IMPROVING STUDENT SUCCESS CAN BE AS SIMPLE AS 1-2-3

Susan L. Beane
University of Houston-Downtown

Key factors which contribute-e to student success in mathematics are retention and concept mastery. Three strategies where implemented-one per year-that research has shown to improve these factors. Therefore, these findings result from a three-year period of research and involve the outcomes of approximately 300 students per year. Each strategy was initially implemented and tested during the summer or fall semester each year. After introducing the strategy, the strategy was then refined and adjusted and re-tested in the semester immediately following strategies initial implementation. Data was then collected during the second implementation of the strategy. Each subsequent strategy was then introduced along with the existing previous strategy or strategies following the same implementation sequence. The first strategy implemented in the classroom involved the immediate repetition of the individual test with a group test. The second strategy implemented involved test remediation options for in-class tests with grades below 70%. The final and third strategy implemented during the research involved the use of a class homework notebook requirement. The research and results of these three success strategies is given below in the order in which they are combined and implemented within a course.

Success Strategy -1-Homework

The homework is comprised of two parts, the "Class Homework Notebook" and the typical online homework component available through most textbook publishers. A three year study from 2003 through 2005 by the *Pathways Through Algebra* project which was funding by *Natural Science Foundation and Lumina Foundation* on homework found that doing homework helps students prepare for exams with confidence. Further, homework should be assigned and should be handed in on a regular basis, and that students should receive feedback often and on a regular basis. Additionally, the research showed that homework has a psychological aspect in that homework allows students to make mistakes in an emotionally safe environment. The study also included an electronic component of homework as well. The results of this part of the study indicated that the research showed that it is highly recommended that math courses be linked with computer software. The project concluded that the success rate in computer-aided classes increased from 54.18% to 65.75%.

The first course strategy to improve student overall course success was based on the outcome of this project; the "Class Homework Notebook" included a required assignment of the written textbook exercises as part of the overall course grade. For each assignment in the notebook, all exercises had to be clear and readable, and all work must be shown. Students are given a "Class Homework Notebook Information Sheet" with the notebook's requirements and grading method along with the "Class Homework Notebook Grading Rubric" coversheet. Approximately 30 textbook exercises are assigned for each section in the textbook. Three-ring binder notebooks are submitted on test days as the students enter the room. The notebooks are then quickly skimmed and a grade is assigned and recorded on the grading rubric during the testing period. The graded notebooks are then returned to the student upon leaving the room at the end of the testing period. The notebook grade is comprised of: Neatness (10%),

Organization (10%), Section Exercise Homework (60%), Group Activities & Exercises (10%), and Overall Completeness (10%).

The grading rubric sheet included individual squares divided into four sections by two diagonal line segments connected opposite corners of the square which produces an "X" inside each square (see Exhibit 1) . One square provided for each main notebook section as well as each textbook's sections exercises. At the bottom of the page of the grading rubric, a total grade box was provided for recording the total of each of the four grading periods. The "Class Homework Notebook" shown that the written homework exercises where completed with the majority of the students having completed the assignments where the exercises had been completed with all work shown. Further, the notebooks provided an example that the students were more likely to complete textbook exercises when the exercises where actually graded. The notebooks where shown to represented a form of student commitment and accomplishment (see Exhibit 2).

Grading is carried out quickly for each of the grading areas on the grading rubric. The neatness grade is based on the presentation of the homework and the notebook in general. The organization grade is based on the grading rubric correctly in place as the first page, the group grade material placement behind the grading rubric, and the homework exercises being placed orderly and assessable. The grade for the homework exercise sections is divided equally by the sections to be graded, with each section receiving a check (70% or above) and receiving full credit, a check-minus (50% to 70%) and receiving third-credit, a minus sign (less than 50%) and receiving half-credit, or a zero (no credit). The homework grade is then computed by the number of homework exercise credits time the average value per homework section. The group grade is equally distributed per group item to be graded each grading period with the first group grade comprised of the names and phone numbers of two fellow classmates recorded on the back of the grading rubric sheet (these names and phone numbers are exchanged during the first week of class) as at least the first group assignment. Respective group assignments will include the group test corrections for each group test taken. The completeness grade was based on the overall "completeness" of the notebook and the completion rate of the homework section exercises based on a scale of one-to-ten, with ten being the best.

The textbook homework exercises that were assigned paralleled methods and styles of test questions and the results of this research study indicated that a success homework notebook only resulted in a better test success rate, then only online homework in students who had chosen to do one or the other. Additionally, the notebooks gave the instructor the opportunity to relay information about poor math skills to each student. Overall, the study showed that passing class homework notebook grades correlate with passing test grades (see Exhibit 3). Student comments about the additional requirement can be summarized by the following quote by Muhammad Ali, "I hated every minute of training. But I said, 'Don't quit. Suffer now and live the rest of your life as a champion.'", as most students initially complained about the additional work load but after successful completion of each test, most commented that they felt their test grade adequately reflected and was a result of the effort they had put into their homework notebooks.

The course homework grade also included an on-line homework component as well which carried twice the weight percent for the overall course grade. This part of the homework component was assigned the double weight since students were given the opportunity to always correct any incorrect responses prior to submitting the assignment to the instructor for a grade. The on-line homework was assigned to supplement the textbook homework. As Aristotle once

said, "We are what we repeatedly do. Excellence then, is not an act, but a habit." The on-line assignments varied in size from 10-20 exercises depending on previous student outcomes in each particular concept, and as well as the amount of repetition I believed the students would need to obtain mastery of the concept. Each of these on-line assignments was due one week from the completion of the lecture over each particular section in the textbook. The benefits of the on-line homework also included the student having an instant response to correctness of answer, and the option to correct wrong answers without penalty. Additionally, students reported that they found the additional resources, tutorial aids, and access to grades that most online services provide beneficial.

Research provided by the *Pathways Through Algebra* project also indicated that the on-line component helps build confidence in mastery, encourages repetition and self correction of errors, and provides beneficial teaching supplements and grade reports for the student. The results of this student show that the on-line homework should serve as a supplement to the written textbook homework (see Exhibit 4), but not as a replacement for written textbook homework due to the fact that the correlation between online average and test average is weaker than those associated with written textbook average and test average (see Exhibit 5).

Success Strategy -2- In-Class Testing

Each test given is comprised of two parts, the individual test and the group test. In-class test sessions began with the individual test, and then were followed immediately by the group test. Both tests were multiple-choice selection with the majority of credit given for the showing of work or "proof" of why the specific answer was chosen.

The individual test is the first part of each test. Each student is given between two-thirds and three-fourths of the total class period for the individual test. All work must be shown on the test for full credit. Students were also reminded at the beginning of each test that "Whatever you do, do it with all your heart and soul, make it your own; remembering to always be honest and do your best." After the completion of the individual test, students were told to form groups of three to take a group bonus points test. The group test was incorporated into the testing environment based on group learning research completed by a Johnson, Johnson, & Smith, 1998, presented in *Active Learning: Cooperation in the College Classroom.*

Studies on effectiveness of cooperative learning show that the basic elements of cooperative teams foster; positive interdependence as group members perceive that they need each other to be successful, individual accountability created by the group work helps to make students feel more accountable for their individual performances, the face-to-face group interactions help to promote each student's productivity by helping, sharing information, and encouraging each other that each concept and skill is obtainable. During group work students explain, discuss, and teach what they know to each other, interpersonal and small group skills are developed by the instructors when they structure teams so that members sit knee-to-knee and talk through each aspect. The instructor also helps to foster the group's collaborating skills of instructorship, decision-making, trust building, communication, and conflict-management skills, and group processing is promoted as the instructor monitors groups and gives feedback on how well group is performing. The research showed that groups also need to be given specific time to discuss how well they achieved their goals. Therefore, additionally instructors should assign group processing tasks to improve overall performance. This research can be summarized by the acronym T-E-A-M-S or Together Everyone Achieves More Success.

Utilizing these research results, the group test was the instituted as the second part which followed each individual test. The components of each group test are as follows. Five minutes prior to the end of each individual test, group exams are randomly distributed around the room preferably on empty seats, if available. The students are given a five minute warning as to the end of the individual testing period. As student's individual exams is then collected, the student is told to form a group of three members maximum around each desk which has a group exam. The groups then take the exact same test, showing all work, and are given the remainder of class time. Each group member will receive 10% of the group's test grade as bonus points which are added to the individual's test grade. Groups then are re-assembled when tests are returned, and each individual is responsible for turning in a sheet with the corrections for any missed question on the group test. Groups receiving 90% or better are also instructed to help another group with their corrections and to sign the top of the individual's paper that they helped. Corrections will then be counted as a portion of or as the entire group grade in the next Class Homework Notebook grading period.

The benefits of group testing the where shown by this research indicate that students report that they enjoy the experience, students assume more responsibility for their own performance as indicated by less student complaints about the test and its components, students report gaining better mastery and understanding of the tested material and feeling as though they were able to master some additional skills that they lacked on the individual test after the group test. Additionally, almost 90% of the group test have scores are 70% or better, even when groups have been formed by individuals that scored below 50% on the individual test (see Exhibit 6 and 7). Furthermore, the group test are graded on a all-right or all-wrong basis, therefore they are quick and easy to grade…its either right or wrong period. The group tests were also found to provide valuable feedback about overall class comprehension and mastery, and were thus graded prior to the individual tests to determine grading standards to be instituted when grading the individual tests. This valuable feedback along with the "bonus point" aspect of the group test resulted in eliminated the need to "curve" the grades or add "bonus" question within each test. Students reported this system of grading and testing to be fair and favorable. There are some cons of group testing however. Individual tests have fewer questions, and therefore each question is worth more weight. Some students voiced opposition to a group test and therefore all students were also given the option to not participate in a group forfeiting the bonus points, and spend more time on the individual test (very few ever took advantage of this and the following test decided to participate in a group). Group testing results in additional tests for the instructor to grade each test. Additionally, instructors have to monitor individuals to insure participation within each group during the group testing period.

Success Strategy -3-Test Remediations

Students scoring below 70% on the individual test are given the option to remediate and improve their grade (See Exhibit 8 and 9). This remediation is separated into two types which depend upon the student's individual test grade; a meeting session or a makeup session. The meeting session is a 15-30 minute remediation and correction meeting held in the instructor's office or other meeting place such as a math lab facility, and the second is a 3-hour remediation and test makeup session.

The *Pathways Through Algebra* project also showed that tutoring was a successful strategy. The study indicated that tutoring programs generate statistically significant increase in student success. Additionally, mentoring and tutoring demonstrate a reduction in the

withdrawal rate for beginning algebra. Instructors should also quickly determine if a student should be identified as being required to attend tutoring sessions as a strategy to increase student retention in remedial mathematics. Further, research has shown that poor students who interact directly with the instructor results in students reported that after meeting with the instructor once, they now have no reservations about asking future questions or going to see the instructor during office hours.

The students who scored between 50% -69% were given the option to schedule an office meeting with the instructor to review and discuss the missed test questions. As a reward, one point is given for every question discussed to increase the student's current individual test grade. On average students received an additional 10 points on the individual test grade. Students did comment that they had benefited from the meeting and felt they had a better understanding of the material and how to correct their previous misconceptions. The instructor is also given the opportunity to offer personalized feedback to these students. It was found that these students generally had misconceptions or misunderstandings involving only a few concepts which could be remediated with minor intervention.

Students who score below 50% on a test are given the option to attend a makeup session. These sessions are usually held on either a Saturday morning in an electronic classroom where they are told to form pairs of "work buddies," or during the week in the math lab facility where they are allowed to remediate by working with the facility's tutors. The makeup session begins with a 2-3 hour computer aided remediation exercise. Students must obtain at least 70% mastery level on the remediation exercise to be eligible to take the makeup test. After completing the makeup session's 40 to 50 review exercises, the session concludes with a one-hour electronic makeup test. The makeup test is comprised of both multiple-choice and free response answers. The makeup test grade then replaces the original test grade. Students are shown there grade to each of the components of the makeup session immediately after the completion of each component (number correct is not known until after submission for a grade electronically).

During the semesters researched, results show that the majority of students determined these options a great opportunity for improvement (see Exhibit 10), not all students take advantage of these options. However, the majority who did attend one of these sessions go on to successful mastery and completion of the course requirements (see Exhibit 11, 12 and 13).

The results of this research show that each additional strategy did result in an increase in pass rates, and all together, these three simple strategies did improve not only student success, but also the courses had an increase in retention rates and pass rates (see Exhibit 14). Additionally, students reported that it helped to promote and encourage instructor/student mentoring which will prepare the students for future courses. As instructors, the strategies may increase the workload slightly but can be the process and outcome can be summarized nicely by a quote by Brutus Hamilton, "It is one of the strangest ironies of this strange life that those who work the hardest, who subject themselves to the strictest discipline, who give certain pleasurable things in order to achieve a goal, are the happiest people."

Further information, exhibits, and data can be obtained by contacting Susan Beane at beanes@uhd.edu or University of Houston-Downtown, One Main Street, Houston, Texas 77002

Exhibit 1

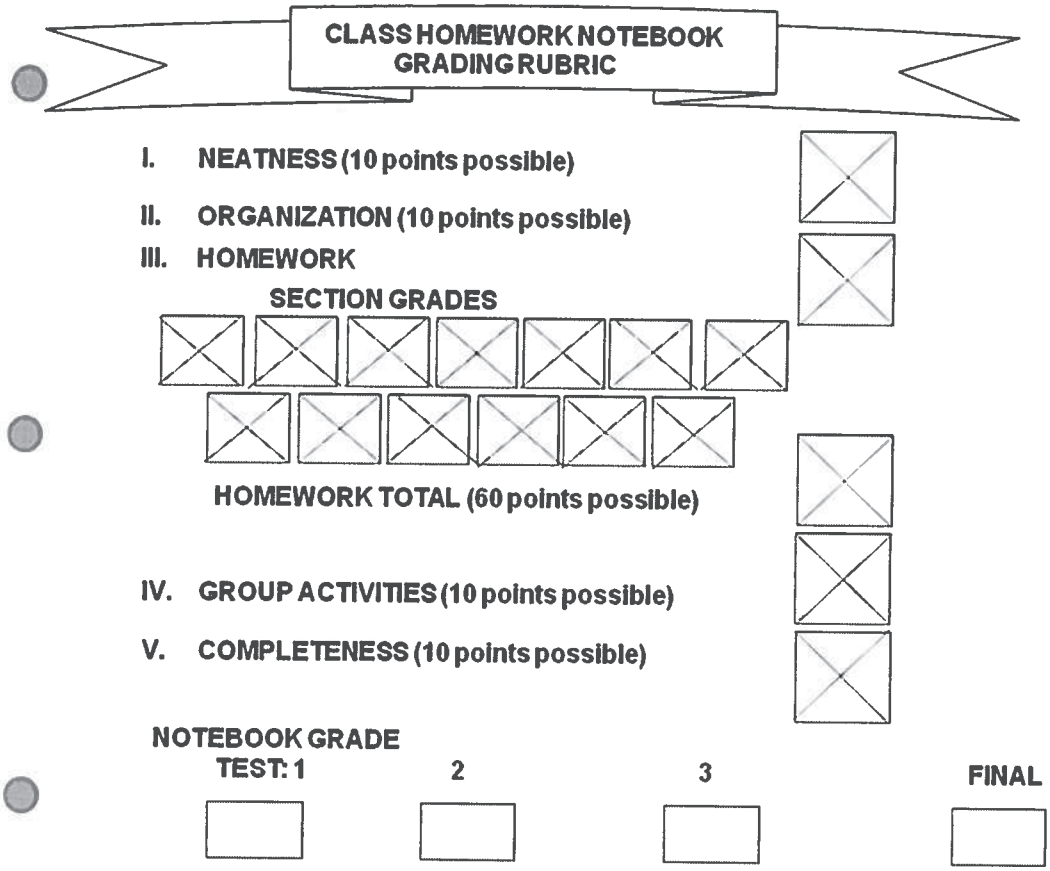

Exhibit 2

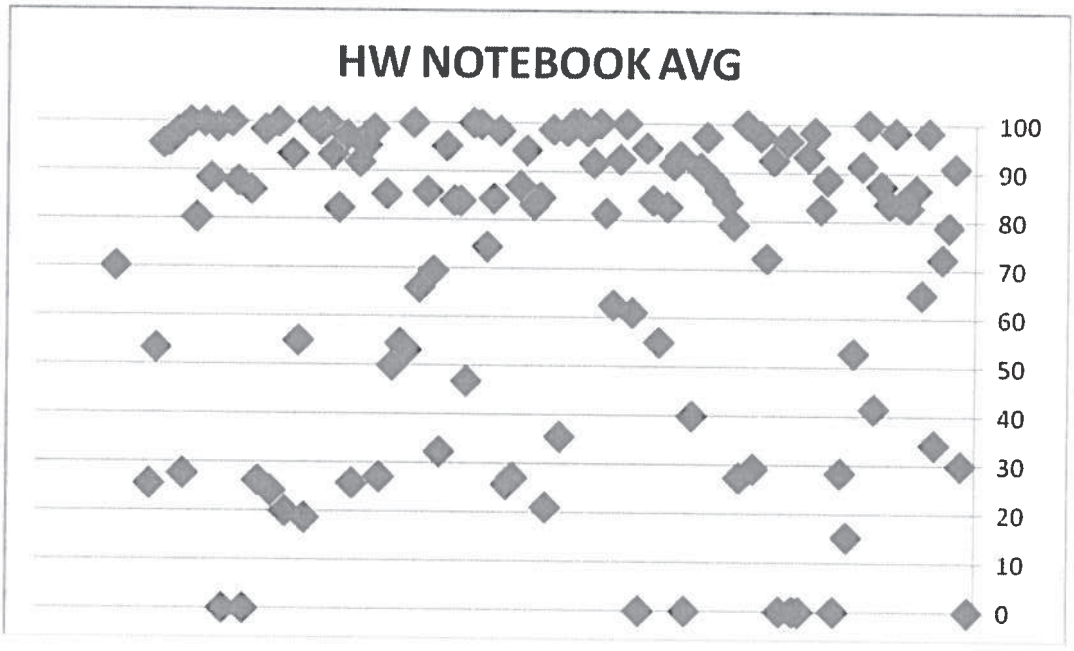

Exhibit 3

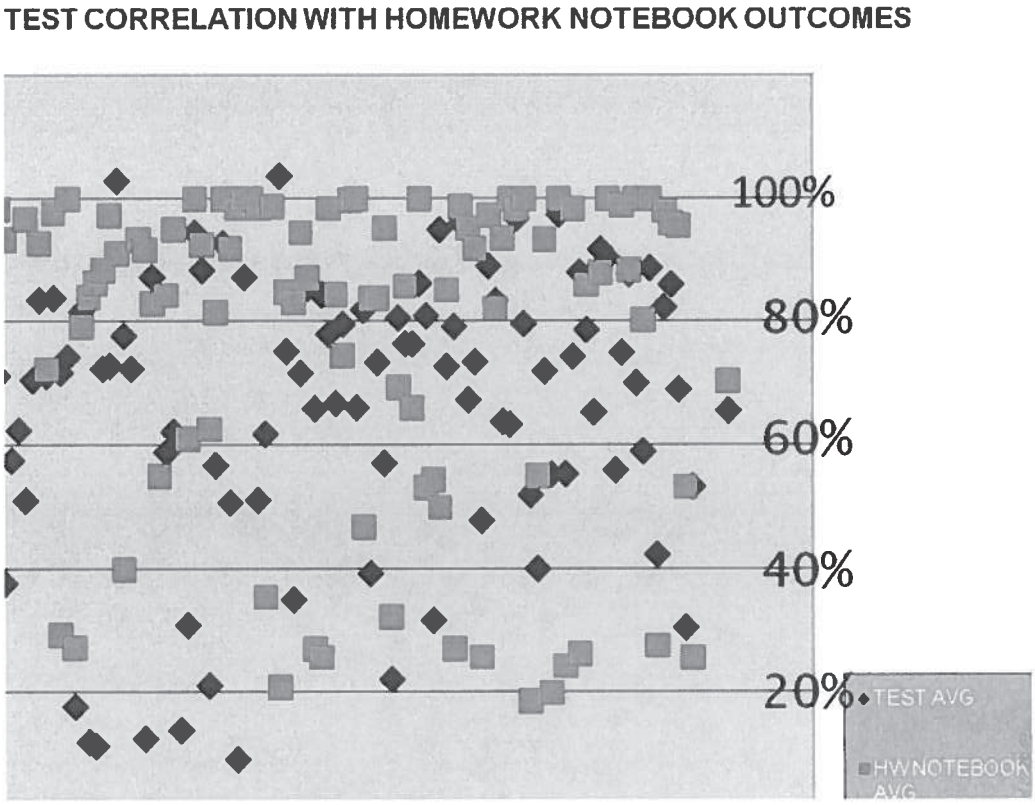

Exhibit 4

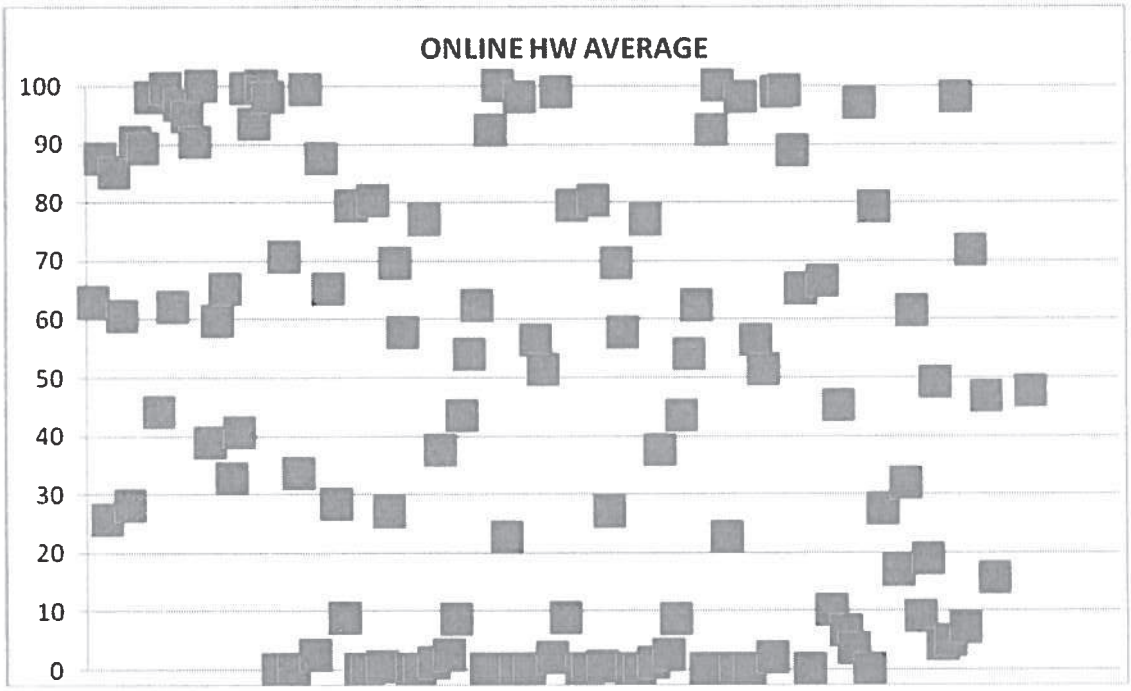

Exhibit 5

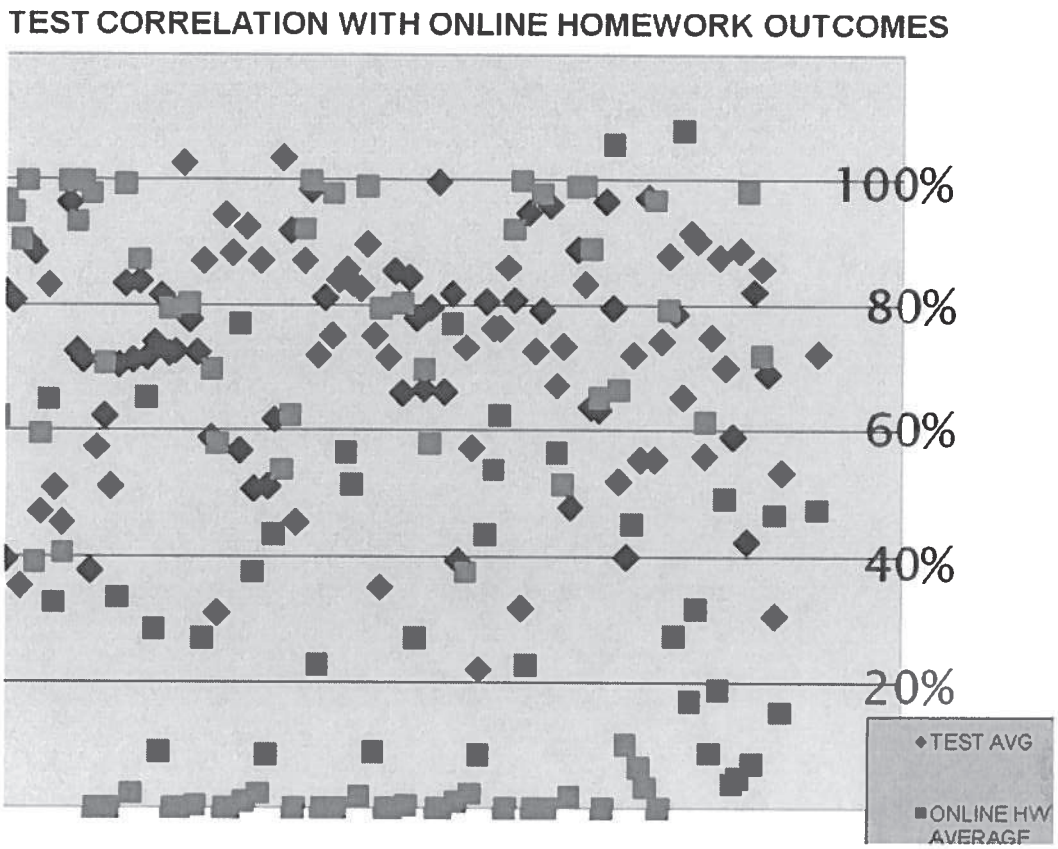

Exhibit 6

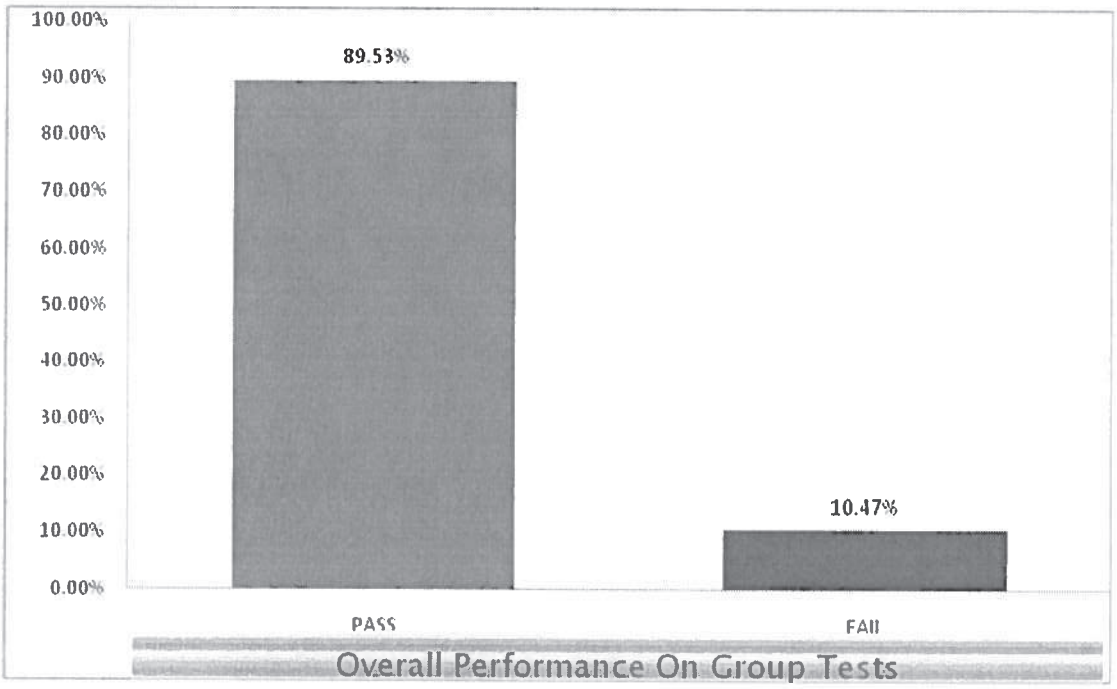

Exhibit 7

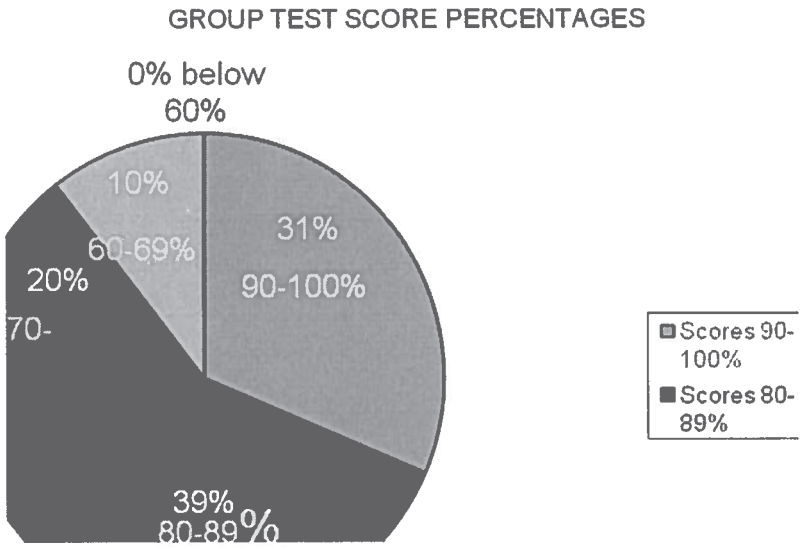

Exhibit 8

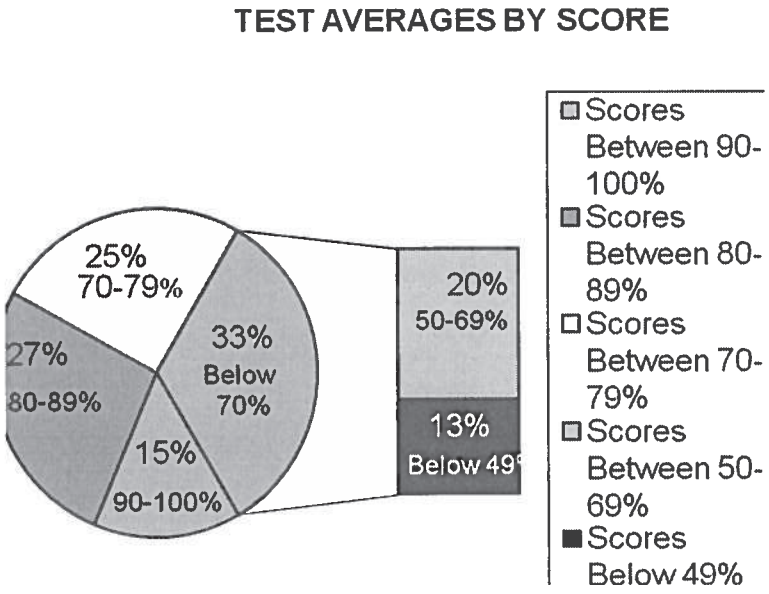

Exhibit 9

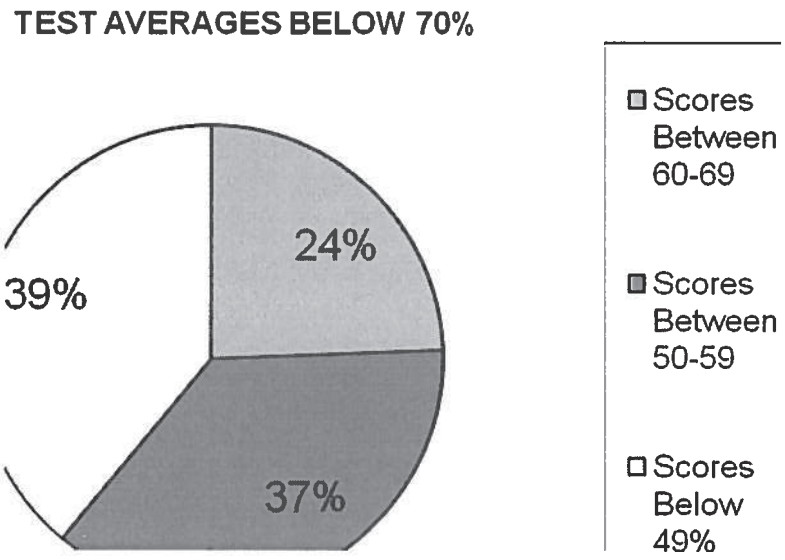

Exhibit 10

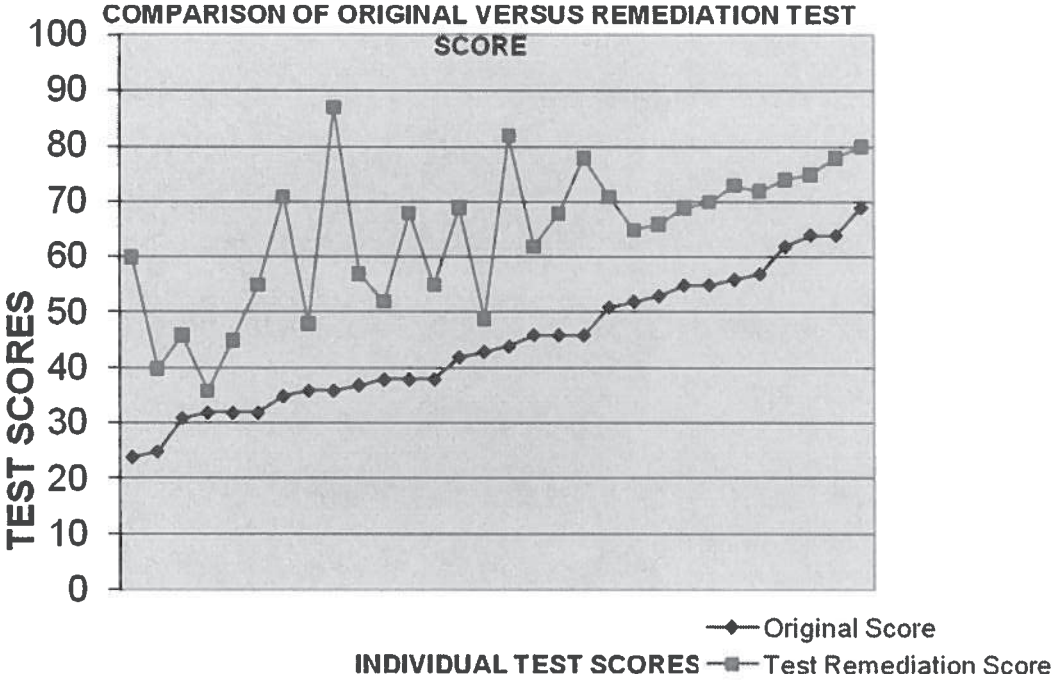

Exhibit 11

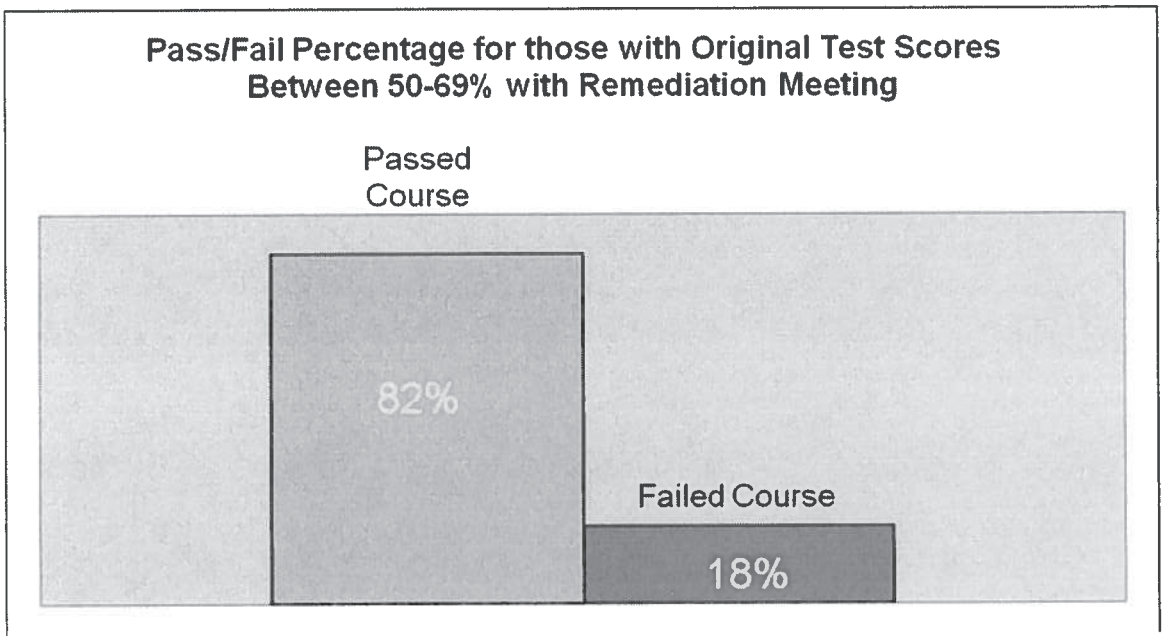

Exhibit 12

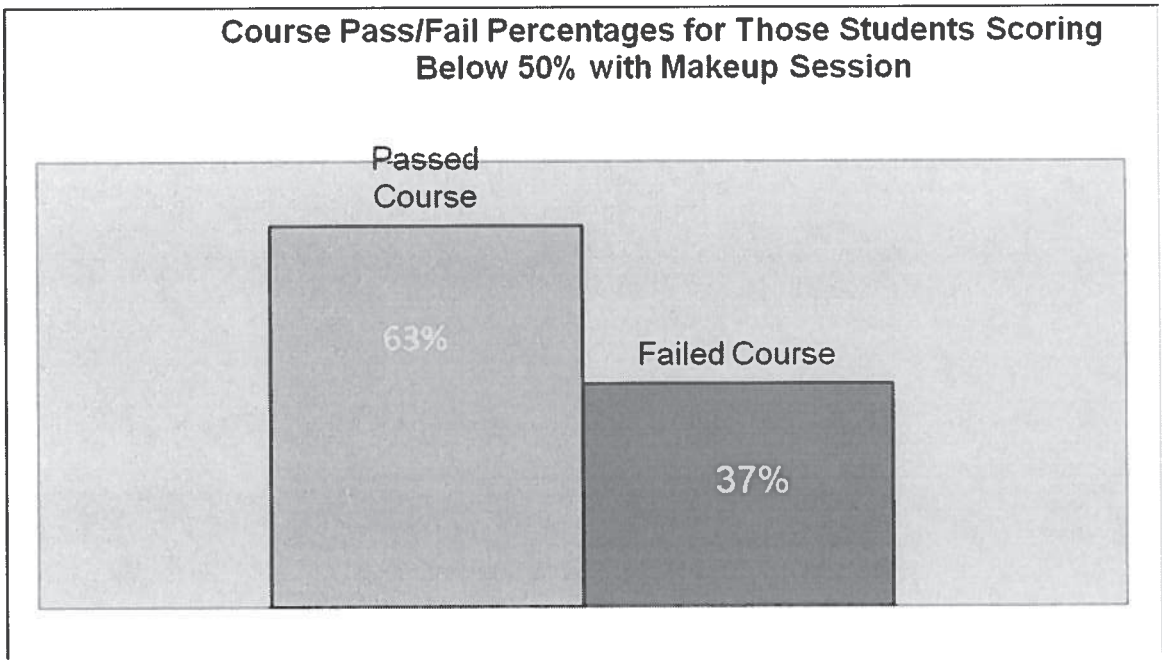

Exhibit 13

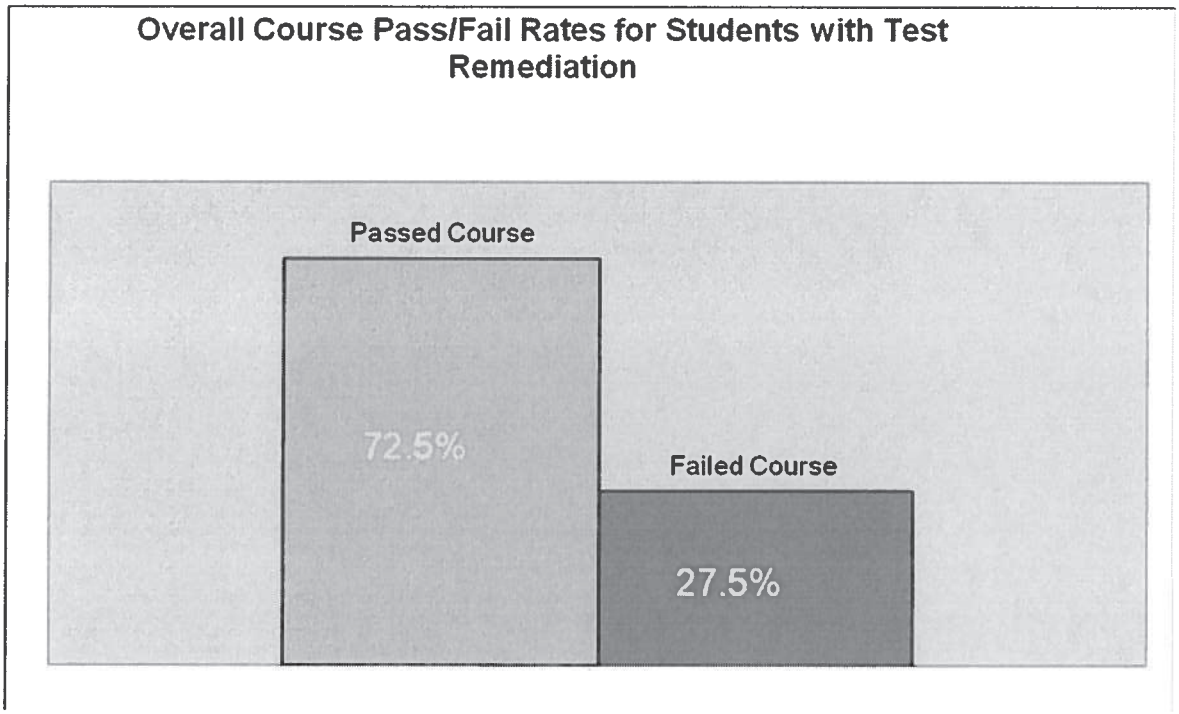

Exhibit 14