Improving Retention in a STEM Field with a
Major Specific One-Credit Course for First Year Students

John B. Polhill
Bloomsburg University of Pennsylvania

Abstract. Due to the nationwide difficulty in retaining students majoring in the sciences and mathematics, Bloomsburg University offers a one-credit course for first-year students in each of the science majors and mathematics. In particular, the university has since 2001 offered sections of this class for mathematics majors during each Fall semester. This version of the course has been successful in terms of preparing students for their college experience and by resulting in a relatively high rate of students receiving their bachelor's degree in mathematics. This paper includes a description of this course, as well as some very positive results in terms of student retention.   In particular, 52% of those first-year mathematics majors that took this class in 2001 and 2002 graduated with a mathematics major by Fall of 2007. This compares very well with both national and previous institutional statistics, both of which are below 35%.

As with many colleges and universities, many students at Bloomsburg University drop out during one year of their matriculation. To help students adjust during their first semester, Bloomsburg University and many other colleges began offering a course called University Seminar. The traditional University Seminar course at Bloomsburg is a one credit course that has the purposes of familiarizing the student to the campus facilities and programs, as well as teaching time management, test-taking tips, and similar life strategies. Many resources can be found for variations on this course (Ellis 2006, Gardner 2005, Holman and Oitzinger 1999). The seminar has indeed helped with the overall retention rate of students at Bloomsburg University. However, in the mathematics and science majors there exists the additional problem of students changing to a less difficult major when faced with challenging exams and time-consuming assignments. Many of these students have the potential to become quality mathematics or science majors if provided with a reasonable amount of support and encouragement. This is especially true in the first year.

Retention of students in mathematics and science majors is in fact a nationwide problem. In particular, the number of mathematics majors across the country has been on

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the decline in recent years (Mathematical Association of America, 2004). The problem of attracting and keeping mathematics majors is, however, nothing new. For years, various methods have been taken with the goal of increasing the number of graduates in mathematics (Cooney, et al, 1990). More recently, William Vélez has been a strong advocate for proactive efforts at producing mathematics majors (Vélez, 2003 and 2006). There have been numerous efforts at improving overall STEM retention as well, such as the very successful program at Bowling Green State University (Gilmer, 2007).

At Bloomsburg University, a variety of efforts have been made to help mathematics majors succeed. One of these methods was to offer a section of University Seminar specifically designed for students majoring in mathematics and mathematics education. This article includes a description of the syllabus for this University Seminar course for mathematics majors, including the basics of a general section but with a focus on the topics specific to the course for mathematics majors. Following the course description will be a brief analysis of the overall benefits that have resulted, including both anecdotal remarks and quantitative data.

Method

During the first week of the class, the students learn the purpose of the course and spend a significant amount of time getting acquainted with each other. The goals of the course, as given in the syllabus, are as follows:

1. Consider ways to improve as a student;

2. Talk about the facets of college life;

3. Learn much more about the mathematics major;

4. Discuss career options within the mathematics major;

5. Form a network with other students in your major.

These goals reflect the need for creating an environment in which students feel encouraged and supported by the department and faculty. These factors have been noted as important in retaining students in the STEM disciplines (Project Kaleidoscope, 2002).

In the second week, the instructor facilitates a student discussion of time management and organization skills, and the following week students examine such topics as learning styles, techniques to take an active part in learning, and test-taking strategies. During the fourth and fifth weeks, guests from various departments on campus discuss alcohol awareness, career development, and library use. During this time, the students write resumes and begin to think about how they should be preparing themselves for their intended career. For the rest of the semester, the class focuses on the mathematics major.

Perhaps the most important meeting consists of curriculum advisement, which includes a discussion of courses, minors, concentrations, internships, and related topics. As an assignment following this class, the students are required to write down their four-year schedule. After completing it, they must meet with their advisor to go over their plan and make sure that it is realistic. This forces them to be aware of prerequisites, courses that are only offered once every two years, and similar obstacles. They also hear about the importance of internships during this advisement day.

On other occasions, invited guest speakers talk about their various professions. In 2001, we had an actuary panel, a speaker from the National Security Agency, and another speaker from an area business. In both 2002 and 2005 the class visited the National Cryptological Museum, the museum for the National Security Agency in Fort Meade, Maryland.

Finally, during a few meetings the students learn some entertaining yet relevant mathematics. One day, the students are given a standard false proof that $0 = 1$ and must determine where the error occurred. On another day, they receive material on active learning that is encrypted and must decode it. The students seem to catch some of the instructor's enthusiasm as they perform these exercises.

Another assignment involves credit card debt, and accomplishes three goals at once. First, students are made aware of the danger that lies in the credit that is so easily available to college students and the fact that so many students graduate with substantial credit card debt. Second, the students are familiarized with the TI-89 calculators, a necessity for all Bloomsburg University mathematics majors. Third, since mathematics majors need to be given as many mathematical applications as possible, they are given the following problem:

> Problem: If you buy 4 pizzas per month on your credit card at $10 each every month during 4 years of college and pay off the debt at the end of college, how much will you pay if the interest rate is 18%? What if you pay this debt six years after graduation?

This task allows them to use the calculator for a significant computation, refreshes their memories on calculations with interest rates, and demonstrates the dangers of credit card abuse. The answers to the two questions are $2824.35 and $8250.37 respectively if interest is compounded monthly. Certain things are neglected, such as inflation, but the students still get to use mathematics and technology while learning about one potential danger in college life.

> Alternate problem: If you set aside $20 per month during college and invest at a rate of 5%, how much will your investment be worth when you retire at age 65?

Course Assignments/Grading

The following list displays the assignments for the University Seminar during a typical semester:

1. Project 1: Resumes and cover letter

2. Project 2: 4-year class schedule

3. "Journal" e-mails (3 total)

4. Outside Event Attendance/Summary

5. Advisor Assignment

6. Class participation

7. Final Examination/Library Assignment

Notes on the Assignments:

1. The resume assignment consists of 2 resumes, one of which is the student's current version and the other a projected, perhaps idealized, version that the student would hope to accomplish by graduation. This familiarizes pupils with resume writing and forces them to think about what types of things they should be doing to prepare themselves for the future.

2. The 4-year class schedule assignment is given during a day of advisement. Students are expected to devise a tentative schedule for their entire college experience and to review it with their advisor.

3. The "Journal" e-mails are given to ensure that students feel comfortable asking questions of the instructor of the University Seminar course. Communication is a very important component of the class.

4. Each student must attend some activity outside of class, whether it be our departmental career day, a mathematics presentation given in our seminar, or

the trip to the National Security Agency. The hope is that the students will become involved in the life of our department outside the classroom.

5. The advisor assignment is given on the first day, and ensures that the students get to know their academic advisors early.

6. Self-explanatory.

7. The library assignment is a combination of online and text searches, and has a focus on mathematics journals and books.

Results

Survey data from the 2002 course indicated that students respond well to the course. Twenty-five out of twenty-six students responding thought the course was useful to them. More importantly, of the 50 students that declared mathematics for their major and enrolled in the seminar course in 2001 or 2002, 25 had completed their bachelor's degree in mathematics by January of 2007, with another student that will finish by the end of the 2006-07 academic year. This 52% five-year graduation rate in the originally declared major compares favorably with national STEM graduation rates at selective universities such as Bloomsburg University (Table 1).

Cohort	% Graduated with Mathematics Degree by May of 2007
Mathematics Majors in Bloomsburg University Seminar – 2001 and 2002	52.0
	% Graduated with Any STEM Degree
Declaring STEM Major - selective schools 1999-2004	33.7
Bloomsburg University 1999-2004	31.0

Table 1: 5-year Mathematics-specific graduation rates at Bloomsburg University versus national and previous Bloomsburg University STEM graduation rates.

The STEM data in Table 1 was taken from Hayes, 2006. The data is not a perfect

comparison, since the first entry represents the specific major of mathematics while the

latter two are derived from all STEM majors. Nationally, 33.7% of students declaring a

STEM major in 1999 had received a STEM degree of any type within 5 years.   This

includes those students who change to a different STEM major.   During that same period

of time, 31% of Bloomsburg University students declaring a STEM major in 1999 had

received a STEM degree within 5 years (Hayes, 2006). Even more impressive is the fact

that 66% (19/29) of the female mathematics majors enrolled in the seminar graduated

with their degree in mathematics. Another indicator of the success of this course is the

number of students in the mathematics major at Bloomsburg University, which has been

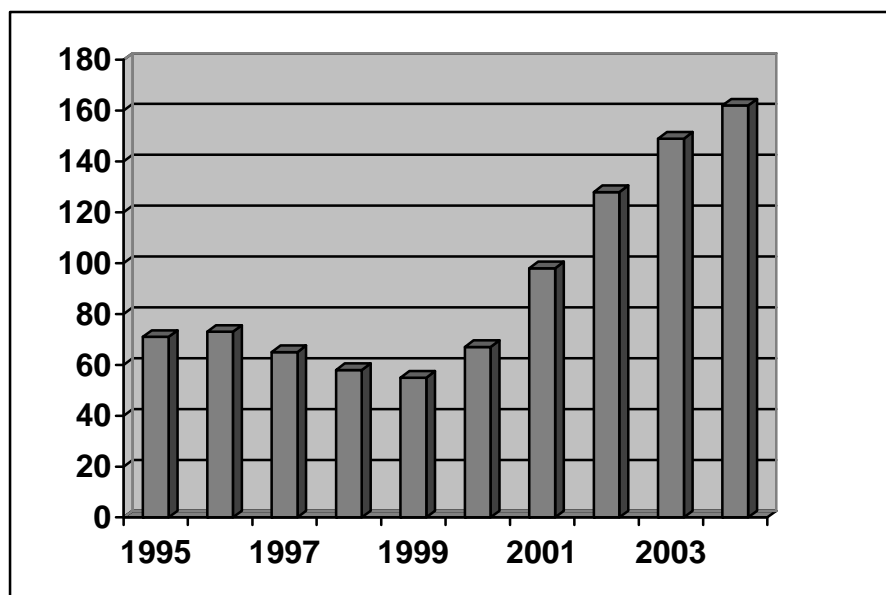dramatically on the increase at Bloomsburg University since 2000 (Chart 1).

**Chart 1: Total number of mathematics majors at Bloomsburg University for the
years 1995-2004.**

The University Seminar course is by no means the only reason for this increase in

the number of mathematics majors or for the relatively high retention rates, as there have

been a variety of other means taken to recruit and retain majors within the Department of

Mathematics, Computer Science, and Statistics at Bloomsburg University. However, the course has made a positive impact on the retention of our math majors.

Discussion

I have been teaching the mathematics sections of University Seminar since they have been offered at Bloomsburg University in 2001, and have faced a few challenges. I feel that it takes more energy and preparation to guide three one-credit sections of University Seminar than to teach one three-credit mathematics course. Moreover, I see my role in this course as more of mentor and encourager than instructor and definitely had no training to prepare me for this type of assignment.

Still, I feel strongly that this course has been a positive experience for me and for my students. First and foremost, I get to know the students well and they get to know both their fellow mathematics majors and me. I have discovered that students in the course develop a great deal of trust in me to answer academic questions for the entire college experience. In addition, I have come to a better understanding of what my students face as freshmen in college, and have had the chance to help the students prepare for their careers. I have on several occasions had the opportunity to help students make immediate improvements on their course schedules within the first week. For instance, one student was able to get on the right track with a double major in mathematics and physics as a result of some changes we made after the initial meeting of the seminar course. The seminar also helps the students make the transition to college and provides them with some tools that will help them succeed in the mathematics major. Based on the data and my personal observations, the idea of offering a major-specific college transition course has a positive effect on student performance as well as with graduation rates in the specific major.

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John Polhill received his Ph.D. from the University of Virginia in 1999, where he was the student of Dr. Harold N. Ward and Dr. James A. Davis of the University of Richmond. He currently serves as an Associate Professor at Bloomsburg University. His areas of research include difference sets, coding theory, and Galois ring theory. He also has a strong interest in the recruitment and retention of good students in the mathematics major.