Mathematics 2011 AOC Report

At UW-Platteville, the mission of the Mathematics Department is to teach and give constructive feedback to the following four types of students:

- math majors, some of whom go on to graduate school in mathematics;
- first-or-second-year students wanting to enter an engineering program;
- prospective K–12 teachers; and
- “captured” students [Stein 1972: the wide variety of students who, much to their surprise and disappointment, are suddenly forced to study a subject that they have been fleeing for years, even if fresh out of high school], needing to meet the UWP “mathematics competency” requirement.

We assess each of the four student cohorts as follows.

<table>
<thead>
<tr>
<th>Student Type</th>
<th>Assessment Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math majors</td>
<td>Senior program evaluation paper And exit survey</td>
</tr>
<tr>
<td>Engineering students</td>
<td>Math portion of Fundamentals of Engineering exam</td>
</tr>
<tr>
<td>Prospective K-12 teachers</td>
<td>Praxis II exam</td>
</tr>
<tr>
<td>Captured students</td>
<td>Basic skills math test</td>
</tr>
</tbody>
</table>

The information generated is used to assess our success at teaching students mathematics competency.

**Mathematics Major Evaluations and Exit Surveys**

In the period from spring 2008 through spring 2011, 38 graduating seniors completed a program evaluation paper. They were asked to reflect on their experiences in the program as a Mathematics Major and comment on each of our departments six learning outcomes. The learning outcomes are that the student can:

1. communicate mathematics effectively;
2. demonstrate a computational ability in solving a wide array of mathematical problems;
3. differentiate between valid and invalid mathematical reasoning;
4. develop mathematical ideas from basic axioms;
5. utilize mathematics to solve theoretical and applied problems; and
6. identify applications of mathematics in other disciplines and in society.

Student comments consistently indicated that outcomes 1–5 were met, while a majority felt that learning outcome 6 was met. Nearly all students commented positively on their experiences in their math courses. Students commented on their positive interactions with the faculty, both in their Senior Seminar projects and in their upper division courses. Many
commented with pride on how they made connections between their different courses. Many commented positively on their trials of doing homework, and their own growth as mathematicians. Nearly all of the students appreciated the standards held by the faculty in the Mathematics Department.

All evaluation papers indicate that the math courses we offer helped the student to either learn to communicate effectively, or to communicate mathematical ideas more effectively. Many cited their experiences in learning to write proofs and their experiences in their upper level statistics class. Students overwhelmingly felt that our courses developed their computational ability in solving a wide array of mathematical problems.

The students gave strong positive remarks on being able to differentiate between valid and invalid reasoning. In mathematics, this is developed through proof writing. Most courses offered beyond the Calculus sequence will require the students to write proofs, which is more than doing mechanical computations.

Many of our mathematics majors have commented in the past that they would like an introduction to proof writing before taking our advanced proof courses: Advanced Calculus, Geometry, and Modern Algebra. The department has addressed this in two ways. We have made an effort to direct our majors into the Discrete Mathematics course, which is a course where students learn how to write correct proofs. We have also increased the amount of proof techniques in Linear Algebra, and have made “a grade of C or better in Discrete Mathematics or Linear Algebra” as a prerequisite for our advanced courses such as College Geometry, Modern Algebra, and Advanced Calculus.

Nearly all students expressed their belief in being able to develop mathematical ideas from basic axioms. Most cited their experiences in Modern Algebra, Geometry, and Advanced Calculus. Nearly all students commented on their repeated experiences in utilizing mathematics to solve theoretical problems and applied problems. The last learning outcome is to identify applications of mathematics in other disciplines and in society. The students who took the upper level statistics class felt that this outcome was met. Others thought it was a weakness in our program.

In the period from spring of 2008 through spring of 2011, 28 graduating seniors completed exit surveys. Uniformly, the students were satisfied with their education, and expressed in various ways that the faculty was the strength of the department. Comments touched on the faculty’s knowledge, teaching ability, accessibility and willingness to help. Interestingly, one student also felt very strongly that the department’s high expectations was an important strength of the department.

The students were asked for their perceived weaknesses of the department. There were no consistent suggestions in the responses, except that many thought that there should be more (or less) coursework of a particular type, usually in line with their interests. That is, those going to graduate school thought that there should be more advanced theoretical courses, while those in education thought there should be fewer such courses and more material related to teaching mathematics. There were a few isolated comments suggesting a need to have more consistency in expectations in multi-section courses taught by different professors.

All students are required to take senior seminar. A few students felt that they could have been better prepared to take the course, but the majority of the respondents thought that this was a very enjoyable and rewarding experience. Some suggested that there should be more opportunities for undergraduate mathematical research. Also, those students that attended the Mathematics Department Colloquiums felt that the presentations were interesting and beneficial.
The students were asked to evaluate eight “academic preparation areas”, which were rated on a scale of 1 (poor) to 5 (excellent). The average scores for the eight areas ranged from 3.79 to 4.46. The four lowest scores were in the areas of “ability to use technology appropriately and correctly” (4.04), “ability to formulate and write correct mathematical proofs” (3.93), “ability to communicate mathematical ideas in written form effectively” (3.93), and “ability to orally communicate mathematical ideas effectively” (3.79). While all of the scores are in the above average range, it may indicate a need to provide students with more opportunities to write and communicate mathematics.

The Fundamentals of Engineering and Praxis II exams

A portion of the FE exam contains 19 questions covering material from the Calculus sequence, Differential Equations, and upper level Statistics. Two distinct groups take the test: current students in an engineering program, and graduates. Between October 2008 and November 2010, 363 engineering majors and graduates took the FE. The scores on the math portion tend to be around 75% correct response rate. Individual scores varied from 47% to 95% correct response rate. The math content covers material the student may have had two or more years prior to taking the exam. We note that the overall FE pass rate for these test takers was 88.4%. We feel that our efforts are helping these students succeed in their major studies.

From 2008–10, eighteen secondary education mathematics students took the Praxis II exam. The test covers five broad categories:

- Algebra and Number Theory,
- Measurement, Geometry, and Trigonometry
- Functions and Calculus
- Data Analysis, Statistics, and Probability
- Matrix Algebra and Discrete Mathematics

Over this time, 17 of 18 students passed the exam on their first attempt, and the remaining student passed on their third attempt.

From the 2009 and 2010 data (12 students), students performed best within the category Measurement, Geometry, and Trigonometry (76.2 % correct) and poorest within the category Algebra and Number Theory (71.9% correct). The department is concerned with the low percentage of correct answers. These passing, but low, percentages have at times been reflected in some of our senior mathematics education majors not having a high enough grade point average to student teach. In response, we implemented a new prerequisite in our course, MATH 3020: Teaching of Mathematics in the Middle and Secondary School, which requires a grade of B or better in Calculus I and Calculus II.

The Basic Math Skills exam

In the late 1990s at UWP, the university was trying to assess math skills with the ACT-CAAP (Collegiate Assessment of Academic Proficiency) test. There had been an attempt on the part of the Assessment Oversight Committee to relate variables like ACT scores or UW System math placement levels vs. the CAAP scores we had been working so hard to get. The problem with doing this from within the math department was that the relevant student data is not easy to obtain.

Yet, if you want to analyze test scores, you need this data — at the very least, you need to know what UWP math courses the student has taken and what grade(s) they earned. The simplest way to at least know what course the student is presently taking (and a very good way
to get students to take the test seriously) is to perform the assessment within the math courses themselves. So this is how we administer the math skills test (every three years, starting in 2004).

When constructing an assessment, the question of interest is not really “what do students know?”, as much as it is “what can students do?” With this in mind, creating interesting problem situations is not hard, but it is a challenge to do well. First of all, questions must be about the real world, in a way that is understandable to most students. The philosophy that underlies what we do here — and what distinguished our test from the CAAP test — is that we felt that, in a mathematical “word problem”, a solid relationship between the questions and the real world would be more likely to inspire genuine effort than contrived questions, where students might feel they were just sorting out an abstract puzzle.

The exam must also refer to specific content as little as possible. The underlying purpose of a general education class is that you want students to be able to recognize the subject of your course in the world around them. You want them to be able to apply what they already know and learn about what they don’t know. Whether they learned to do this in high school or learned it here is not important; you just want to know if they can.

The Basic Math Skills test is given to students in the following mathematics competency courses:

- 1630: Finite Mathematics,
- 1730: Math of Finance,
- 1830: Elementary Statistics,
- 2030: Math for Educators II,
- 2450: Pre-Calculus, and
- 2530: Trigonometry/Analytic Geometry.

Every three years the department administers the test. Three years was chosen because it is long enough that the department shouldn’t tire of going through the process again and again; also, so that there is almost no chance of someone taking the test twice. In 2010, 278 students enrolled in the math competency courses took the test. In 2004 and 2007, we sampled 279 and 258 students, respectively. These should be compared to the sample sizes of 30–40 that were obtained when the test was tied to the ACT-CAAP.

Overall, comparing the proportions of correctly answered questions between these three sets of data, we have concluded that students in 2010 performed very similar to those in 2004 and 2007. We have observed in some of the test questions, where two basic mathematical concepts are combined (like distance and area), some students performed significantly lower, especially those enrolled in Math 2030. On the other hand, in questions involving probability, we noticed that students performed significantly better in 2010 than in 2004 and 2007. Perhaps, most interesting are the high scores the 1630 students achieved in 2010.

We plan to continue administering the Basic Math Skills test every three years. What we have now are some solid benchmarks that future numbers can be held up against. One’s first expectation might be that the numbers should be going down, because of a general perception that, over time, students’ math skills are eroding. This doesn’t seem to be happening at UW-Platteville. On the contrary, because of solid work being done by the math department — for example, the last few years of working through important issues of math teaching and student learning in day-long meetings with area high school math teachers — one might wonder if the numbers might actually go up. That’s always the hope.