

# MTH 100 SLOAT ASSESSMENT STUDY REPORT (Fall 2010)

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## I. Introduction:

A comprehensive assessment study on MTH 100 at Essex County College was conducted in fall 2010 as part of SLOAT (Student Learning Outcomes Assessment Team.) The principal coordinators for this study were two full-time faculty members of the Math and Physics Division (MAP): Carlos Castillo, Instructor of Mathematics, and Soraida Romero, Professor of Mathematics; another important contributor to this study was Alvin Williams, Associate Professor of Mathematics, who did all the statistical analysis for the study.

### a. Purpose:

The purpose of this study was two-fold. First, the study attempted to determine whether MTH 100 students are indeed learning all four (4) Course Goals (CGs) that were established by the Math Department for this course. Under each CG, there are also specific Measurable Performance Objectives (MPOs) that students are expected to attain; these CGs also assess specific General Education Goals (GEGs) established by the College. The list of these CGs for MTH 100 and the MPOs contained in each with the relevant CGs in parenthesis for each are listed below:

- CG #1: Demonstrate knowledge of the fundamental concepts and theories from algebra and geometry, (GEG 2)

- (1.1) *Solve linear equations*
- (1.2) *Solve literal equations*
- (1.3) *Solve rational equations*
- (1.4) *Solve radical equations*
- (1.5) *Solve quadratic equations*
- (1.6) *Solve linear inequalities*
- (1.7) *Solve systems of equations*
- (1.8) *Factor polynomials*
- (1.9) *Simplify exponential expressions*
- (1.10) *Perform basic operations on polynomials*
- (1.11) *Perform basic operations on rational expressions*
- (1.12) *Perform basic operations on radical expressions*
- (1.13) *Perform basic operations on complex numbers*
- (1.14) *Find the equation of a line based on given geometric properties*
- (1.15) *Graph a line in the Rectangular Coordinate System*
- (1.16) *Graph a parabola in the Rectangular Coordinate System*
- (1.17) *Graph a circle in the Rectangular Coordinate System*
- (1.18) *Determine whether a given relation is a function, find its domain, and use function notation*

- CG #2: Utilize various problem-solving and critical-thinking techniques together with algebra to set up and solve application problems taken from a variety of disciplines, (GEG 2)

(2.1) *Apply algebraic methods to solve varied real-world applications (such as, consecutive integer problems, coin/stamp problems, distance problems, investment problems, area problems, and work problems) that can be modeled by a linear equation, quadratic equation, rational equation or system of equations.*

- CG #3: Communicate accurate mathematical terminology and notation in written and/or oral form in order to explain strategies to solve problems as well as to interpret found solutions.(GEG 1)

(3.1) *Write and explain solutions to application problems related to the course material using appropriate mathematical terminology and notation.*

- CG #4: Use calculators effectively as a tool to solve such problems as those described above, (GEG 2)

(4.1) *Use a calculator to perform basic arithmetic operations, evaluate powers and find the square root of a number.*

The second purpose of this study was to ascertain what factors or variables impede some students from performing well in mathematics. Some of the variables to be investigated in this study include student's prior math background, study habits, placement, attendance, going to tutoring, participation with on-line homework package, etc.

## II. Methodology:

### a. Population sample used -

Based on information gathered from Linda Suskie's book on *Assessing Student Learning: a common sense guide*, 2<sup>nd</sup> edition, we decided to use 10 sections of MTH 100 for our study to ensure a 5% margin of error. While the study started with 405 students, the sample population was reduced to 314 since 91/405 or 22% of the students were voided out of their MTH 100 class and got no grade by the end of the semester. Using representative random sampling, the following ten sections and instructors of MTH 100 were selected to participate in this study conducted in fall 2010.

Day Sections in the Main Campus:

MTH 100-002 TRF 10-11:20 (adjunct instructor Jayson Swanson)  
 MTH 100-004 TRF 10-11:20 (adjunct instructor Douglas Platt)  
 MTH 100-005 TRF 1-2:20 (full-time instructor Soraida Romero)

MTH 100-007 TRF 1-2:20 (adjunct instructor Alex Taran)  
MTH 100-013 TRF 11:30-12:50 (full-time instructor Ron Bannon)  
MTH 100-016 TRF 7-8:20 AM (full-time instructor Soraida Romero)

Evening Sections in the Main Campus:

MTH 100-OEC MW 7:25-9:10 (adjunct instructor Jose Iglesias)  
MTH 100-OGC MW 5:15-7 (adjunct instructor Mathew Cherian)

Day Section in the West Essex Campus:

MTH 100-CW2 MWF 11:30-12:50 (full-time instructor Shohreh Andresky)

Evening Section in the West Essex Campus:

MTH 100-CWC MW 5:35-7:20 (full-time instructor Shohreh Andresky)

b. Instrumentation –

There were three different methods used to gather data for this study. These were as follows:

- i. Multiple-choice questions blue-printed with MPOs
- ii. A Student Questionnaire
- iii. Data obtained from IT

i. Multiple-choice questions blue-printed with MPOs-

As a means of determining whether students taking MTH 100 are meeting the Measureable Performance Objectives (MPOs) for this course, Professors Castillo and Romero decided to include eight multiple-choice questions blue-printed to the MPOs in each of the 4 Departmental exams for MTH 100 given out during the fall 2010 semester. Scan Tron sheets prepared by Prof. Williams (including Student Name, Student ID and a section to place the answer for each of the 8 multiple-choice questions) were included in each exam packet to facilitate the easy grading of these multiple-choice questions. The time-line for administrating these 4 tests was: Test #1, late September; Test #2 (Midterm), late October; Test #3 (Midterm), late November; and Test #4 (Final), late December. After each exam period was over, the instructor returned the completed Scan Tron sheets to Prof. Castillo who first verified that each sheet had a student name and ID number, after which he submitted all these Scan Tron sheets to Prof. Williams for statistical analysis. See Appendix A for a listing of the multiple-choice questions used in each test and the corresponding MPO associated with each of these questions.

ii. A Student Questionnaire –

In order to ascertain what factors impede student progress, the two course coordinators along with Alvin Williams designed a student questionnaire consisting of twenty-four multiple-choice questions. These questions were formed to investigate students' prior math background, study habits, class attendance, tutoring attendance, on-line homework package participation, etc. The questionnaires were packaged together with a Disclosure Statement, prepared by Prof. Romero, which informed the students that their responses would be kept confidential and used only for the purposes of this SLOAT study. Since it was felt that some students may not feel comfortable answering the questions truthfully if their instructor administered the questionnaire, other full-time professors were asked to come to the 10 classes, ask the instructor to leave, give each student a copy of the Disclosure Statement as well as read it to them, then administer the surveys; the professors who assisted were Professors Andresky, Castillo, DeLaTorre, Gauden, Romero, and Rozak. The completed questionnaires were then gathered by Professor Castillo and submitted to Prof. Williams for statistical analysis. See Appendix B for a copy of the student questionnaire.

iii. Data Obtained from IT -

Student attendance, instructor, class location and time, prerequisite completion, and others variables may have an influence on a student's final grade. To determine whether there is a significant correlation between factors such as these and a student's final grade, a spreadsheet containing student information was required. In late September, Prof. Romero requested the following data from the Office of Information Technology (IT) for all 314 students participating in this study: name, ID number, MTH 100 section, Placement Test scores, and all math courses taken at ECC up to the MTH 100 class being taken in fall 2010 including the grades earned in each and the semester when taken. The requested data was first received in early October, and then re-submitted in early November when it was noted that some information was missing. Throughout the month of November, Prof. Romero organized the data and created an Excel spreadsheet that was used for further analysis of the data. In late December, each instructor who participated in this study submitted a complete list of all their students, their ID numbers, their final grade for the course, number of absences in the class, and indicated if the student participated in on-line homework for the course. This data was returned to Prof. Romero who then added it to the student spreadsheet that had been prepared earlier. This completed spreadsheet was subsequently submitted to Prof. Williams to determine any significant correlations. See Appendix C for a copy of the spreadsheet prepared by Prof. Romero and used for this part of the study.

### III. Results obtained from the three different methods used to gather data for this study:

#### (a) Results from multiple-choice questions blue-printed with MPOs -

Out of the original 314 students chosen to participate in this MTH 100 study, 300, 294, 207, and 206 students took test 1, the midterm, test 2, and the final exam, respectively. Each test or exam consisted of 22 or 23 questions including 8 multiple-choice questions used to examine for the acquisition of 8 MPOs, not all necessarily distinct. At the end of the fall 2010 semester, all 21 MPOs were eventually tested. Each MPO, the question(s) used to determine its acquisition, the average percentage score of students who met the particular MPO, and the number of students who answered the question(s) relating to it are listed in the table found in Appendix A. It was found that of the 21 MPOs that were tested, 15 out of the 21 MPOs (71.4%) were met with students scoring an average of 70 percent or more. An average score of 70 percent or higher on a given MPO is considered a success.

The MPOs that were acquired include:

- 1.1 *Solve linear equations*
- 1.2 *Solve literal equations*
- 1.3 *Solve rational equations*
- 1.4 *Solve radical equations*
- 1.6 *Solve linear inequalities*
- 1.8 *Factor polynomials*
- 1.9 *Simplify exponential expressions*
- 1.10 *Perform basic operations on polynomials*
- 1.11 *Perform basic operations on rational expressions*
- 1.13 *Perform basic operations on complex numbers*
- 1.14 *Find the equation of a line based on given geometric properties*
- 1.15 *Graph a line in the Rectangular Coordinate System*
- 1.16 *Graph a parabola in the Rectangular Coordinate System*
- 1.17 *Graph a circle in the Rectangular Coordinate System*
- 1.18 *Determine whether a given relation is a function, find its domain, and use function notation*

There were 6 out of the 21 MPOs (28.6 %) that failed to be acquired in the study. These are listed below with the average score of students who met the MPO, followed by a description of the reason why the MPO was probably not met.

(1.5) Solve quadratic equations. (average score: 63.11 %)

Students may have had a difficult time solving the quadratic equation on the final exam since to solve it required the use of the quadratic formula, a formula which they may have forgotten, or the use

of completing the square technique, which students usually avoid. In fact, it is possible that perhaps some students may have used the quadratic formula correctly and arrived at the following solution  $x = -4 \pm 2\sqrt{5}$ . However, they may not have understood that  $\pm$  implies that the quadratic equation has two answers namely:  $-4 + 2\sqrt{5}$ ,  $-4 - 2\sqrt{5}$ . Perhaps this MPO can be met if the instructor highlights the details of writing solutions and provides the Quadratic Formula to the students.

(1.7) Solve systems of equations. (average score: 68.37 %)

The liberty of choosing any method to solve the question on system of equations may have confused some students. The question was designed so that the substitution method was the most convenient method to use. However, since the graphing method and the substitution method are taught in the same lecture, students' exposure to the substitution method may have been inadequate. Since the addition method is taught separately in another lecture and it is the method that most students prefer, it is possible that students would have used this method and perhaps have obtained the correct answer had the problem been set up in the traditional way to facilitate the use of this addition method. Since this MPO was met by over 68% of the students in the sample, perhaps it can be met the next time if it is tested by simply setting up the equations the traditional way.

(1.12) Perform basic operations on radical expressions. (average score: 61.86 %)

The topic of radicals is first covered in MTH 100 and not in any of the prerequisite courses: MTH 086 and MTH 092. Also, the chapter on radicals is taught towards the end of MTH 100 and generally difficult for students to understand especially since a good deal of terminology is used. Since we have so many topics in MTH 100 that were already covered in MTH 092, it may be the proper time to revise the course outline to include the chapter on radicals at a much earlier time to allow students time to master this important topic of college algebra.

(2.1) Apply algebraic methods to solve varied real-world applications that can be modeled by a linear equation, quadratic equation, rational equation or system of equations. (average score: 68.00 %)

Regardless of the math course, students have a hard time solving word problems especially setting up the proper equation to solve it. However, since this MPO was met by 68 % of 500 students (not all distinct), it is a positive sign that this MPO can be met from next semester and on with some improvements on how to teach word problem-solving techniques.

(3.1) Write and explain solutions to application problems related to the course material using appropriate mathematical terminology and notation. (average score: 58.69 %)

With regards to the MPO requiring the verbal explanation of an answer, no question in the MTH 100 homework set requires a student to verbally explain their answer. As a result, it may be the case that many instructors do not emphasize that theory is vital for their understanding of the subject. Students become satisfied arriving at an answer and not interested in the explanation of their answer

since they may feel that only teachers have to explain answers. Since this was the MPO that was met by the lowest percent of students, it is important that the Department look at ways of getting students to practice more on verbal explanations of solutions.

(4.1) Use a calculator to perform basic arithmetic operations, evaluate powers and find the square root of a number. (average score: 68.33 %)

The question on finding the distance between two points then using the calculator to get the answer may have been a poorly chosen problem to determine if students know how to use the calculator to perform an operation. Students may have forgotten the formula and perhaps this is the reason why they responded incorrectly; as a result, one cannot determine if an incorrect response to this question is on account of not knowing the distance formula or how to use it or else not knowing how to use the calculator properly to get the square root of a number to get the correct answer. However, since this MPO was met by 68% of the students, perhaps next time a more carefully selected problem can be used to test this MPO.

(b) Results from the student questionnaire –

The student questionnaire was conducted the first week of December 2010 since it was felt that by this time most students who had withdrawn or stopped coming to class would no longer be attending. There were 172 students who completed the questionnaire (n = 172 or 55% of the sample population in this study.) The student responses to each question on the student questionnaire are shown in Appendix D.

Prof. Williams did a statistical analysis on the results of this questionnaire to determine whether there is a significant correlation between the following:

- (1) Grades earned in MTH 100 and prior math background of student before coming to ECC (see question #4 on questionnaire.)
- (2) Grades earned in MTH 100 and math attitude of student (see question #19 on questionnaire.)
- (3) Grades earned in MTH 100 and student using tutoring facilities (see question #8 on questionnaire.)
- (4) Grades earned in MTH 100 and student having a textbook for the course (see question #6 on questionnaire.)
- (5) Grades earned in MTH 100 and student perception of their amount of absences (see question #5 on questionnaire.)
- (6) Grades earned in MTH 100 and student perception of their meeting course pre-requisites (see question #2 on questionnaire.)
- (7) Actual grade earned in MTH 100 and student perception of the grade they will be getting in MTH 100 (see question # 1 on questionnaire.)
- (8) Grades earned in MTH 100 and student perception of how much homework they have done in the course (see question #7 on questionnaire.)
- (9) Teacher reporting of student participation with on-line homework vs. their perception of their involvement with this on-line homework (see question #11 on questionnaire.)
- (10) Grade earned in MTH 100 and student perception of math being useful (see question # 17 on student questionnaire.)

(11) Grade earned in MTH 100 and student perception of math being applied to topics in their major (see question # 18 on student questionnaire.)

Prof. Williams performed a regression analysis on the entire group of variables listed above by using a reduced data set containing only those 172 students who responded to the survey. In statistics, regression analysis includes techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable (MTH 100 Grade) and one or more independent variables. More specifically, regression analysis helps us understand how the typical value of the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed. In this way, the analysis discovers "predictors" of the dependent variable (grade in MTH 100.) From this regression analysis made by Prof. Williams, it was discovered that the predictors of the MTH 100 grade from among the above variables entered were Q1 (Perception of grade earned) and Q5 (Perception of absences). Quite surprisingly, the other remaining variables did not affect the variability of the MTH 100 grade in a statistically significant way.

Since three weeks before the end of the semester students should be well aware of how they are performing in the course, they apparently predicted what their final grade would be; therefore having students' perception of their final grade as a predictor of the actual grade is to be expected. Attendance is also a predictor of performance implying that a student's attendance and their final grade are directly proportional. In other words, the more lectures students attended, the higher their grade.

A further study, an Independent Samples T-Test, was then done to compare groups of students that passed and students that did not pass. The T-Test found that the following variables are significantly different between groups of passing and non-passing students in this study: Actual number of absences submitted by the professor; Q1 (Student perception of grade earned); Q5 (Student perception of absences); Q7 (Student perception of homework done); Q16 (Student perception of math test anxiety); and Q23 (Student perception of need for more time to take tests).

Since homework is usually 0, 5, or 10 percent of a student's final grade, students may feel that homework will have a minimal impact on their final grade. The T-Test shows, however, that the students who did most of their homework performed better than those who completed a minimal part of their homework. A student's lack of preparation from doing little to no homework may cause anxiousness during a test. Even though some MAP faculty members have offered workshops on dealing with math test anxiety, these workshops have not been well attended; since the T-test results indicate that students with math test anxiety are not performing as well as those without it, perhaps these workshops should be continued. Also, the lack of sufficient time to complete tests certainly does not help students with math anxiety. The T-Test confirms that many students, in general, need more time to take tests.

### (c) Results from student data obtained from IT –

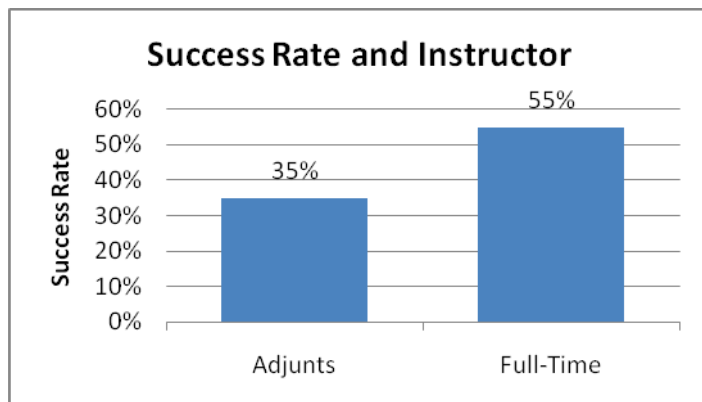
Using the Student Data Spreadsheet for the 314 students involved in this study (Appendix C), the data was analyzed to determine success rates based upon the following variables:



- (1) Grades earned by students and the type of instructor for MTH 100 (that is, if there is a difference in success rates by those students who took MTH 100 with a full-time instructor and those who took it with an adjunct instructor.)
- (2) Grades earned by students and the time of day for MTH 100 (that is, if there is a difference in success rates by those students who took MTH 100 during the day and those that took it in the evening.)
- (3) Grades earned by students and the location where students took MTH 100 (that is, if there is a difference in success rates by those students who took MTH 100 at the Main Campus and those who took MTH 100 at the West Essex Campus.)
- (4) Grades earned by students and student placement (that is, if there is a difference in MTH 100 success rates between those students who were initially placed correctly on their first math course at ECC on the basis of placement test scores and those who were not correctly placed.)
- (5) Grades earned by students and meeting MTH 100 pre-requisites (that is, if there is a difference in MTH 100 success rates between those students who met the MTH 100 pre-requisite of passing MTH 092 or being placed into MTH 100 on the basis of placement test scores and those students who did not meet the MTH 100 pre-requisite.)
- (6) Grades earned by students in MTH 100 and their grade earned in MTH 092 (that is, if there is a difference in MTH 100 success rates between those students who earned B or higher in MTH 092 and those that earned less than B in MTH 092.)
- (7) Grades earned in MTH 100 and the track where students started taking math at ECC (that is, if there is a difference in MTH 100 success rates between those students who started with AFM – track 1, those who started with MTH 086- track 2, those that started with MTH 092 – track 3, and those who started with MTH 100 – track 4.)
- (8) Grades earned in MTH 100 and leaving a gap between math courses at ECC (that is, if there is a difference in MTH 100 success rates between those students who do leave a gap between math courses at ECC and those that do not leave a gap between their math courses.)
- (9) Grades earned in MTH 100 and number of absences incurred in MTH 100 (that is, if there is a difference in MTH 100 success rates between those students who have few absences (three or less) and those students who have excessive absences ( four or more)).
- (10) Grades earned in MTH 100 and participation with on-line homework (that is, if there is a difference in MTH 100 success rates between those students who participated with on-line homework and those who did not participate.)

The following results from this analysis were noted for the 314 students in this study:

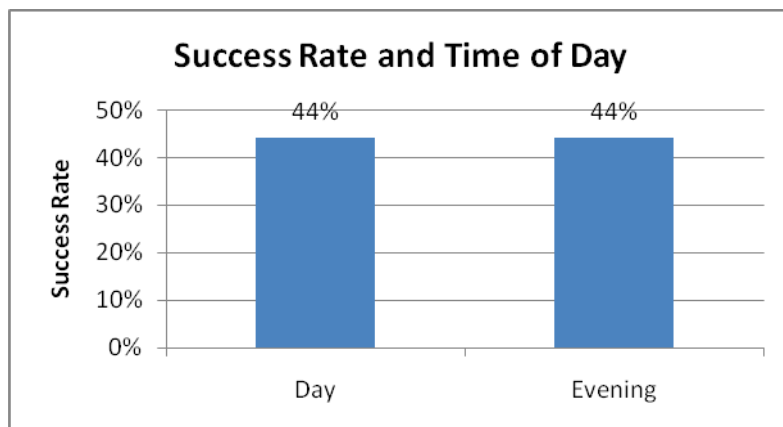
- (1) Grades earned by students and the type of instructor for MTH 100:  
Of the 314 students, 142/314 or 45% were taught by full-time faculty and 172/314 or 55% by adjuncts. The success rate of students taught by full-time faculty was 78/142 or 55% and that of the adjunct faculty was 61/172 or 35% as is shown below.



Discussion: It appears that students in this study learned better from full-time than adjunct faculty and this was confirmed by the regression analysis conducted by Prof. Williams where it was found that the type of instructor the student had in our study (full-time vs. adjunct) was a top predictor of the MTH 100 grade obtained by the student.

(2) Grades earned by students and the time of day for MTH 100:

Of the 314 students, 227/314 or 72% took MTH 100 during the day and 87/314 or 28% during the evening. The success rate of day students was 100/227 or 44% and that of the evening students was 38/87 or 44% as is shown below.

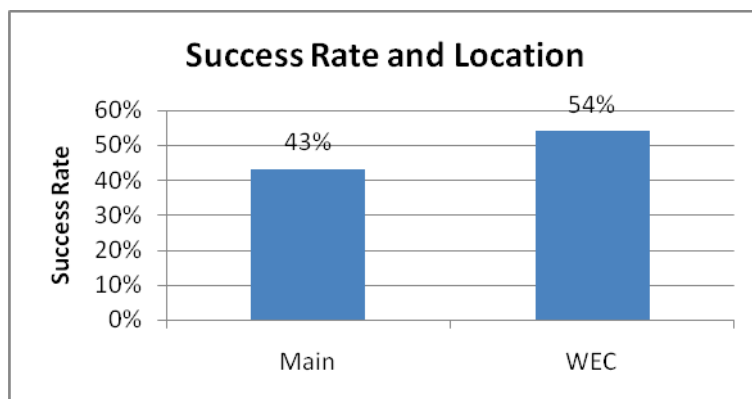


Discussion: It appears that in this study there is no difference in success rate based on the time the class was taken (day vs. evening). This was confirmed by the statistical analysis conducted by Prof. Williams with no significant correlation being found between the time the course was taken and success rate.

(3) Grades earned by students and the location where students took MTH 100:

Of the 314 students, 258/314 or 82% took MTH 100 in the Main Campus and 56/314 or 18% took MTH 100 in the West Essex Campus. The success rate of the main campus

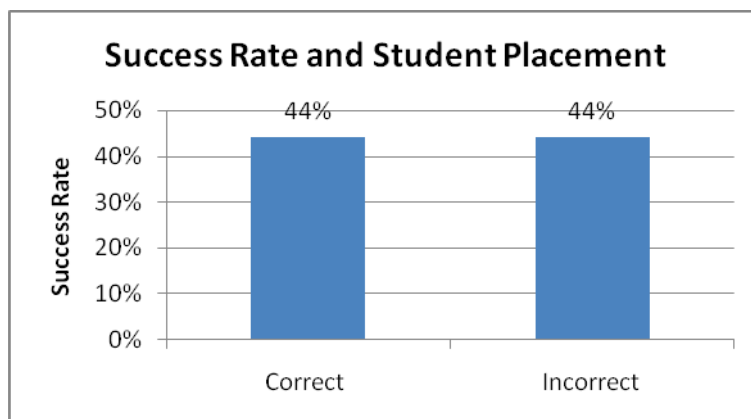
students was 112/258 or 43%; that of the WEC students was 30/56 or 54% as is shown below.



Discussion: It appeared that in this study the MTH 100 success rate was higher for those students in the sample taking the course at the West Essex campus than those taking it in the main campus. This could be due to the fact that many students in the West Essex Campus come from suburban high schools where they may have had more a rigorous mathematics education program than those students who take math in inner-city high schools like Newark.

(4) Grades earned by students and student placement :

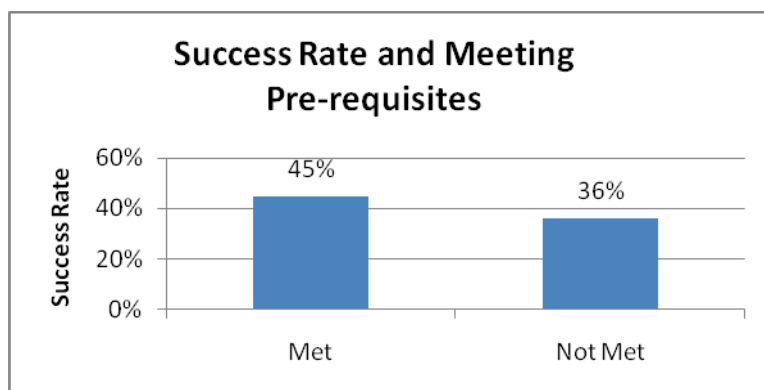
On the basis of their placement score, 256/314 or 82% of the students were placed correctly into their math courses; 36/314 or 11% of the students were placed incorrectly and the remaining 7 % includes those 22/314 students that did not take the placement test. According to the Testing Office policy, those students who are exempt from taking the math placement test are those who had taken the SAT and/or transferred in a college-level math course and are therefore considered prepared to take college level math courses; therefore, this would make those 22 students who did not take the placement test as also being properly placed. Thus the percent of students who were placed correctly into MTH 100 in this SLOAT study would then be higher at 89%. The success rate in MTH 100 for those students who were not placed correctly was 16/36 or 44%; also the success rate of the group of students who were placed correctly (either on the basis of the placement test or the Testing office exemption policy) was 121/278 or 44% as is shown below.



Discussion: In our SLOAT study it was found that there was no difference in success rates in MTH 100 by those students that were placed correctly and those that were not placed correctly. Perhaps this is due to the fact the number of students who were not placed correctly was quite small (36) especially in comparison to those that were placed correctly (278).

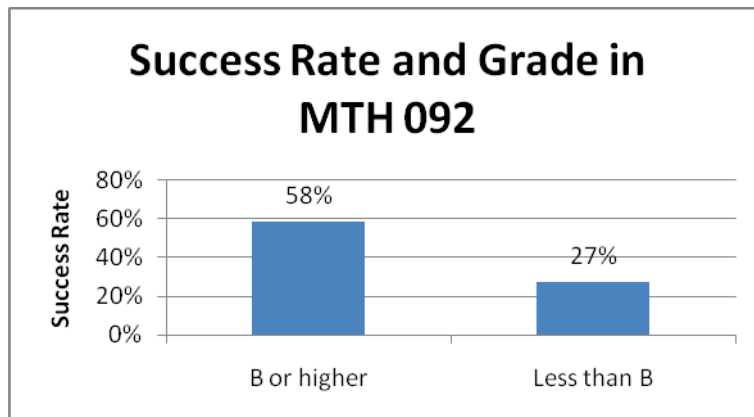
(5) Grades earned by students and meeting MTH 100 pre-requisites :

Of the 314 students, 259/314 or 82% of the students met the pre-requisites for all their math courses taken up to MTH 100; 33/314 or 11% did not meet the pre-requisite for at least one math course; and, 22/314 or 7% did not take the placement test so we do not know if they met pre-requisites or not. The success rate of those students that did not meet pre-requisites was 12/33 or 36% and 117/259 or 45% for those that did meet the pre-requisites; also, 10/22 of 45% of the students for whom meeting pre-requisites was unknown were successful in MTH 100. This is shown below.



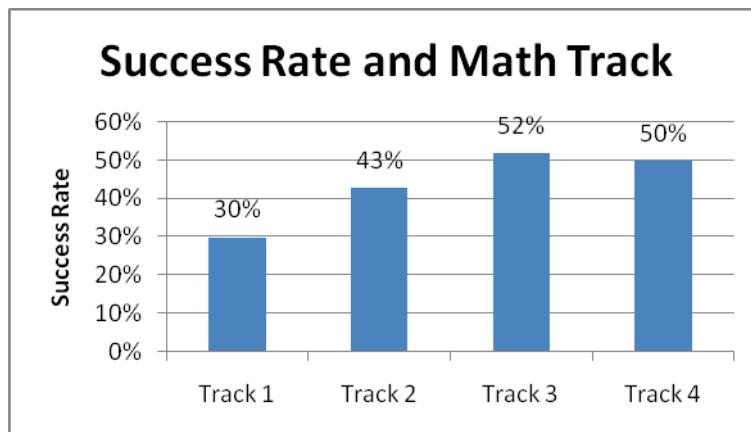
Discussion: In this study, it appears that meeting pre-requisites for MTH 100 gives a student a better chance for success in MTH 100.

- (6) Grades earned by students in MTH 100 and their grade earned in MTH 092:  
 Of the 314 students in the sample, 209/314 or 67% of them took MTH 092. Of these 209 students in the sample that took MTH 092 before they took MTH 100, 102/209 or 49% earned grades less than B in MTH 092 and 107/209 or 51% earned a grade of B or higher. The MTH 100 success rate of those students who obtained a grade of B or higher in MTH 092 was 62/107 or 58% while that of the 28/102 who got a grade lower than B in MTH 092 is significantly lower at 27%. This is shown below.



Thus it would appear that a student who gets a good grade in MTH 092 is more than twice as likely to pass than those who barely passed MTH 092.

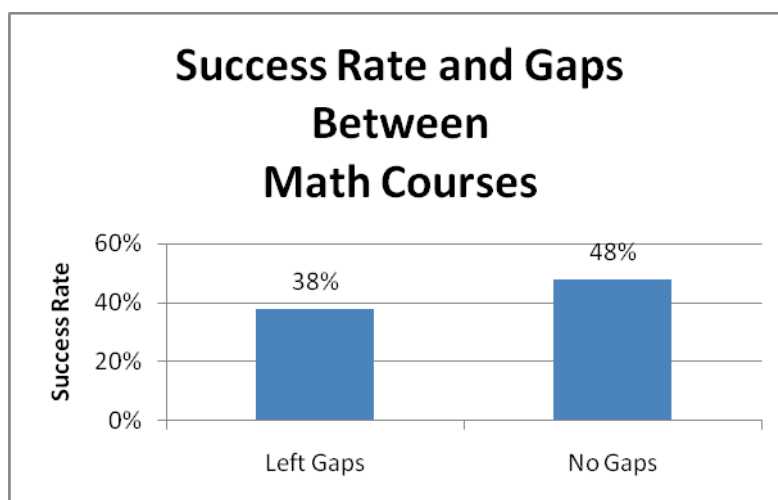
- (7) Grades earned in MTH 100 and the track where students started taking math at ECC:  
 Of the 314 students, 27/314 or 9% of the students started their math courses with AFM 083 (Track 1); 166/314 or 53% started with MTH 086 (Track 2) ; 31/314 or 10% started with MTH 092 (Track 3); and, 90/314 or 29% started with MTH 100 (Track 4). The success rate of the 27 students that started with AFM 083 was 8/27 or 30%; that of the 166 students that started with MTH 086 (Track 2) was 72/166 or 43%; that of the 31 students that started with MTH 092 (Track 3) was 16/31 or 52% ; and finally that of the 90 students who started with MTH 100(Track 4) was 45/90 or 50 % . This is shown in the chart below.



Discussion: In this study it appears that the students that performed the best were those that started with MTH 092 (Track 3); the second most successful group included those who started with MTH 100 (Track 4); the third most successful group consisted of those that started with MTH 086 and the track that did the poorest included those who started with AFM 083.

(8) Grades earned in MTH 100 and leaving a gap between math courses at ECC:

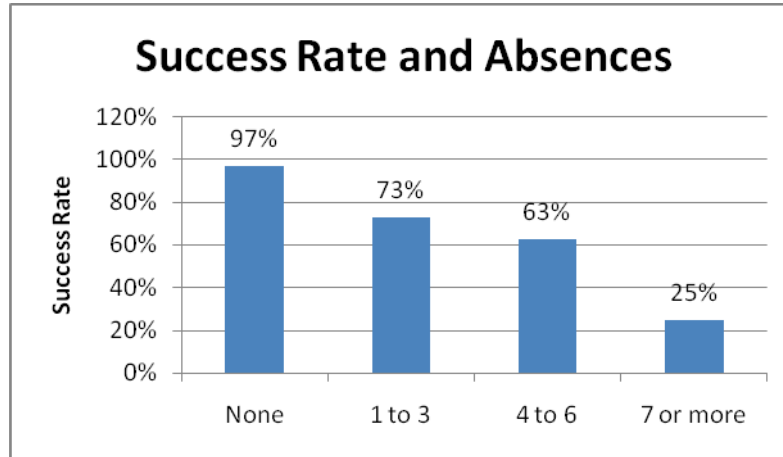
Of the 314 students, 115/314 or 37% students left at least one gap between one math course and the next in the sequence and 199/314 or 63% did not leave a gap between math courses. Comparing the success rates of those that left gaps and those that did not, we noted the following: 44/115 or 38% of those students who left gaps passed while 95/199 or 48% of those that did not leave the gap passed. This is shown below.



Discussion: In this study it appears that leaving gaps between previous math courses which are pre-requisites for MTH 100 lowers the chances of a student passing MTH 100.

(9) Grades earned in MTH 100 and number of absences incurred in MTH 100:

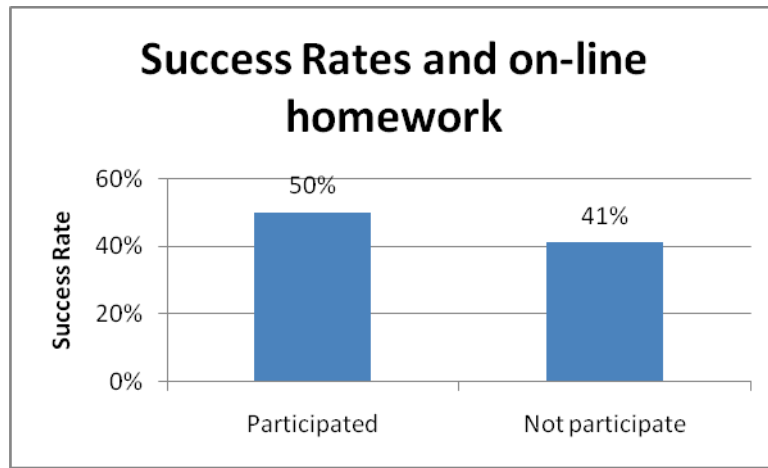
Of the 314 students, 38/314 or 12% had no absences, 73/314 or 23% were absent one to three times, 48/314 or 15% were absent 4 to 6 times, 71/ 314 or 23% had 7 or more absences, and 84/314 or 27% stopped attending. This means that only 35% of the students had three absences or less with the remaining 65% of students having 4 or more absences, or stopped attending. When comparing the success rate of students with amounts of absences, the following was noted.



Discussion: This table clearly suggests that as the number of absences increase, the success rate in the course dramatically decreases. This was confirmed by the regression analysis conducted by Prof. Williams; the data noted that number of absences incurred by the students was a statistical predictor of the MTH 100 grade received by these students.

(10) Grades earned in MTH 100 and participation with on-line homework :

Of the 314 students in the sample, 111/314 or 35% participated with on-line homework and 203/314 or 65% did not. Of those 111 that used this homework software, 55/ 111 or 50% earned grades of 60% or higher on this on-line homework and 56/111 or 50% earned grades less than 60% on this homework. When comparing the success rate of students who participated with on-line homework and those that did not, the following was noted: those who participated with on-line homework and received a grade of 60% or higher had a success rate in MTH 100 of 43/55 or 78% whereas those who participated and received a grade below 60% had a MTH 100 success rate of 12/56 or 21%. Also, comparing the success rate of all those who participated with on-line homework and those that did not, we note the following.



Discussion: The data obtained from this study suggests that those who participated with on-line homework have a higher success rate in MTH 100 and in particular those who score well (above 60%) on this on-line homework seem to have a much higher chance of success in MTH 100.

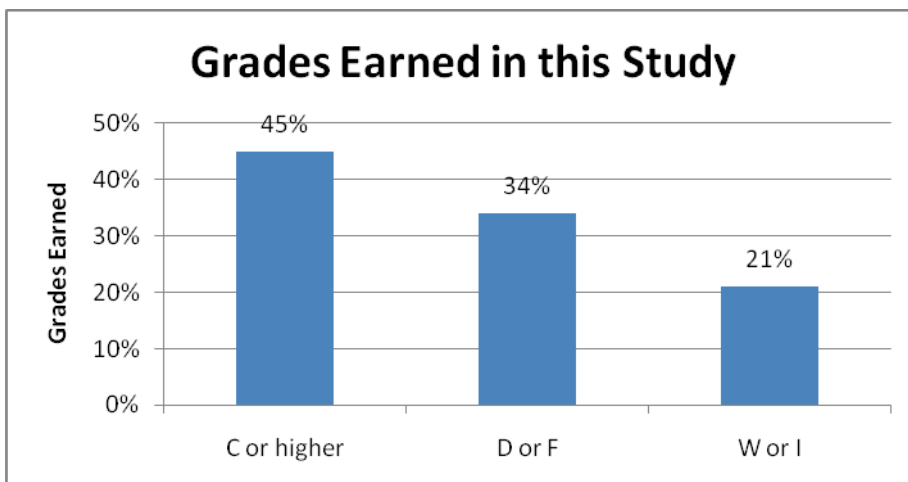
#### Other Findings:

Math Courses Repeated: 88/314 or 28% of the students in the study repeated at least one math course. Of these repeating students, 7/88 or 8% repeated MTH 086; 13/88 or 15% repeated MTH 092; and 75/88 or 85% are repeating MTH 100. The success rate of all those students repeating MTH 100 was 36/75 or 48%; thus, persistence does seem to pay off and students who fail MTH 100 once should be encouraged to repeat the course.

Retention in the study: While the study started with 405 students, the sample population was reduced to 314 since 91/405 or 22% of the students were voided out of their MTH 100 class and got no grade by the end of the semester. Of these 314 students remaining in the study, one month later when Test #1 was given, only 300/314 or 96% took this test; two months later, only 294/314 or 94% took Test 2 (Midterm); three months later, 207/314 or 66% took Test #3; and finally, by the end of the semester, 206/314 or 66% took Test #4 (Final). If we define retention as the number of students who stay until the end, take the final exam and get a grade for a course, then 206/314 students or 66% of the sample of students in the study were retained in the course until its completion.

Grades Obtained by students in this study: Of the 314 students, 35/314 or 11% earned an A ; 26/314 or 8% earned a B+; 30/314 or 10% earned a B; 24/314 or 8% earned a C+; 25/314 or 8% earned a C; 15/314 or 5% earned a D; 91/314 or 29% earned an F; 67/314 or 21% earned W; and 1/314 or 0.3% earned a grade of I. Since Success Rates are determined by those students that earned grades of C or higher, this indicates a 45% success rate for this sample of students. The following table shows the breakdown of grades in this study.





#### Summary of Findings from the Student Background Data Analyzed:

Of the 10 variables investigated, the above data shows that there were a number of variables that do seem to affect student success rates in MTH 100. These are: type of instructor, location where class is taken, meeting pre-requisites for the course, gaps between math courses taken, math track where started, grade in MTH 092, participation with on-line homework, and number of absences incurred by the student. The two variables that did not show a difference in student success rates are: the initial student math placement on the basis of the placement test score and the time of day when the course is taken. The statistical analysis of this student background data conducted by Prof. Williams found that there was indeed a significant correlation between those students who passed the course and those who were taught by full-time faculty. Since full-time faculty have more expertise in mathematics, have more experience teaching math, as well as are more accessible to students, it is not unusual that students perform better when taught by full-time over adjunct faculty. This result stresses the need for the Department to hire more full-time faculty and decrease the number of sections taught by adjuncts.

#### IV. Summary, Conclusion and Recommendations:

An intensive study on MTH 100 considering many factors impacting student success in this course was done by Professor Soraida Romero, Professor Carlos Castillo and Dr. Alvin Williams of the MAP Division during the fall 2010 semester as part of the Student Learning Outcomes Team (SLOAT). To determine whether students taking MTH 100 are meeting the Measurable Performance Objectives (MPOs) for this course, Professors Castillo and Romero included eight multiple-choice questions blue-printed to the MPOs in each of the 4 Departmental exams for MTH 100 given out during the fall 2010 semester. By the end of the semester, Professors Castillo and Romero were able to test for the acquisition of all 21 measurable performance objectives in MTH 100. Of the 21 MPOs that were tested, 15 out of the 21 ( $15/21 = 71.4\%$ ) had the given MPO met by 70% or more of the students who answered the question(s) relating to that MPO. As a result, 6 out of the 21 ( $6/21 = 28.6\%$ ) MPOs failed

to be acquired. The MPOs which failed to be acquired are described in the first part of the Results section and the following suggestions may help future students acquire these MPOs:

- The Department should consider including in the MTH 100 final exam a formula sheet consisting of the distance formula, the quadratic formula, the area of a rectangle, and the Pythagorean Theorem in order to ensure that student errors are not based on forgetting formulas.
- Each instructor should devote more time to solving a system of equations by the substitution method. In addition, a supplemental worksheet containing several systems of equations will be designed for use by all interested instructors. The instructions on this worksheet will not be conventional and will be as follows: Solve each system of equations by both the substitution method and the addition method. Which method was more convenient? What would you change to make the less convenient method become more convenient?
- Instead of teaching the chapter on radicals towards the end of the course, a suggestion will be made to the curriculum committee to include this chapter at a much earlier time. To help this transition go smoothly, the coordinators of MTH 086, MTH 092, and MTH 100 should meet with the curriculum committee and talk about a considerable restructuring of all three courses.
- In order to facilitate the process of learning how to solve word problems, seminars should be conducted by the Math and Physics Department open to all instructors (part-time and full-time) to discuss strategies and best-practices for teaching how to solve word problems using algebra.
- A supplemental worksheet containing problems requiring a verbal explanation will be designed and made available for use by all interested instructors.

Professors Castillo, Romero and Williams designed a student questionnaire consisting of twenty-four multiple-choice questions formed to investigate students' prior math background, study habits, class attendance, tutoring attendance, on-line homework package participation, etc. It was found that the top predictors of the MTH 100 grade from among all the variables of the questionnaire were Q1 (Perception of grade earned) and Q5 (Perception of absences). Prof. Williams also conducted an Independent Samples T-Test to compare groups of students that passed and students that did not pass. The T-Test found that the following variables are significantly different between groups of passing and non-passing students: Actual number of absences, Q1 (Student perception of grade earned), Q5 (Student perception of absences), Q7 (Student perception of homework done), Q16 (Student perception of math test anxiety), and Q23 (Student perception of need for more time to take tests). Given these study results, Professors Castillo, Romero, and Williams make the following recommendations:

- On the first day of class, all MTH 100 instructors should stress to their students that our research has shown that students who get good grades in MTH 100 are ones that have excellent attendance and complete their homework assignments.

- Every semester, the Math Department should offer workshops on dealing with test anxiety. Professors Ming McCall and Kathleen Powell have conducted seminars on test anxiety in the past and will be asked to continue offering similar seminars in the near future.
- The Math Department should consider making arrangements that would allow more time on exams (particularly high stakes exams like Midterms and Finals). If not, the exam committee should consider reducing the number of questions asked on each test to allow students enough time to take the test.

Professor Romero did her own study on success rates using control variables such as student's prior math background, study habits, attendance, going to tutoring, and participation with an on-line homework package, among others. Of the 10 variables investigated from student's background data gathered from the Office of Institutional Research, 8 out of the 10 appeared to affect student success rate in MTH 100. These are: type of instructor, location where class is taken, meeting pre-requisites for the course, gaps between math courses taken, math track where started, grade in MTH 092, participation with on-line homework, and number of absences incurred by the student. The two variables that did not show a difference in student success rates are: the initial student math placement on the basis of the placement test score and the time of day when the course is taken. The statistical analysis of student background data conducted by Prof. Williams found that two variables, whether the instructor was a full-time or adjunct faculty, and the actual number of absences of students, were the only variables that affected the MTH 100 grade in a statistically significant way. It is not surprising that being taught by a full-time faculty member and the number of absences incurred by students were top predictors of the MTH 100 grade of students. On the basis of these results from student background data, Professors Castillo, Romero and Williams make the following recommendations:

- Since students, in general, earned better grades with full time instructors than with adjuncts, it is the appropriate time to hire new full-time faculty. Full-time faculty members are much more available to students than adjunct faculty since each member holds regular office hours as well as office hours by appointment to assist students. In contrast to full-time faculty, adjuncts are not required to hold office hours and while many of them do volunteer their time to help their students it is clear that their poor compensation, job status, and other job commitments make it nearly impossible for all of them to do this on a regular basis.
- All students should satisfy the pre-requisite for MTH 100 before taking this course. Since it was found that those students who start with MTH 092 generally do better in MTH 100, if a number of years have passed since a student last studied algebra, then that student should take MTH 092 before MTH 100 to review elementary algebra before taking college algebra. Also students should be encouraged to do well in MTH 092, that is get a grade of B or higher in MTH 092, to give them the strongest background in elementary algebra which will best enable them to succeed in college algebra. Also, since it was found that those students who score less than a B in MTH 092 have a lower success rate in MTH 100, these students may want to consider taking an easier college-level math course, like MTH 101 or 103, to satisfy the math requirement for their major.
- Students who get low math test scores on the College placement test should be advised to take MTH 086 rather than AFM 083 to review arithmetic concepts since the success rate in MTH 086 is much higher than that of AFM 083. This could be due to the fact that MTH 086 is taught by members of the Math Department while AFM 083 is taught by instructors who do not have the

same expertise in mathematics as well as the experience in teaching math as the instructors in the Math Department. Also, if AFM 083 is to continue being offered at the College, assessment studies need to be conducted to determine the success rate of these students who take AFM 083 not only in AFM 083 but also in their subsequent math courses.

- Students should avoid gaps between the math courses taken prior to MTH 100 so that they do not forget important topics, concepts and rules as they move up from one course to the next.
- Students should try to use on-line homework software and if so, try to get a score of 60% or higher; this would give them additional practice on course material on top of the regularly assigned homework.
- Students should definitely limit the number of absences in MTH 100 to less than 3. Too much material is covered in MTH 100 in a somewhat rapid pace so that important topics are missed for each absence incurred by students, lessening their chance of success in the course.