Student Success in Mathematics: Guiding Principles

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The Problem

- College Algebra is required for many majors, including all the sciences.
- Student success (a grade of C- or better) was low.
- Drop-rate was high.
- Students hated math and procrastinated as long as possible.
- Students had to retake College Algebra.
Concerns of the math faculty

- High failure rate
- Effect on student retention
- Sacrificing quality for quantity
- Lack of uniformity among course sections
Our Goals

- Increase student understanding and success in math
- Better prepare students for success in future courses
- Provide uniformity among all the sections of the course
- Increase student retention
- Increase students’ confidence in their math ability
Increase in Student Success

Student Success Rate in College Algebra

Success Rate

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Academic Year

01-02 02-03 03-04 04-05 05-06

Pre

Post
Structure of the Redesigned Course

- One 75 minute lecture
- Two 75 minute labs in the Math Technology Learning Center (MTLC)
- Homework online using software called CourseCompass
Pre-Lecture Preparations

Weekend Prior to the Lecture

- “Task of the Week” Worksheet
- Outline of material
- CourseCompass homework – can be done at home or in MTLC
“Lecture”

- Present overview of new topics
- Answer questions
- Review for upcoming tests
- No formal lecture
- Sample problems worked for students
Sources of Student Help

- Online tutorials and guided solutions
- “Ask My Instructor” online help
- Peer tutoring
- TA and faculty
Math Technology Learning Center

- Complete homework
- Individual help
- Peer tutoring
- Take quizzes and exams
Assessment

- Weekly online homework
- Weekly online quizzes
- Four hourly exams
- Comprehensive final exam
What are the results?

- Increased passing rate in the course
- Fewer repetitive questions in class
- Fewer student complaints
- Better prepared students for the future
Why does it work?
Guiding Principles

Principle 1: Provide a clear structure for the course that helps the students through the course

Principle 2: Provide sufficient time-on-task and enforce deadlines

Principle 3: Reward students for their efforts
Guiding Principles

- Principle 4: Provide regular assessment of progress
- Principle 5: Accommodate diverse styles of learning
- Principle 6: Stay in touch
Principle 1: Provide a clear structure for the course that guides the students through the course

- The lecture session provides an anchor and structure for the course that helps the students to focus on the tasks they need to complete that week.
  - Online, post lecture outlines, a worksheet, and the tasks for next week
  - Open homework for the next week
  - Since many of the students have already worked on the homework at home before they come to the lecture class they are better prepared to ask questions

- The responsibility for learning is on the shoulders of the students.

- The instructors are there to provide structure, guidance, and to help students in their learning.
Principle 2: Provide sufficient time-on-task and enforce deadlines

- Use technology to provide sufficient information and practice problems for students to learn at their own pace.
- **Not** a self-paced course. Less interested and motivated students require a high degree of structure to be successful in courses they do not want to take.
- Use a rigid schedule, use technology to open and close student access to assignments, to quizzes and exams.
  - Students must complete the assignments within a specified window of time or the opportunity is lost.
- Tutorials and problems are always available so students who get behind can catch up, but they lose points if they do not complete an assignment on time.
- When a new instructor complains that the homework system is not working, it is generally because homework deadlines are not enforced.
Principle 3: Reward students for their efforts

- Students can retry a homework problem multiple times, and many will try until they get the correct answer.
- The reward is a higher score if they succeed.
- The homework contributes one-eighth of their final grade and their homework score is entirely under their control. More effort leads to a higher grade.
- The weekly quizzes have the same types of problems as the homework, so students who have practiced the problems to increase their homework scores also score better on the quizzes.
- Students who spend the time to improve their homework scores actually understand the concepts, know how to work the problems, and therefore do well on the exams.
Principle 4: Provide regular assessment of progress

- Online homework and quizzes with online grading provide students with
  - immediate feedback
  - the opportunity to correct their homework mistakes
  - ongoing assessment of their success in the course

- Students have both the responsibility for their own learning and the means to be successful in learning math.

- Online grade book - students know their grades, know when they need help and know where to find it.
Principle 5: Accommodate diverse styles of learning

- Students seek and benefit from help that is available in a variety of forms.
- Some successful students work individually using the tutorials and guided solutions that are available with the software.
- Most students benefit from the resources provided in the MTLC where the instructor and several teaching assistants are available for individual assistance.
- The MTLC also allows students to collaborate, teaching each other and solving problems together.
- The MTLC also has an area with tables and whiteboards for small group lectures and discussions.
- Especially for students who are not comfortable with the subject, the availability of help in the MTLC is critical to their success.
Principle 6: Stay in touch

- Even with guidance, structure and help, some students fall behind.
- Many students prefer anonymity; however the online grade book makes their progress easy to track.
- A missed assignment triggers a quick message offering help.
- Intervention must begin early and must be maintained with reluctant students. Once these students get off the right track it can be very difficult to get them back on.
- The personal attention of the instructor often provides all the motivation a student needs to complete the assignments.
Benefits

- Uniformity in course content
- Promotes active learning
- Provides students with individualized assistance
- Promotes student collaboration and peer learning
- Builds in ongoing assessment and prompt feedback
- Ensures sufficient time on task and monitors student progress
Applying These Principles across the Curriculum

- Less lecture time – more time in active learning
  - Smaller classes - group discussion and presentation interspersed with short lectures
  - Larger classes, personal response systems, keep students engaged
  - Points for active learning experiences within a lecture setting increases student engagement

- Defined course structure with clear expectations for students
  - Many students overwhelmed by the amount of work expected of them in college courses
  - The less structure, the more likely students are to procrastinate
  - Homework assignments with a firm deadline can enhance student success in many courses

- Technology can increase contact with students, personalizing interaction
  - Communication by e-mail and instant messenger is not only normal for most students, it is perceived as personal.
  - Small gestures such as using a student’s name in an e-mail can further the sense of connection and motivate students who often feel invisible.
Cost issues

- Negative - Course reductions for the faculty who were developing the redesign.
- Negative - $350,000 for the MTLC
- Positive - increase in class size (35 to 70), which decreased instructional costs over the longer term. Despite increase, more individual student attention.
- Positive - cost savings from the increased student retention and progression to graduation.
- Negative ($) and positive (success) - decline in enrollment because many students do not retake the course.
Cost of Shattered Dreams

- Pre-pharmacy major
- Failed College Algebra twice
- Changed major to Communication
- Took College Algebra in MTLC – earned an A
- Took Calculus in MTLC - earned an A
- Changed major back to pre-pharmacy
Facilitating Change

- Maintain flexibility, make incremental changes, remember that slow progress is better than no progress, and keep both a sense of perspective and a sense of humor.

- Faculty resist change.
  - Be respectful but insistent that technology, used appropriately, not only enhances student learning but also frees their time to work individually with students.

- Provide adequate training in the guiding principles, the techniques for implementation of these principles, and in the technology.

- Students resist change.
  - They are accustomed to having a passive role in their learning and often object when the responsibility is placed on their shoulders.
  - Many of them do not want to use technology as a major tool for learning.
  - Be respectful but insistent that they learn best when they are actively engaged in the process of learning and that help is available.
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