

Development of a Project-Based Technology Course for Preservice Mathematics Teachers

1 Project Summary

We are requesting funding for the development of a technology-based course and related materials for preservice teachers of mathematics. The course is aimed at preparing preservice teachers to integrate technology into the classroom by giving them a set of ready-to-use labs appropriate for the middle and high school classes, hands-on training with a variety of software tools, and competency to independently research and learn new technologies. The proposed Mathematics Software Tools Course will be a dynamical and exciting course, changing as technology continues to evolve.

2 Background and Current Status

The Elmhurst College mathematics faculty have used graphing software and computer algebra systems in its calculus sequence and advanced mathematics courses since 1987, and graphing calculators since the early 1980s. Our experience indicated that students who use technology early in their careers incorporate technology into their learning. However, those who had not learned to use technology often had problems doing so. In 1990, the Mathematics Department faculty felt that something needed to be done for those students. After extended discussions and brainstorming sessions, Dr. Allen Rogers developed MTH 101 - Mathematical Software Tools as a one-quarter course to address these difficulties. The course was "designed to teach students the use of the technology and to introduce or reinforce mathematical concepts." [1]

The Mathematics Department found that students who had taken the calculus sequence at Elmhurst were familiar with the technology that the department used. However, transfer students often had difficulty adjusting to the increased use of graphing calculators and advanced computer software. The MTH 101 course was specifically developed to assist the transfer students who had not had a "technologically rich" experience prior to attending Elmhurst College. The student response to the content and technology was very encouraging, especially by those future teachers of non-traditional age. However, the class lasted only a few years and the statement

as high schools and other colleges and universities increase their use of technology in the mathematics classroom, we envision eliminating this course. It is our hope that in the next few years the typical transfer student will be familiar with graphing calculators from high school and computer algebra systems, from their prior college work. Until that time, we feel that this course meets the students' and our needs

in [1] was prophetic: by 1995 the course was no longer needed or given.

Elmhurst continues to be at the cutting edge of the use of undergraduate level software tools (e.g. the funded 1997 National Science Foundation Instrumentation and Laboratory Improvement grant submitted by the Mathematics and Physics Departments for a computer lab and software). However, not all of the software tools are appropriate for the high school or middle school curriculum (e.g. software designed for solving partial differential equations would have no use in

a 9th grade classroom). Since nearly half of Elmhurst College mathematics majors go into teaching at the high school or middle school level, the Department realized that the technology we use in our classes is not the same as what the students will use in their future. Hence, we need to revive and revise the MTH 101 course to best meet the needs of our students who will be teaching middle and high school mathematics students in the 21st century.

The Elmhurst College Mathematics Department is particularly qualified to revise the MTH 101 course to meet the needs of our secondary education concentration students. In the past ten years, the Department has received two State of Illinois Eisenhower grants to present in-service technological workshops to high school teachers. In addition, the Department received a grant of over \$700,000 to work with high school teachers from 12 schools over a three year period in developing technology rich classroom material and introducing appropriate use of technology in the mathematics classroom. The combination of these grants, a large collection of curricular material developed by local teachers, our close working relationships with many high school and middle school teachers, and our technological expertise place the Department in a position to develop a superb course for future teachers. In fact, the two faculty who will develop the course this summer have already responded to a request to speak on this topic at the 14th Annual International Conference on Technology in Collegiate Mathematics in Baltimore, MD in November, 2001.

The Mathematics Department seeks funding for a summer curricular project involving two Mathematics Department faculty members and one undergraduate student to develop the MTH 101 Mathematical Software Tools Course into an offering which will best address the technological needs of future secondary and middle school mathematics teachers.

3 Project Description

The proposed Departmental project is to develop a technology-based course for preservice teachers. Many of the secondary and middle schools have purchased expensive technologies geared at making difficult mathematical concepts more understandable. In fact, the Illinois State Board of Education's (ISBE) newly revised Mathematics Content-Area Standards explicitly states the technological expectations for mathematics teachers [2]:

STANDARD 5: The competent teacher of mathematics selects, integrates and uses appropriate technologies.

Knowledge Indicators: The competent teacher of mathematics

- 5A. Becomes familiar with the capabilities and benefits of current and emerging technologies.
- 5B. Understands the selection, integration and utilization of appropriate technologies throughout the mathematics curriculum.

Performance Indicators: The competent teacher of mathematics

- 5C. Selects appropriate technologies for instruction.
- 5D. Integrates current technology as appropriate for instruction.

Despite expectations, the schools unfortunately do not provide the necessary training for the teaching staff. All too often, these technologies go unused or used in the most minimal of ways due to inadequately prepared teachers. With this course, we plan to provide the necessary technological preparation for our preservice teachers using the knowledge and performance

indicators 5A-5D of the ISBE standard as objectives for the course. This preparation will be provided primarily through the laboratory projects we are creating.

The bulk of this project is the development of laboratory projects suitable for use in the secondary and middle school curriculum. Several types of technologies used include graphing calculators and accessories produced by Texas Instruments and Casio; the software packages Derive, Geometer's Sketchpad, Maple, Excel, and Fathom; and material on the Internet. Time and resources are also needed for faculty to research new technologies and to become competent in using them.

This course is being developed in conjunction with an undergraduate assistant who is a preservice teacher. With her input, we expect the course to be more accessible and comfortable for the students. She will also assist us in making the laboratory projects relevant to the current trends in the secondary and middle schools.

This course will fill a large gap between the technological competency that teachers are assumed to have when they first start their professional career and what they actually have. It is a course that we believe many colleges should include for their preservice teachers. For this reason, we have submitted a proposal to present our experiences with developing and teaching this course at the 14th Annual International Conference on Technology in Collegiate Mathematics. A copy of the proposal is attached to this application [3]. In the presentation, we will explain how the course was developed and discuss the progress of the students in the first semester. The undergraduate assistant will accompany two of our faculty members to this conference.

4 Anticipated Benefits to Students and Faculty

We foresee several benefits to the students arising from this course. First, students will master the main types of technology they will be expected to use when they first start teaching. Another benefit is that students will learn how to approach new technology and develop the skills to learn it on their own. They will then be able to transfer their understanding of one system to a similar system by using manuals and other help resources.

A secondary goal for the students is that they will become interested in researching new technology options on their own. This self-initiative benefits schools since these teachers can then help their schools make purchasing decisions based on actual classroom needs, not administrative guesswork.

The undergraduate student assistant benefits from the project by gaining experience in developing a new course. She will also have the opportunity to assist in a conference presentation related to the course development.

This project also benefits the Mathematics Department faculty by strengthening their individual technical expertise and unifying the technologies used in our curriculum. Faculty members currently have their own technological strengths and weaknesses, which, in turn, affect the type of technologies and the manner in which they are incorporated into the classroom. This course and its development provide the Mathematics faculty an opportunity to fill in the gaps in their own technological competency. This overall competency enriches each individual's teaching

and ability to effectively incorporate technology in the classroom. Furthermore, ongoing development and teaching of this course ensures that the entire faculty remains abreast of the latest technological tools and trends.

Additionally, for the Mathematics Department faculty, the success of this project provides an excellent foundation for developing new proposals, courses, and stronger ties to the secondary and middle school communities. Possible future projects are described below.

a) Previously, members of the Elmhurst College Mathematics Department faculty developed a proposal for technology connections in mathematics as an in-service training project for middle school and high school teachers of mathematics. This proposal was aimed at obtaining funding from the State of Illinois through a Dwight D. Eisenhower Professional Development Program Grant for In-Service Training of K-12 Teachers of Mathematics and Science. This project would use one highly trained “mentor” high school teacher to assist middle school (grades 6 through 8) mathematics teachers in a summer program at Elmhurst College. Each “mentor” teacher would work with three to ten teachers from that high school’s feeder schools on how to use technology in the mathematics classroom to increase the students’ use of real-life data, expressions, equations, formulas, and graphing in algebra and in preparation for algebra. In this process, the middle school teachers would have direct contact with a high school teacher where their students would be attending high school. Reapplying for the funding and the subsequent workshops would be a natural extension of our current project by taking the objectives, materials, and resources developed for our preservice course and making them available to in-service teachers. In addition, our current project develops more future teachers who are highly trained in technology to serve as “mentors” and strengthens our connections to the local schools.

b) Although this course is currently intended for preservice teachers of mathematics, mathematical tools, both analytical and technological, are used in virtually all disciplines of science. Hence, it may be desirable to extend this course to encompass preservice teachers in other disciplines. As stated in the project description, the course will provide students with a packet of labs and other technology resources that can be used in their future classrooms. It would be exciting to provide an interdisciplinary approach in the course where labs packets are developed that connect mathematics to other branches of science. Such a course would provide Elmhurst College with an interesting, interdisciplinary course for preservice teachers that can develop and strengthen bonds between disciplines. By already having these bonds and the resources of interdisciplinary labs, future teachers can more easily enhance the secondary education curriculum with interdisciplinary and collaborative work.

5 Budget

Most of our budgeted items for this project fall into three main categories: a stipend for our undergraduate assistant, technology for the course, and conference travel and registration expenses for two faculty members and the undergraduate assistant. Our student assistant, Tiffany Harms, will be working for at least two semesters on this project and assisting in the conference presentation of the course, and we would like to provide her with a stipend of \$600. Our technology needs reflect the intention that the course present the students with the most up-to-date tools used in high schools and middle schools. The conference expenses are estimations based on this year’s cost.

Estimated Expenses

Stipend for Undergraduate Assistant	\$600
TI-89 graphing calculator	\$140
Casio FX 2.0 graphing calculator	\$95
CBR motion detector	\$100
<i>Fathom Dynamic Statistics</i> software package	\$125
Conference Registration	\$450 (\$150 × 3 people)
Airfare	\$750 (\$250 × 3 people)
Hotel Room	\$450 (\$150 × 3 nights)
Food during travel	\$180 (\$20 × 3 people × 3 days)
Copying Fees	\$100

Total: \$2990

6 Timeline

Spring 2001: Preliminary Work

The undergraduate student assistant is currently working through curricular material developed for the previous technology course and for the NSF-funded project working with local high school teachers. This preliminary work provides an evaluation of the content and relevance of the material and detects needed modifications due to changes or advances in technology.

Summer 2001: Research and Development

The bulk of the project development will take place during the summer, during which time the faculty members and student assistant will research new technology and Internet resources. Additional time will be committed to increasing competency in using the various technological tools. The culmination of the summer project will be the development of a course packet that will become a valuable resource for future teachers as they incorporate technology into their classrooms.

Fall 2001: Course Implementation, Presentation, and Assessment

Dr. Abigail Hoit and Dr. Catherine Crawford will jointly teach the newly revised Mathematical Software Tools as a one-quarter course. Classes will meet every other week for approximately ninety minutes each in a hands-on, interactive learning environment.

Dr. Abigail Hoit, Dr. Catherine Crawford and the student assistant Tiffany Harms will speak on *Cooperatively Developing and Teaching a Technology Course for Preservice Teachers* at the 14th Annual International Conference on Technology in Collegiate Mathematics in Baltimore, MD (see the attached abstract submission).

7 References and Attachments

1. Jon L. Johnson, “Technology for Transfer Students” in *Proceedings of the Fourth International Conference on Technology in Collegiate Mathematics*, November 1991.
2. Illinois State Board of Education *Content-Area Standards for Educators*, p.110-119. Document available at <http://www.isbe.net/profdevelopment/PDFs/standards.pdf>.
3. Speaker nomination form and abstract submission for *The Fourteenth Annual International Conference on Technology in Collegiate Mathematics*.