

## Improving Mathematics Success Through Enhanced Support Services

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### ABSTRACT

Over the past year the Department of Mathematics, Statistics, and Computer Science at the University of Wisconsin-Stout has worked to improve the quality of tutoring available to students enrolled in introductory level mathematics courses. The principle investigator of this project worked alongside student tutors on a daily basis to document the quality of tutoring provided as well offer guidance to the tutors themselves. In addition, online testing modules were developed to establish the level of mathematical mastery that the department's tutors possessed. Overall the conclusion is that tutors generally have a high level of mathematical proficiency, yet many lack the interpersonal and time-management skills necessary to be successful tutors.

**Keywords:** STEM, Conference Proceedings, Math, Student Support

### INTRODUCTION

While almost all undergraduate students at UW-Stout take at least one mathematics course, with UW-Stout's polytechnic nature, many students take several math courses. Nine of UW-Stout's forty undergraduate programs require completion of first semester calculus (or higher). Further, a large number of students enter UW-Stout under-prepared for Calculus and so need to take one or more pre-calculus courses. A growing body of research indicates that each mathematics course that a student struggles with is likely to lead to equal or greater difficulty at the next level (e.g., Fayowski, Hyndman, & MacMillan, 2009; Ma 2000). Given this, the investigators began a project to improve the quality of tutoring for College Algebra and Trigonometry as many students at UW-Stout will be taking at least one of these two courses. Success in these courses is also essential for higher level mathematics and physics courses which a large number of those students will go on to take.

The Mathematics, Statistics and Computer Science Department runs a tutor lab that provides services for students in College Algebra, Trigonometry, Concepts of Mathematics, Finite Mathematics, Calculus, and Elementary Statistics. This tutor lab is staffed by a combination of faculty members and student tutors that have received high marks in their mathematics courses. During the Spring 2012 semester, nineteen student tutors were employed. Of those, there were four freshmen, five sophomores, five juniors, three seniors, and two graduate students. Students came from various majors: Applied Mathematics and Computer Science (9), Manufacturing Engineering (4), Applied Science (1), Computer Engineering (1), Packaging (1), Plastics Engineering (1), Master's in Career and Technical Education (1), and Master's in Food and Nutrition (1). The last student was hired specifically to tutor statistics and did not participate in the testing discussed below.

In order to improve the quality of tutoring, the investigators set out to establish the level of mathematical proficiency of our tutors and how they conveyed their understanding to students in the lab. In order to assess tutor proficiency, a series of computer based tests were developed to establish a baseline of tutors' mathematical knowledge. The principle investigator (Dr. Seth Dutter) of this project worked side by side with tutors on a daily basis in order to observe and document the tutors' ability to work with students in the lab.

### **COMPUTER BASED TESTING**

Each of the College Algebra and Trigonometry courses was broken down into key sections. For each section a testing module was created. The exams were written in WeBWorK, a free web-based mathematics assessment suite. Tutors took the exams in a proctored environment on two separate occasions, once for each course. Each time, the tutors were given two hours to complete the exams.

The nature of the online exams posed some unintended difficulties. Many of UW-Stout's mathematics courses make use of WeBWorK for homework assignments. The assumption had been that tutors would be proficient at working with an online homework system. While the vast majority of tutors were proficient, some clearly had difficulty entering their answers and working with a web based system. After correcting for these anomalous results, it became very clear that there were only a couple of key sections which tutors consistently struggled with. In general they had no difficulty completing a large number of problems within the two hour time frame with a very high level of accuracy.

### **TUTOR LAB OBSERVATIONS**

The principle investigator worked in the tutor lab for two semesters, watching and assisting the tutors and students. Tutors were seen consistently giving accurate explanations on how to solve problems. On occasions when the tutors were not sure of themselves they sought out assistance from faculty. These results backed up those of the computer based testing.

Despite the fact that the tutors were strong mathematically, their ability to manage a large room was frequently found to be lacking. Tutors were observed working with a single student for an extended period of time while many other students waited for assistance. Additionally, tutors were not making their availability clear to students. Rather than roaming the room and offering their assistance, many tutors had a tendency to sit waiting for students to approach them. This was commented on by both students and faculty in the lab.

### **CONCLUSIONS**

The investigators had anticipated that the primary deficiency among tutors would be a lack of mathematical expertise. The computer based testing and observations made in the tutor lab countered these anticipations. However, some subjects have been identified where tutors consistently struggled. To address these issues the testing modules will be converted into training modules for the next school year. Tutors will use the modules to practice problems before students cover the related topics in their courses (and come to the lab with questions).

To address the concerns about tutor availability and responsiveness to student needs, beginning next year tutors will go through an extensive training program. Faculty will work with tutors on how to better manage their time to serve more students. Faculty will also work with tutors on making their presence known and better presenting their availability.

Based on observations of faculty and suggestions from users of the lab, faculty will work on developing a collection of resource materials for the lab. These materials might include key formulae, strategies for solving certain types of common problems, and worked out examples. The goal here is two-fold. First, especially when there are a large number of students seeking help, these resources may be all that some students need. Further, the resources can also be used by tutors as needed to refresh their memory as needed.

To-date, due to a number of logistical factors, the investigators do not have any data on how student use of the tutor lab impacts their class performance. This is an avenue that may be explored in the future.

### REFERENCES

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