

# Mathematics Placement And Student Success: The Transition From High School To College Mathematics

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## Abstract

A team of concerned mathematics instructors at the University of Wisconsin-Platteville spent the 2009-10 and 2010-11 academic years working, in collaboration with area teachers of secondary mathematics, to identify and reduce obstacles experienced by students in the transition from high school to college. It is widely agreed that this transition is difficult for many students; the most tangible evidence is the unacceptably high proportion of students who require remedial instruction at the start of their undergraduate careers. We describe our experience with promoting intentional, ongoing conversations among students, secondary teachers, and university instructors, which we have found to be informative and professionally rewarding.

Keywords: STEM, K-12 Outreach, Student Retention.

## Introduction

At the University of Wisconsin-Platteville, the percentage of first-year students needing remedial education in mathematics is growing dramatically. In 2008, 43% of incoming students placed into a remedial math course, a course which receives no college credits. Additionally, the percentage placing into the lowest remedial math course grew from 9% in 2000 to 23% in 2008. These percentages, though alarming, understate the increased need for remediation, since the university has grown significantly during the same time period: the University of Wisconsin-Platteville's undergraduate enrollment has increased from 5300 in 2000 to nearly 6500 in 2008, as part of an intentional program of "planned growth."

A serious problem is evident: as the number of incoming freshmen has increased, University of Wisconsin-Platteville is committed to serve an ever larger group of students who require significant remedial work before being allowed to register for a math course that will satisfy their graduation requirements. This is a true barrier to student success: moreover, in the last decade, 48% of students who began their careers at the University of Wisconsin-Platteville in a remedial math course either failed or withdrew from their first college mathematics course, or simply never attempted a math course before withdrawing from the university altogether. This rate of attrition is unacceptably high.

This is not a secret: math departments everywhere are fully aware of the problems facing ill-prepared math students. The question is not who is at fault (we all are), but what can be done to change the patterns of failure. Yet, the response of the education community to issues is confusing. For example:

*The majority of enrollments in collegiate mathematics (over 60% in four-year colleges and universities, approximately 80% in two-year colleges) are in courses whose content is taught in high schools, while the fastest growing part of the high school curriculum is in courses that carry college credit. Much of this growth has been fueled by the marketing of Advanced Placement courses, notwithstanding recent studies that question the efficacy of the programs. (Steen, 2004)*

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The challenges that students must overcome in their math courses are quite real, whether they are working towards a degree in a technological field or just trying to graduate from the university.

A team of individuals in the Mathematics Department at the University of Wisconsin-Platteville decided to try to understand the reasons for this problematic situation, and to work towards improving it. A main short-term goal was to develop tactics that influence student success in their first math course; long-term goals included increasing mathematics placement levels for incoming students, as well as increasing success rates of students in their initial course, both of which would lead to increased university retention rates. With these goals in mind, the group initiated an externally funded project called “Mathematics Placement and Student Success at the UWP.” In this article we will describe the team’s activities, give an overview of what we have learned about our students, and present a detailed account of our assessment plans.

### **Teacher Meetings**

During the 2009-2010 academic year the team focused on reaching consensus regarding the knowledge base and skill level that we deemed essential for new students at the University of Wisconsin-Platteville. We believed that the systematic problem of poor mathematical performance of incoming students would be best addressed through cooperation and teamwork between university and high school faculty, together with the involvement of parents and counselors. Our implicit belief was that poor student performance could be attributed to misalignment between the mathematics curricula of area high schools and that of the University of Wisconsin-Platteville. With this mindset, during the Fall 2009 semester we organized two meetings of University of Wisconsin-Platteville mathematics instructors with regional high school mathematics teachers,<sup>1</sup> asking them to articulate their priorities when preparing students for college-level math courses, and to share their perceptions of the expectations of a university math instructor. The team then merged the high school teachers’ priority lists with the list of essential knowledge and skills created by the University of Wisconsin-Platteville team, and shared the result with all participants. Two similar meetings in Spring 2010 focused on creating strategies for increasing student success.

During the 2010-11 academic year, three more meetings were organized. In one meeting, the participants (college instructors as well as high school teachers) worked to become more familiar with the Common Core State Mathematics Standards, which have recently been adopted as our state’s official PK-12 mathematics curriculum. In the others, teachers educated each other about the reality of day-to-day mathematics instruction at each level. For one example, we graded samples of written work submitted by college students, and enjoyed the resulting discussion of our diverse expectations and requirements. In another session, high school teachers discussed the variety of non-traditional course offerings currently being provided to high school seniors in hopes that more college-bound students will take four years of math in high school.

These meetings were attended by an average of 76 high school teachers and 12 college instructors. Exit surveys indicated that the high school teachers appreciated the conversations: for example, one anonymous high school teacher wrote, “I liked the questions and discussions with the other teachers. It is interesting, and not unusual, that many of us struggle with the same concepts and student issues.” As teachers left the last meeting of the present semester, a common refrain was “Thank you, and try to find some way to keep this going.” The most positive (though intangible) outcome of these meetings is that the University of

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<sup>1</sup> Though it is convenient to identify these participants as “high school teachers,” the group included a number of high school administrators, as well as a few middle school mathematics teachers.

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Wisconsin-Platteville has helped to build constructive and collaborative relationships with and among our region's high school teachers.

### **Student Surveys**

It was evident that any study of the transition from high school to college required the input of the people who actually experienced the transition; namely, students at the University of Wisconsin-Platteville. In the Spring 2010 semester, the project team collected 457 surveys from students who were then enrolled in mathematics courses. This represents about thirty percent of the students taking mathematics on our campus at that time. The survey investigated students' perception of a variety of issues, including their initial placement into a college math course, their performance in that course, their level of effort in the first math course compared to high school, and their current level of confidence compared to high school. Additionally, we asked them to offer advice on placement and transition issues to college math teachers, as well as to teachers and students in high school. The survey was given again, to 495 students, in Fall 2010, with similar results. [Data quoted below are from the Spring 2010 survey.] A third round of surveys was administered in Spring 2011, but those data have not yet been analyzed.

Surveys were collected in selected class sections, during the second half of the semester. All data were self-reported, so accuracy is not guaranteed. It is easy to see that the students were not sampled randomly, and to find ways in which the sample was biased. The project team preferred to survey their own students when possible, to avoid inconveniencing other instructors. More significantly, students enrolled in courses beyond first-semester calculus were not surveyed. Finally, many of the students for whom the transition was most difficult could not be surveyed, because they had chosen not to take math, had stopped attending or withdrawn from their math classes, or had left the University of Wisconsin-Platteville entirely. Thus it was necessary for the project team to consider sampling bias when interpreting the survey results. Still, it was possible to draw interesting conclusions from the data.

Since the study of mathematics is uniquely cumulative, proper placement at matriculation is a critical concern for math educators. Though about 51% of students were placed in a lower course than they initially expected, only about 30% believed when surveyed that they should have started in a more advanced class. [About 8.5% of this smaller group still earned an "unsuccessful" D, F, or W grade.] This leads us to believe that the test used for math placement at the University of Wisconsin-Platteville generally places students in appropriate courses.

Another positive indicator for the placement test can be found by studying the grades of students for whom significant time (a "math gap") elapsed between the end of the last math class in high school first math class at the University of Wisconsin-Platteville. We found that students with math gaps less than four years showed no significant difference in performance in the first college course, as measured by average GPA, while the few non-traditional students with a math gap of four years or more performed markedly better than the rest. Likewise, the percentage of students earning an "unsuccessful" D, F, or W grade decreased as the math gap increased. Of course, these findings are contrary to the common belief that students with long math gaps tend to lose mathematical fluency. We certainly do not believe that each high-school math class taken by a student makes him or her a less able mathematician! Instead, we judge that the placement test does a good job of matching students with courses in which they can succeed, and that students with long math gaps compensate for "rusty" skills by greater maturity.

### **Student Interviews**

A third part of the project focused on student interviews. In this phase, we targeted students who were unsuccessful in their first college mathematics course, independent of placement level. We conducted hour-long interviews with these students, hoping to learn about their preparation for and experience in their first college math course. Some interviews were one-on-one between a member of the project team and a single student. Others were in small groups, with one member of the math department and at most five or six students. Though students with diverse backgrounds were interviewed, the typical participant was a traditional student who had taken four years of mathematics in high school, and enrolled at the University of Wisconsin-Platteville immediately after graduation. Each participating student earned ten dollars as an incentive. The project team ultimately interviewed a total of 38 students, mostly in October 2009.

The interview process, while it yielded some insight, was challenging. The pool of students who could potentially be interviewed was limited, in that we concentrated on students who failed or withdrew from their first mathematics course. However, since we only interviewed active students, we were unable to speak with any student whose struggles were so severe that they had withdrawn from the University of Wisconsin-Platteville, though the input of such students would have been valuable. Advertising and interview scheduling were both nontrivial issues. Of course, the students' responses represented only their subjective impressions, sometimes many semesters after the math class in question. Finally, when multiple students were interviewed together, it often appeared that the first student to speak influenced the responses given by other students.

Despite these challenges, the students who participated told us that they genuinely appreciated our interest in their experiences. They typically gave thoughtful explanations of their initial struggles with college mathematics, and they offered advice for new incoming freshmen. Here, we can offer only a summary of their responses.

Of the 38 students interviewed, 25 believed (when interviewed) that the University of Wisconsin-Platteville's initial placement test had placed them appropriately; the remainder were split, some thinking they should have begun in a lower math course, and some higher. When asked what they could have done to succeed in their first math class, several common answers emerged:

- Seventeen said they should have spent more time on homework.
- Fourteen said they should have taken advantage of free on-campus tutoring.
- Eight said they should have gone more often to see the instructor outside of class.

When asked, students also had suggestions for their math teachers. For high school teachers, by far the most common advice was to challenge their students more. Others responded that it was, at least, important for high school teachers to make their students aware of the higher expectations of college instructors. The most commonly repeated advice for college teachers, given by eight students, was simply to slow down. Other students urged easier grading or extra credit; a third theme was improved presentation of lectures, such as better organization or clearer examples.

At the end of the Fall 2009 semester, the project team decided not to continue interviewing students. Though the interviews were regarded as valuable, it was believed that the necessary investment of time would yield diminishing returns. Again, the most valuable outcome of the interviews was intangible: they gave instructors a rare opportunity to engage students in a discussion of their education, in a context where the interaction was not distorted by an ultimate need to evaluate student performance.

### **Assessment**

The assessment plan for this project is only beginning to unfold. Our original idea of interviewing students, while quite an eye-opener for individual faculty, turned out to be far too complicated to organize on a large enough scale to be statistically significant.

Dropping the interviews, we then redoubled our efforts on the survey already in progress. After a semester of piloting it and passing it through the Institutional Research Board, we have now given the survey in both semesters of 2010–11, to about 30% of the students in general education or remedial math. Preliminary data in the form of pie-charts have been shared with teachers (at the teachers' meetings and at conferences of the MAA and WMC) and with principals (at a meeting of CESA 3), and have provoked good discussions. Even now, the survey is still evolving; we have learned that it takes time to learn to ask the right questions.

Our assessment plan is as follows. To determine if there is a measurable improvement in the rate of student success in their first year at our university, we will analyze:

- student survey information,
- results from the Math Skills Assessment Exam, administered in fall 2010 to a sample of students in general education math courses,
- math placement data, and
- data tracking students' mathematical progress.

One goal all along has been to “*develop processes for sharing and using relevant data between high schools and college credit-bearing entry courses.*” All data we can get is relevant, but the most immediately relevant statistic is the rate at which students graduate from our university. Giving students a better chance of making it through their first college math course gives them a better chance at graduation. Success for us would include that graduation rate going up. Assessment measures evolve, and we will see direct measures of whether students are succeeding: placement scores, pass rates within targeted courses, and most importantly, the rate at which students graduate from our university. Can we positively affect those numbers? This is where a lot of programs fail. The process often becomes the end and not, as it should be, the means, to a deeper understanding of what we need to do to improve.

*To achieve transformation in higher learning, we must develop shared trust, a transformative vision of goals worth working toward, and a shared language and set of concepts equal to the challenge. If we plan and conduct our assessment projects at every step as if learning matters most – not just the students' learning, but ours, as well – then the distance between means and ends will be reduced and our chances of success increased.* (Angelo, 1999)

### **Conclusion**

The main strategy of this project has been to “*collaborate with the PK-12 community to enrich college preparation in the area of mathematics*”, in an effort to increase students' placement test scores, and, more importantly, their grades in that critical first math course. Success would mean that at some point more students are graduating from the University of Wisconsin-Platteville. It might seem that graduating more seniors is the end that we are working towards, and perhaps it is. But the main overall point is that we need to find ways to do this, not by lowering our standards, but by raising the students. This can be done. It must be done.

*It takes time for ideas to mature and take hold. Thus, one should not expect significant short-term results. If you're in it, you have to be in it for the long haul. What really counts, beyond one's personal contributions, and the relationships one builds, is capacity-building. (Schoenfeld, 2009)*

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