The National Center for Academic Transformation

Increasing Success in Developmental Math:
SMART Math at Jackson State Community College

by
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What is SMART Math at Jackson State Community College (JSCC)? SMART stands for Survive, Master, Achieve, Review and Transfer, and it represents JSCC's vision of how students experience developmental math in its redesigned format. Smart is also a word that can be applied to JSCC's innovative approach to increasing student success, although brilliant might be a more appropriate descriptor.

JSCC has been a participant in the Tennessee Board of Regents (TBR) Developmental Studies Redesign Initiative to reform its remedial and developmental math and English curriculum. JSCC redesigned its remedial and developmental math sequence, three courses with an average annual enrollment of ~2200 (283 in Basic Math, 909 in Elementary Algebra, and 1020 in Intermediate Algebra.) Prior to the redesign, the three courses were taught in traditional sections, and math professors developed their own instructional strategies to cover common course objectives. Students were required to pass a course or start over in the same course the next semester. Students also had to complete all three courses successfully before being accepted into most programs of study or taking certain college-level courses.

The traditional developmental math courses faced a number of academic problems, the most important of which was that typically only 42% of students passed. The developmental math program did not meet the needs of students who were diverse in levels of preparation, learning styles and specific educational goals. The courses were designed to *remediate high school algebra deficiencies*. Students were required to study topics that were not relevant to their majors, to take an entire course even though they were deficient in only some topics and to learn at the same pace using the same instructional strategies as the entire class. Developmental math frequently presented a road block to students' achieving their educational goals. Many students were delayed in taking college-level courses or applying for admission to their programs of study. Others gave up and dropped out completely.

JSCC's course redesign was complex. What were its key features?

1) Replacing Courses with Modules

JSCC's redesign replaced the three developmental math courses with 12 clearly defined modules mapped to the competencies originally required in the three courses. Courses were divided as follows: Modules 1, 2 and 3 for Basic Math; Modules 4, 5, 6 and 7 for Elementary Algebra and Modules 8, 9, 10, 11 and 12 for Intermediate Algebra. Students were required to complete one module satisfactorily before moving on to the next. If needed, students could begin the next semester with the next required module not completed during the previous semester. The redesign's multi-entry and multi-exit opportunities and individualized pacing permitted students more frequent opportunities for successful completion and more time to focus on deficient areas. Students could progress more quickly or more slowly, if needed. Because all sections used the same structure and procedures, students could change their schedules if needed without interrupting their learning. That meant they could go to different classes, during the day or in the evening, online or on-ground, as their life circumstances dictated.

2) Changing Collegewide Developmental Math Requirements

In the traditional sequence, students were placed into a particular developmental course based on ACT/Compass scores. Students were required to progress through one, two or three courses on a semester schedule until they exited Intermediate Algebra. Only then could they enroll in college-level math courses or their desired programs of study. JSCC recognized that student goals are different: they may plan to enter a program of study that requires advanced mathematics, to complete a general education mathematics course or to apply for admission to a nursing or allied health program. Consequently, the redesign moved away from remediating students' high school algebra deficiencies to preparing students for their particular educational goals. Students were required to master only the concept deficiencies that were relevant to their educational and career goals.

After defining the competencies to be included in each of the 12 modules, the math faculty determined which modules were necessary to succeed in each college-level general education math course. All other departments identified which modules were necessary to succeed in their college-level courses as well as their discipline's core math requirements. Departments with programs not requiring college-level math determined the modules necessary to succeed in those programs. Changes in developmental math prerequisites were approved by the college curriculum committee.

Of the 48 programs of study requiring college-level math courses, 35 required only seven modules (47.1% of the students); four required eight modules (31.2% of the students), and seven required all 12 modules (20.3% of the students). One required only six modules (0.8% of the students), and one required only four modules (0.6% of the students).

Students were advised of their multi-exit opportunities based on their program of study choice and of the need to take more modules if they later changed their majors. This was accomplished via information sheets for each major, focus-group sessions and individual counseling with math instructors and the students' academic advisors. The team made a campus-wide presentation at an in-service training and conducted sessions for advisor training in order to educate the college faculty and staff.

3) Using the Emporium Model

JSCC followed many successful NCAT math redesigns based on the Emporium Model and created the SMART Math Center, a computer lab where students worked with *MyMathLab* and received immediate one-on-one assistance from instructors and tutors. Students and their instructors were scheduled in the SMART Math Center three hours per week where attendance was taken. The SMART Math Center was open from 8:00 am to 9:00 pm Monday through Thursday and 8:00 am to 1:00 pm on Friday. Students could also work in the SMART Math Center more than the required three hours.

The availability of on-demand individual assistance in the SMART Math Center ensured that students received immediate help when needed. The variety of resources available accommodated students' various levels of preparation, math anxieties and diverse learning styles. While working homework, students had the option to ask for help online--where they could follow a step-by-step interactive guide, view an example, watch a video explanation or view the online textbook--ask the instructor or request assistance from a tutor. Students received immediate diagnostic feedback on homework and tests, which helped motivate them to persist until they understood the concepts.

An online grade book gave students continued feedback on progress. This motivated students to keep on until they got it right, increasing student persistence. Instructors monitored each student's progress as well as time-on-task and took appropriate action when needed. This let students know that they were being watched, which was an additional motivation for them to complete their work. The 12 different modules provided students more frequent opportunities to succeed. As a result, students acquired the attitude, “I can do this!” Students demonstrated a willingness to work harder and longer. Student attitudes were altered. Students persisted and saw math as something that could be mastered with lots of hard work and time. They perceived success as their responsibility and sought individual best ways to succeed such as using videos, the example button or the help-me-solve-it button requesting individual help from the instructor or a tutor; or initiating a small-group discussion with the instructor.

4) Emphasizing Mastery Learning

JSCC used a customized textbook to provide a bridge for students from the traditional way of learning to a technology-guided method. Instructors developed Guided Studies for each module, which correlated with sections in the textbook. Guided Studies (the equivalent of a paper-and-pencil workbook) provided key problem-solving techniques, examples and practice problems. After completing a section of the Guided Studies, students were prepared to start the online homework generated by *MyMathLab* with problems chosen to correlate with the textbook and the Guided Studies. Each student maintained a notebook, containing the completed Guided Studies and practice tests. The notebook was graded holistically for organization, completeness, neatness and accuracy in general.

Before students could move from one homework assignment to the next, they were required to demonstrate 80% mastery. After all homework for a module was completed, students took a practice test where the online learning aids were not available. Students could work the practice test as many times as needed. Once ready, students took an online proctored post-test in the SMART Math Center. The post-test comprised 70% of the overall module score. If a student was not successful on the post-test, he or she could ask for help at the Coaches’ Corner where an instructor reviewed the student’s work on the test and recommended remediation techniques before retaking the test. The remaining 30% of the module score was for attendance (5%), notebooks (10%) and homework (15%). The overall score had to be at least 75 to satisfactorily complete the module.

Originally, students were placed in a developmental course if their ACT/Compass scores were less than 19 or 29 respectively. Students were then given an in-house diagnostic test using MyMathTest. Since most students ended up being placed in Module 1, the team decided that the second testing was a waste of students’ time. The team now starts all students in Module 1 and requires them to pre-test out of each module that their program requires after doing the Guided Studies. Now each student passes each module, proving mastery of each skill rather than a general level of competency as indicated by ACT/Compass scores. A student demonstrating 80% mastery on the pre-test passes the module and moves to the next module. A student making less than 80% on the pre-test completes the homework, Guided Studies and post-test for that module. Some students choose to do the Guided Studies before taking the pre-test if they just need to refresh their memory.

The Results: Improved learning

Students in the redesign learned significantly more than students in the traditional classroom format.

Mean Module Post-Test Scores

All Courses

Redesign students ultimately increased their average post-test scores in all courses by 15 points. In spring 2008, 11 traditional sections (220 students) and 13 redesigned sections (356 students) were offered on JSCC's main campus. In the traditional sections, the average post-test score for all 12 modules was 73%. For the redesigned sections, it was 82%. In fall 2008, the average increased to 85%. In spring 2009 the average increased to 88%.

Basic Math (Modules 1 through 3)

Redesign students ultimately increased their average post-test scores by five points. In spring 2008, Basic Math post-test scores from traditional sections were compared with post-test scores from redesigned sections. In the traditional sections, the average post-test score for all three modules was 82%. For the redesigned sections, the average was 82%. In fall 2008, the average in the redesigned sections was 86%; in spring 2009, the average was 87%.

Elementary Algebra (Modules 4 through 7)

Redesign students ultimately increased their average post-test scores by 18 points. In spring 2008, Elementary Algebra post-test scores from traditional sections were compared with post-test scores from redesigned sections. In the traditional sections, the average post-test score for all four modules was 69%. For the redesigned sections, the average was 81%. In fall 2008, the average in the redesigned sections was 84%; in spring 2009, the average was 87%.

Intermediate Algebra (Modules 8 through 12)

Redesign students increased their average post-test scores by 12 points. In spring 2008, Intermediate Algebra post-test scores from traditional sections were compared with post-test scores from redesigned sections. In the traditional sections, the average post-test score for all five modules was 70%. For the redesigned sections, the average was 82%.

Beginning in fall 2008, students could early-exit the developmental math sequence based on the requirements of their programs of study. Only 20.3% of JSCC students were required to complete all five modules, the equivalent of Intermediate Algebra. (Another 31.2% had to complete only module 8; these students did not have to complete modules 9 – 12.) Because the "weaker" math students—those not requiring the equivalent of the Intermediate Algebra course—were removed from the redesign sample, the higher average scores of 85% in fall 2008 and 89% in spring 2009 may be partially due to the remaining students being "stronger."

The Results: Student Success Rates

Because JSCC radically changed the structure of its developmental math program, it is impossible to show comparative completion rates of individual courses other than in the spring 2008 pilot semester when all three developmental courses were offered using the module concept. Only the pedagogy differed: traditional sections were taught in traditional classrooms using traditional pedagogy whereas redesigned sections were offered in the SMART Math Center using the Emporium Model.

In spring 2008, 11 traditional sections (220 students) and 13 redesigned sections (356 students) were offered. In the traditional sections, 41% of the students received a passing grade (C or better) compared to 54% of students in the redesigned sections. The spring 2008 pass rate was comparable to JSCC's historical 42% pass rate.

- In Basic Math, 47% of traditional students received a passing grade compared with 54% of redesign students.
- In Elementary Algebra, 32% of traditional students received a passing grade compared with 66% of redesign students.
- In Intermediate Algebra, 48% of traditional students received a passing grade compared with 44% of redesign students.

From fall 2008 onward, students in the redesign proceeded through the required modules at their own pace. When one semester ended and another began, students simply resumed work on the modules not completed. Thus, both the elements of "course" and "time" were removed. Since students "completed" "courses" under very different conditions, it is only possible to compare overall completion rates in the traditional and redesigned format for the developmental math program as a whole.

In the redesign, students enrolled in a "shell course" described below. The grade awarded was the average of the four (or fewer if required) modules completed.

In fall 2008, 57% of the 711 students enrolled in redesigned sections received a passing grade (C or better) compared to 41% in the spring 2008 traditional sections. In spring 2009, 59% of 670 students enrolled in redesigned sections received a passing grade.

Thus, JSCC increased the overall student success rate in developmental math by a very impressive 44%.

Completion Rates per Module

In order to pass a module, the overall score had to be at least 75. The chart below shows the number of students enrolled in each module and the percentage of those students who scored 75 or above on the overall module score.

	Redesign	Fall 2008	Redesign #	Spring 2009
Basic Math		**Passed**	**Students**	**Passed**
1	487	91%	216	85%
2	472	89%	200	87%
3	388	93%	205	87%
Elementary				
4	382	97%	200	96%
5	269	93%	223	84%
6	213	96%	194	94%
7	170	95%	193	93%
Intermediate				
8	178	88%	176	86%
9	98	77%	76	70%
10	91	87%	70	79%
11	68	97%	59	100%
12	52	96%	49	96%

Improved Retention

JSCC defines retention as the percentage of students enrolled until the end of the semester. In spring 2008, 74% of students in the traditional course remained to the end. In fall 2008, 75% of redesign students remained to the end; in spring 2009, 83% remained to the end.

Reduced Failures

Failing grades were reduced in the redesign. In spring 2008, 37% of students enrolled in the traditional course received a failing grade compared with 27% in the redesigned sections. In fall 2008, 22% of the redesign students failed; in spring 2009, 25% of the redesign students failed.

If failing grades are separated by students who stopped coming to class versus students who stayed to the end, the number of those who stopped coming was 12% in the spring 2009 redesign. Therefore, JSCC assumes that the 13% who stayed to the end but did not pass completed at least one or more modules and will likely be successful when re-enrolling in the following semester.

Exiting the Developmental Math Program

Historically, an average of 18% of all students enrolled in the traditional developmental math program passed Intermediate Algebra, which was the only way to exit the developmental math sequence, and were ready to enter college-level courses and/or programs. In fall 2008, 36% of all students enrolled in the redesigned developmental math program completed all required developmental math modules. In spring 2009, that percentage increased to 42%.

Clearly, the policy change requiring students to complete only the number of modules required by their majors had an impact on the increased percentage of student exiting the developmental math program. Of the 1438 students enrolled in developmental math during fall 2008 and spring 2009, 546 students (38%) completed their program-determined developmental math requirements. Of those students, 140 students (26%) completed all 12 modules. Of those 140 students, only 42 were required to complete 12 modules. Seventy-four percent of the students (N=406) completed their requirements, in part, because of the policy change allowing early exit after mastering the modules their programs required..

Future Plans

In order to understand more fully the impact of changed pedagogy on student success versus the impact of the policy changes, JSCC plans to track a cohort of students beginning in fall 2009. They will establish a randomly selected cohort of students (including their ACT/Compass scores) who first enrolled in developmental math in fall 2009 and classify students in three conditions: 1) programs requiring 7 modules, 2) programs requiring 8 modules, and 3) programs requiring 12 modules. They will then determine how many of the students in each condition completed how many modules by the end of fall 2009 and spring 2010.

The Results: Cost Reduction

Institutional Savings

In the traditional model, JSCC offered 89 sections of 20 – 24 students during fall and spring, 63 of which were taught by full-time faculty at an instructional cost of $290,871 (which is 80% of salaries, omitting the 20% of instructor time devoted to other-than-instructional responsibilities) and 26 by adjuncts at a cost of $37,778. The cost of tutors was $4,510, bringing the total cost of the traditional course to $333,159.

In the redesigned model, JSCC offered 71 sections during fall and spring; 44 sections enrolled 30 students and 27 enrolled 24 students. The number taught by full-time faculty was 37 at a cost of $170,829, and the number taught by adjuncts was 34 at a cost of $49,402. (These costs were calculated using the same baseline salary figures as the traditional rather than actual salaries in 2009-09 in order to demonstrate the effect of the structural changes made in the course.) The cost of tutors was $38,298, bringing the total cost of the redesigned course to $258,529. The cost-per-student was reduced from $177 to $141, a 20% decrease.

The availability of several tutors and instructors in each class made it possible to increase section size and still provide individualized attention and assistance to all students. Tutors were utilized at a lower cost per hour, and faculty hours spent on developmental math were reduced by eliminating duplication of faculty responsibilities.

The mathematics department has had three faculty members retire over the past several years, and none have been replaced. Without the redesign of developmental math, it would be impossible to maintain integrity in all math courses with only eight full-time faculty.

Student Savings

Students saved tuition dollars since they were allowed to register for fewer hours in developmental math than would have been required in the past and they could complete their developmental requirements in a shorter length of time (i.e., in one term if they were motivated to do so.) Students did not have to pay for unnecessary coursework. Students could also adjust their schedules to suit life changes instead of having to withdraw from the course and lose the tuition they had paid for the course.

Future Plans

Clearly JSCC made a lot of changes in a very short time. The savings described above reflect what happened in the first year of redesign. JSCC anticipates even greater savings in the future due to three factors:

1) JSCC believes that the ratio of tutors working in the SMART Center to the number of students enrolled may decline in the future since more tutors were needed in the initial redesign development process than will be needed now that the program is fully implemented.

2) By changing the requirements for developmental math completion, JSCC theoretically reduced the number of sections/modules they needed to offer by 31%. (During the 2008-09 academic year, 1836 students were enrolled in developmental math. JSCC needed to offer the equivalent of 15,241 modules to serve these students under the new policy. Assuming similar placement distributions, JSCC would have had to offer 22,032 modules under the old policy.) This reduction was not fully realized in the first year of implementation.

3) Approximately 18% more students are exiting the developmental math program sooner in the redesigned format than previously, which will reduce still further the number of sections needed. This 18% translates to seven sections which do not have to be offered.

Implementation Issues

Since students could exit developmental math once required modules were completed based on declared educational goals, figuring out how to register and charge students for this radically new redesign was not trivial. In addition, JSCC had to also figure out how to phase in the

redesign in the midst of normal operations. They were incredibly clever and resourceful in their solutions!

Shell Courses

Since 12 modules were available and students could complete anywhere from one module to all 12 modules within a single semester, the team had to determine what each student should register for at the beginning of each semester. Three "shell courses" were created: Developmental Math I, Developmental Math II and Developmental Math III. No modules were assigned to any of the three "shell courses." Instead, all new students enrolled in Developmental Math I and were required to complete at least four modules or all modules required if fewer than four. Students completing all required modules or at least four of the required modules passed Developmental Math I. The course grade was the average of the modules completed or all modules required if fewer than four.

One of three things happened at the end of the semester:

1) Students who passed at least four modules and who still needed to complete more modules enrolled in Developmental Math II in the next semester.

2) Students who did not pass at least four modules or the required number of modules but who completed at least half of the required modules and continued working until the end received a PR (progress) grade and enrolled in Developmental Math I in the next semester.

3) Students who passed one or no modules received a failing grade and re-enrolled in Developmental Math I in the next semester.

In the next semester, Developmental Math I and II were offered.

Developmental Math I comprised 1) new students and 2) students who did not pass Developmental Math I in the preceding semester.

Developmental Math II comprised who passed at least four modules in the preceding semester and still needed to complete more modules.

In the next semester, Developmental Math I, II and III were offered.

Developmental Math I comprised 1) new students and 2) students who did not pass Developmental Math I in the preceding semester.

Developmental Math II comprised 1) students who passed at least four modules in the preceding semester and who still needed to complete more modules, and 2) students who received a PR (progress) grade or an F in the preceding semester in Developmental Math II.

Developmental Math III comprised students who passed Developmental Math II in the preceding semester and still needed to complete more modules.

Phase-In

During spring 2008, the three developmental courses were offered using the module concept. Redesigned sections were offered in the SMART Math Center whereas traditional sections were taught in traditional classrooms.

During fall 2008, only one "shell course," Developmental Mathematics I, was offered for all redesigned sections, and all students, both new and returning students who had not completed previous developmental math coursework, were enrolled in that course. New students were assessed to determine deficient modules. Returning students began with the first required module not successfully completed the semester before.

During spring 2009, Developmental Math I was taken by new students and those not passing Developmental Math I during the fall 2008 semester. A student not passing a Developmental Math course had to enroll in the same "shell course" the next term and begin with the first required module not completed. Developmental Math II was offered for students who had passed Developmental Math I but still had more modules to complete. Instructors guided the study of students in combined sections of Developmental Math I and II with each student possibly working on any one of the 12 modules.

During fall 2009, all three "shell courses" are being offered as described above.

Grading

The "shell course" grade was the average of the four (or fewer if required) modules completed. If a student completed more than four modules, the extra module grades were averaged as part of the next "shell course" grade if more modules were needed. The modules completed when enrolled the first time were then counted toward the modules required to complete the course. A student early-exiting developmental math based on educational goals was graded on the required modules. The team is still searching for a way to indicate that the grade was based on the student's declared major.

Tracking

Tracking modules completed by students has been a monumental task for JSCC. A table was created within SOATEST/Banner to indicate modules completed for each student. When a module was indicated as complete, the student could then enroll in any college course for which the module was a prerequisite. Periodically during the term, each instructor reported modules completed by the students. The team is working to automate the process of tracking students' module completion and reporting to Banner.

Groups vs. Individualization

The team originally planned to hold weekly focus groups. In spring 2008, the focus groups were somewhat successful since the students were enrolled in specific courses. However, beginning in fall 2008, focus groups were not very effective since students in any given section could be working on any of the 12 modules. In addition, those students not having particular problems did not want to leave the lab where they were working on their modules to attend a weekly meeting—a delightful problem to have. In addition, the creation of Guided Studies successfully replaced much of the expected need for focus groups by structuring each student's learning experience. Focus groups were not attempted in spring 2009 except at the beginning of the term for orientation purposes where instructors explained the syllabus, the concept of modules and the opportunities the redesign offered.

The team still hopes to use focus groups at the beginning of the semester to help students improve study skills, identify learning styles and understand the SMART Math processes. Some students complained that they missed having a teacher, and the team wishes to fill that need or at least help the students understand that they have the best of all options. Also, with all shell courses now being offered each term, one instructor can be assigned to only Developmental

Math I or Developmental Math II or Developmental Math III with the students more likely to be working on the same competencies.

Conclusion

By any measure, JSCC's redesign of their developmental math program has been an outstanding success. Because it is still early in the redesign process, in all likelihood both student learning and cost reduction can be expected to increase even further.

It may be tempting for some to say that JSCC's success has been achieved primarily by "changing the rules" since the developmental math requirement for a large number of students has been substantially reduced. The data presented above, however, shows clearly that student learning has increased under the redesign and that only the "early-exit" aspect is influenced by the change in policy.

JSCC has decided that it is more important to prepare students to succeed in the future than to remediate the past. That is a decision that every institution struggling with low student success rates in developmental math will need to make. If you decide that requiring students to sit through courses that will not be needed in their programs of study simply delays or prevents them from moving forward and does not add value to their overall education, JSCC's innovative model shows a clear way to implement that decision. If you decide to maintain the same developmental math requirements, JSCC's innovative model also shows a clear way to implement that decision in a way that will increase student success.

We congratulate JSCC on their magnificent achievement!