

## ASSESSMENT WEBSITE INFORMATION

**College:** Sciences and Mathematics

**Degree Program:** Mathematics BSE

**Chair/Director:** Debra Ingram

### **DATA SAY:**

We collected data during Spring 2011 and Fall 2011 on the following learning outcome (proof writing): “The graduate of the B.S./B.S.E. Mathematics degree program will demonstrate competence transferring mathematical reasoning to written statements of mathematical proof through the use of definitions, theorems, and formal mathematical statements.” We collected learning artifacts relevant to proof writing in MATH 3303, Modern Algebra I, and MATH 3343, College Geometry. One finding is that students would benefit from a lower-level course taken early that introduces mathematical abstraction and some proof writing. Students do develop skills in mathematical reasoning through problem-solving in the prerequisite course, MATH 2214, Calculus II. However, practice in applying mathematical reasoning in more abstract settings will enhance students’ readiness for proof writing. Another finding is that time-on-task and continued practice are essential elements to learning how to write proofs.

### **SO WHAT:**

The Department of Mathematics and Statistics Curriculum Committee met on January 11, 2012, and discussed (1) how and when students should be exposed to proof writing; (2) whether or not changes to our curriculum and prerequisite structure would enhance student learning in proof writing. For example, should our curriculum include an introduction to proof writing course? When should it be offered? Should proof writing be assessed through a capstone course? How could we cover additional courses with our limited faculty resources?

### **HOW WE CHANGED:**

MATH 2183, Discrete Structures, is already required for the B.S.E. Mathematics degree; however, there is significant variability in terms of which semester students elect to take the course. The course is not a prerequisite for other courses in the curriculum. It is also quite rigorous and somewhat abstract, so students tend to put it off. The department voted to strongly encourage students to take the course early in academic advising sessions. Making the course a formal prerequisite for courses that involve proof writing or are mathematically abstract (e.g., MATH 3303, Modern Algebra I; MATH 3343, College Geometry; MATH 3243, Linear Algebra; MATH 4553, Advanced Calculus I; and STAT 4453, Probability and Statistics I) was considered but the decision was postponed until the ripple effect on course rotation and faculty coverage can be determined.

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### WHAT WE GOT:

The state-mandated transition to 120-hours for all degree programs (reduced from 124 hours) and ASU's adoption of the state's minimum general education core of 36 hours (reduced from 45 hours) allowed us to add MATH 2183, Discrete Structures, to the B.S. Mathematics degree program without having to "trade out" something else in the major requirements. This was very beneficial.

All incoming freshmen B.S. Math and B.S.E. Math majors for 2012-2013 will take Discrete Structures and will be advised to take the course early. We expect they will benefit from early exposure to applying mathematical reasoning in more abstract settings and introductory proof writing; and that this early exposure will enhance the learning of proof writing in MATH 3303, Modern Algebra I; MATH 3343, College Geometry; MATH 3243, Linear Algebra; MATH 4553, Advanced Calculus I; and STAT 4453, Probability and Statistics I.

Current students will have a choice of whether to use the 2012-2013 degree plan or continue to pursue an older version for which they are eligible. Students who are not far along in the general education requirements (e.g., sophomores) are typically deciding to use the 2012-2013 degree plan. Therefore, these students will also take Discrete Structures and have the opportunity to benefit from early exposure to proof writing as well.

The Mathematics Major Field Test (MFT) was given to approximately 30 students in December 2011. B.S. Mathematics and B.S.E. Mathematics students enrolled in MATH 3303, Modern Algebra I, (a required course for both majors) participated. Although all students are math majors, the mathematical background and maturity of the students who took the MFT varies. (Calculus II is the prerequisite but some students were much farther along in the program.) The Assessment Office helped us collect important data that identifies the mathematical background of each student, including whether or not the student took MATH 2183, Discrete Structures. The data is extensive and is being analyzed. The department will discuss the future use of the MFT and how it can and should be used to measure learning in all of our learning outcomes, including proof writing. For example, should the MFT be used as a capstone, mid-program review, both, or neither?

