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Math 485: Seminar in Mathematical Problem Solving

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Mathematics majors at the University of Wisconsin Oshkosh are required to take a problem solving class. Math 485: Seminar in Mathematical Problem Solving is a course that meets this requirement and is offered annually during the spring term. It is considered a capstone course for mathematics majors. I have taught this two-credit course twice in the last three years. It meets once per week for 14 weeks. The first class had 11 students enrolled and the second class had 17 students enrolled.

This course is also taught by other faculty. Faculty have the option to teach this course alone or to team teach the course. Additionally, faculty have the freedom to design the seminar using whatever problem solving methods they choose. The topics vary by the instructor. I have chosen to focus the design of the class with a research basis to achieve the problem solving outcome competency.

My goal for the students is that each will discover within themselves their abilities, creativities, and desires to engage in mathematical research. The primary objective of the course is to introduce students to an area of mathematics that they may not be familiar with and lead them to discover how problem solving can lead to research. In this case that area is graph theory.

The first few class sessions are spent learning general graph theory concepts. Once the students have an understanding of graph theory I begin to introduce my own research topics to the students as a way of funneling them toward the actual research project they will work on as the final class project.

Generally, three areas of my research interests are chosen as the direction for the course. The students work individually and in groups during class and on homework assignments. The topic areas are introduced one at a time and designed to build students' skills in both solving and designing research problems. As they progress through the homework assignments they learn how to introduce variations to the problems and attempt to solve them as a means to learn how to come up with new research questions.

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> **For example:** One topic covered is on distance related subgraphs of graphs such as the center, median, and periphery. A well known problem in this area is the fire station problem. In class we talk about recent results of the topic and think of new questions. I give them a variation such as; changing the definition of distance. The students try to solve the problem with this variation. They also try to introduce their own variations.

These exercises build student confidence throughout to be able to introduce their own variations and solve them or attempt to solve increasingly difficult variations that I create.

> **For example:** One student's variation was based on a pizza delivery restaurant where she worked. The restaurant management defined distance as delivering two pizzas and returning to the restaurant. They call this the two-stop and return distance.

The final research project is a group project based on one of the three topics that they have the most interest. Class time is used as a time for the groups to discuss what they have been working on. I meet with the students individually or in groups at least once per week outside of class to give individual attention on their research project. I use this time to check their work and guide them in the research. I may present them with additional questions based on the direction and progress they are making.

To date this course has resulted in one published paper, two papers submitted for publication, and five papers in progress.

Other research projects:
In addition to this course I have had the opportunity to work with undergraduate students on research projects through various grant opportunities. The University of Wisconsin Oshkosh has a Student and Faculty Collaboration Research Program that is funded through faculty development dollars. The purpose of the program is to develop student researchers. The grant provides a monetary stipend of $2500 to the student for participating in the project. The faculty receives a $500 stipend to be used for supplies needed as part of the research.

The University of Wisconsin System also has a research program called WiscAMP (Wisconsin Alliance for Minority Participation) which has also given me the opportunity to work with undergraduate students on research. The program was established in 2004 and one of the goals of the program is to increase the number of baccalaureates awarded to underrepresented minority students in STEM disciplines (science, technology, engineering, mathematics). The funding source is different than the Student and Faculty Collaboration Research Program; however, the elements of the program for myself and the undergraduate student are very similar. The student receives the grant award of $3000 and we work together on a research project during the summer. I receive a $500 stipend for this project as well, to be used for the purchase of supplies needed for the research.

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