.

The results are divided into several data components which display the mean data as each new component of variety is added into the existing course structure spanning overall several years of Fall semesters. The initial data set shows the difference between courses taught prior to incorporation of MyMathLab into the course (Table 3) and after the initial requirement of MyMathLab was integrated into the course by the use of online homework assignments for each section covered in the course (Table 4). The data shows a significant increase in overall student success and a slight increase in student retention.

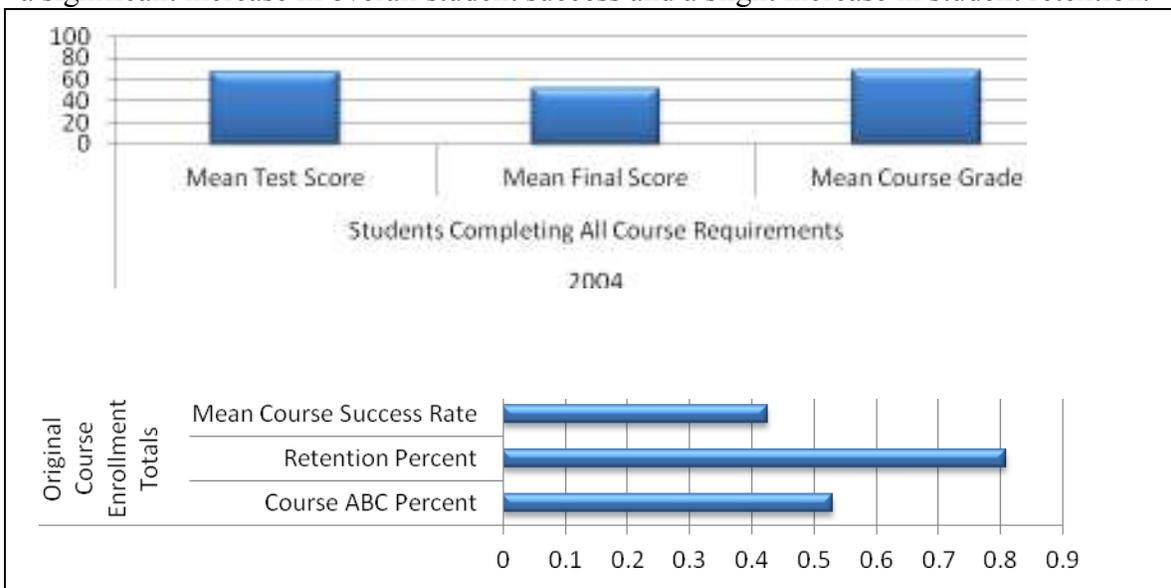


Table 3

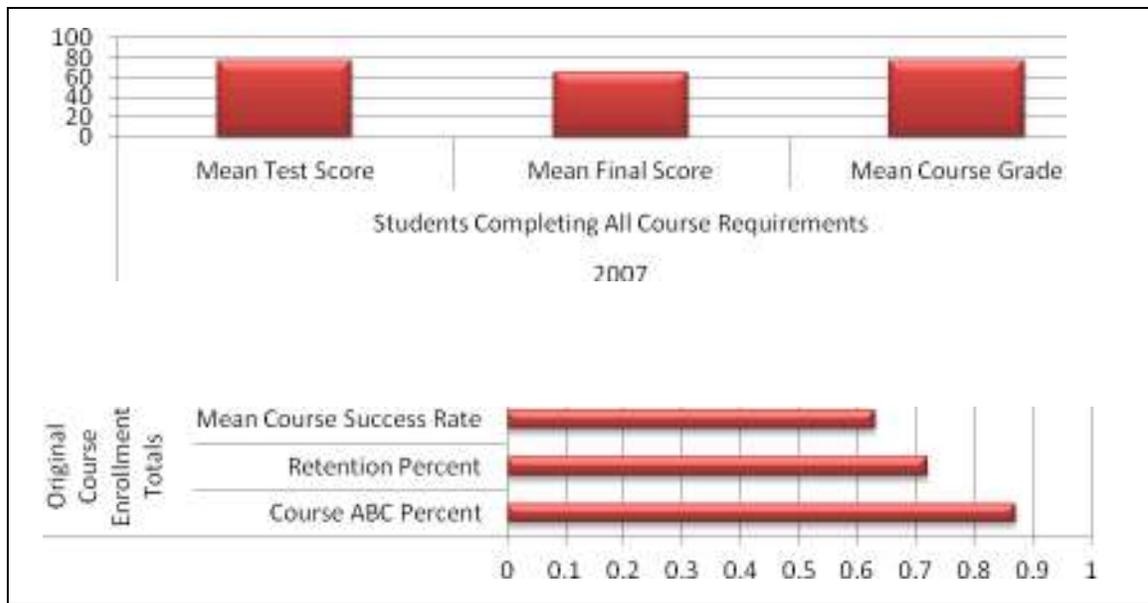


Table 4

The next component added into the research data pool was the addition of group work in the form of in-class exercises in addition to the MyMathLab course component. The result for this semester is shown in Table 5.

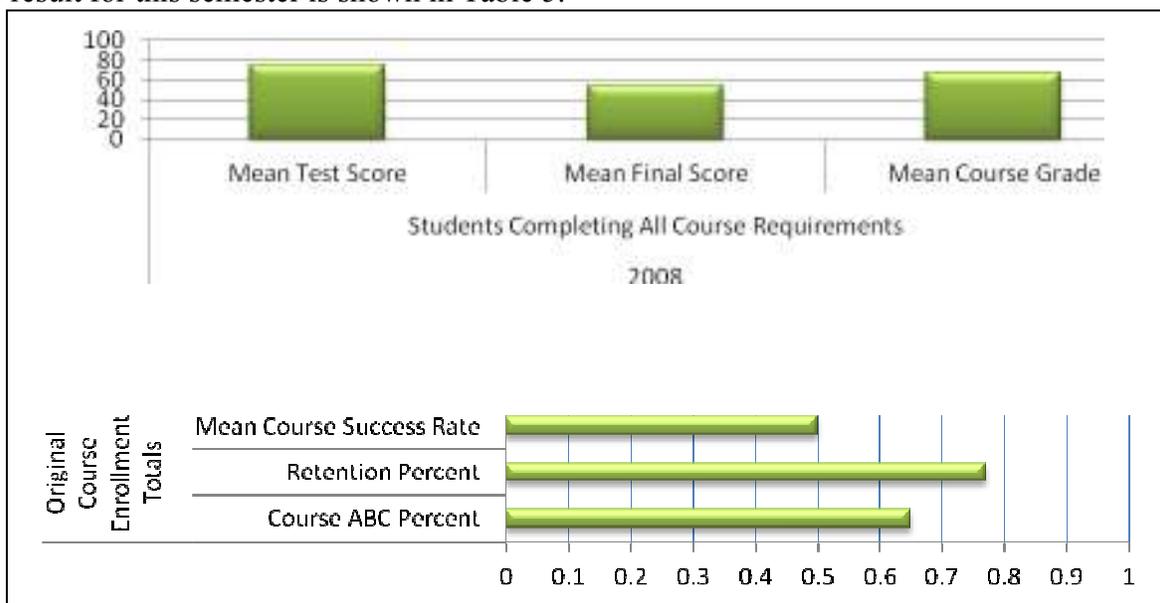


Table 5

This data is then followed data as a steady increase in the nature and activities of group work assigned in and out of class increased (Table 6). Although it should be noted that students did not perceive out-of-class group activities well and as a result subsequent variations of the group assignments did not have an out-of-class component.

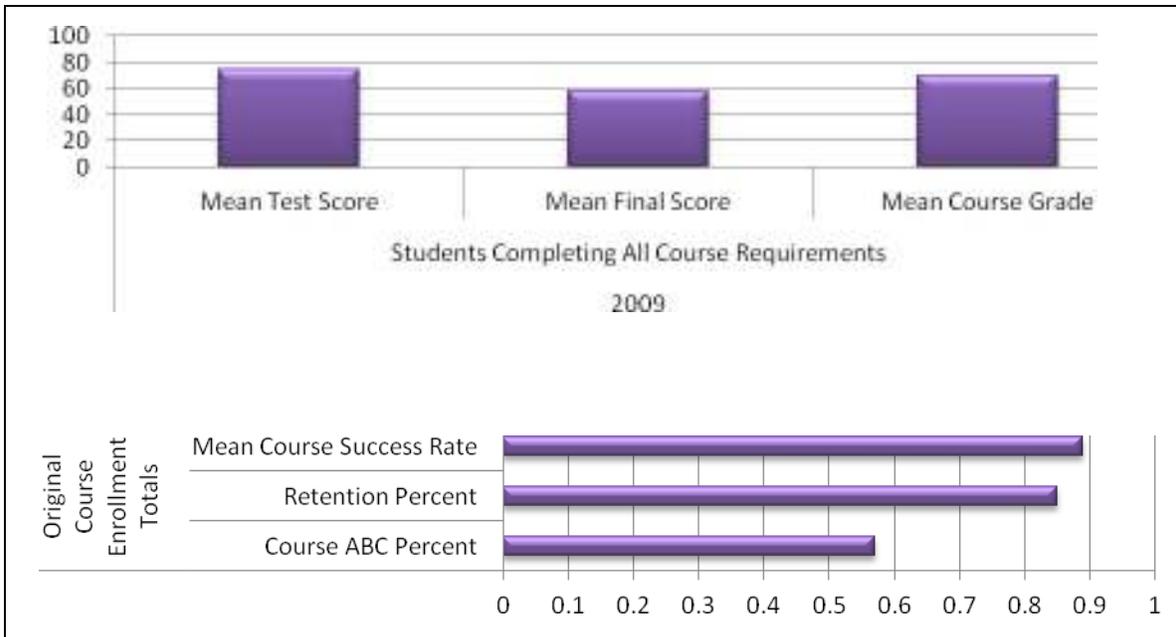


Table 6

Further variations in the group assignment involved continued group exercises, in-class group practice tests, but omitted the group correction of both the individual and the group test. Additions to the group activities involved exercises with a competitive edge, group exercises pacing, and permanent, test-score-based group construction with the last addition being the result of student feedback. The final results are shown in Table 7.

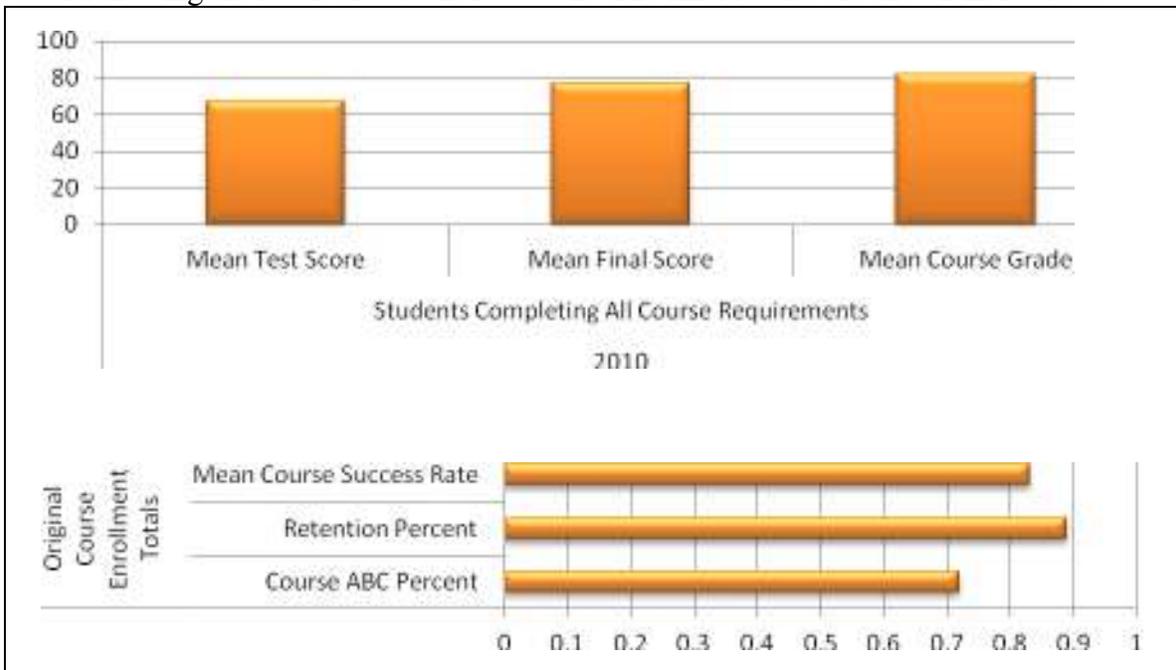


Table 7

The research involving data collection which spanned several years indicates that students gain more information from specific aspects of an assignment when they feel that they are part of the assignment, the assignment is understandable, and successfully completion of the assignment gives an immediate sense of reward. The variety of teaching styles and methods of engagement met the needs of a greater variety of intelligence types and therefore learning styles, while the required lab visitations and online discussion and chat rooms met the variety of social needs resulting in an increased retention rate while the overall percentage of student success increased. The overall results indicate that by making a few adjustments to existing options, students are both more satisfied and successful in the course. The results of a study survey shown below in Table 8 indicated that students also found the last initiative of group tests with the instant feedback answer forms and the individual correction of tests very helpful.

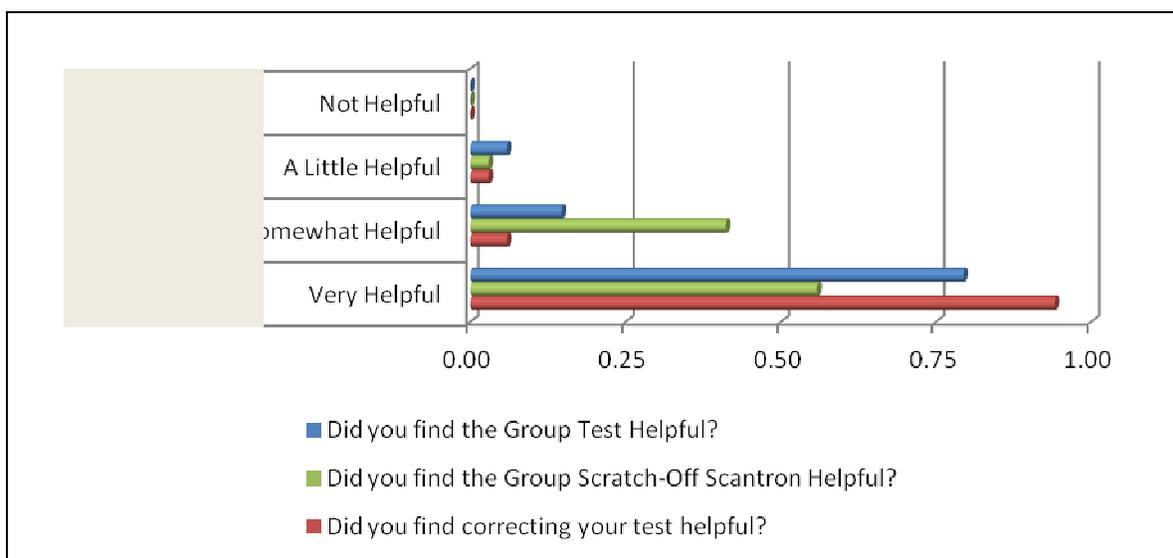


Table 8

The research showed that course success was linked directly to our students' ability to gain knowledge and recall that knowledge based on various teaching methods which was influenced by different learning styles and intelligence types. Without offering variety in our classes, success therefore lies in the percent of students who possess similar learning styles as us. To increase success, we need to bring in a richer variety of teaching methods in order to reach other learning styles. Each additional teaching method we can utilize, therefore, will satisfy an additional group of students within the class increasing overall rates of success.

The next table (Table 9) summarizes how each method was optimally utilized during the last semester year, as shown in Table 7 above, to obtain maximum success. Each component of the class structure is linked to the teaching model(s), learning style(s), and intelligence type(s).

Course Structure	Teaching Method	Teaching Model	Learning Style	Intelligence Type
First Day – Intro	PowerPoint Presentation	Explicit Instruction	Visual/Auditory	Visual-Spatial
Success Skills	Mapping-Study Sequence	Alog.Instru.Method	Visual	Intrapersonal
Initial "Buddies"	Student Handout	Open-Ended Appr.	Kinesthetic/Auditory	Interpersonal
Daily Lectures				
Concept Lecture	Board Presentation	Direct/Concept	Visual/Auditory	Visual-Spatial
	Body Motion Modeling	Implicit	Kinesthetic	Bodily-Kines.
	Multiple Colors	Inquiry	Visual	Visual/Music.
	Arrows, Boxes, & Diagrams	Concrete	Visual/Kinesthetic	Logical-Math.
	Verbal Class Response	Socratic/Discovery	Auditory	Ver.-Linguist.
	Individual 'U Try'	Construct./Implicit	Kinesthetic/Visual	Intrapersonal
Group Activity	Compare Individual 'U Try'	Collabor./Discovery	Auditory/Kinesthetic	Interpersonal
	Book Exercise or Handout	Coop./Indirect	All Types	All
Testing				
Individual	Pre: Online Practice Test	Answer Centered	Visual/Kinesthetic	Bodily-Kines.
	2/3 rd Time on Actual Test	Problem-Centered		Logical-Math.
Group	Pre: Class Practice Test	Group Work	Auditory/Kinesthetic	Interpersonal
	1/3 rd Time Bonus Pts. Test	Collaborative		Ver.-Linguist.
Return of Tests	Individual Test Returned	Implicit	Visual	Logical-Math
	Group Test Inspection Only	Inquiry		Interpersonal
	Test Statistics Released	Indirect		Intrapersonal
Individual Tasks				
Lab Visitation	Individual Test Corrections	Multiple Available	All	All
	Office Hours	Indirect		Logical-Math
	Group/Buddy Meetings	Collaborative		Interpersonal
Online Program	MyMathLab Homework	Answer-Centered		Intrapersonal
	MyMathLab Quizzes	Problem-Centered		Intrapersonal
	MyMathLab Practice Tests	Concept Attain.		Intrapersonal
Math Chat	Blackboard Vista	Moore Method		Interpersonal
	Service Learning Hosting	Inquiry		Ver.-Linguist.
	Virtual Office Chat Hours			Intrapersonal
Discussion Board	Blackboard Vista	Open-Ended Appr.		Ver.-Linguist.

Table 8

In summary, the essential elements of the course consisted of primarily class engagement which offered each student a choice that provided an individual challenge encouraged by peer competition. The class engagement opened communications as a result of student collaboration and connection as evidenced by the overall group commotion as a method of correctness with interjected instructor clarification. The variety of teaching methods was a secondary element which captivates the creativity of a group, and utilized current technological elements that encouraged positive interdependence, individual accountability, personal responsibility, and one-to-one interaction while enabling the individual student the freedom, collaboration, speed, integrity, and support that each individual learner desired. Therefore, overall, students were motivated personally, socially, and structurally to be successful.

The positive outcome which resulted from this research can be summarized nicely by quote from Michaelsen and Sweet, "When the instructor adopts the view that the education process is about learning, not about teaching, instructors and students tend to become true partners in the education process."

Bibliography

Selina Vázquez Mireles, “Teach the Way You Were Taught to Teach” presentation on January 28, 2011 at the Strategies for Helping Underprepared Learners Achieve College & Career Readiness in Mathematics in Austin, Texas.

Mario Seiglie, “Seven Types of Intelligence”, Vertical Thought, January-March 2010.

Michelle D. Specker, “Making the Grade”, V.4, Summer 2010, “Pathways Through Algebra,” a California statewide community college faculty-based initiative, published by the National Science Foundation in 2009

Michael Sweet and Larry Michaelsen, “The Essential Elements of Team-Based Learning,” chapter of New Directions for Teaching and Learning, no. 116, Winter 2008, Wiley Periodicals, Inc., published online in Wiley InterScience (www.interscience.wiley.com).