



MATHEMATICS THROUGHOUT THE CURRICULUM

PROJECT NEWSLETTER

► Fall 1998

► Volume 2, No. 1

Math as a social tool

IUPUI COURSE DELVES INTO CENSUS DATA, TEACHES HISTORICAL LESSONS

For many college freshmen, the term “History” signifies no more than long lists of names, dates, and famous battles. Two professors at IUPUI, however, have discovered a new tool that could help alleviate misconceptions about the study of history: mathematics.

In a course offered last fall, “Introduction to History,” History Professor Monroe Little and his mathematics counterpart Jyoti Sarkar (a “closet historian” according to Little) combined mathematics with history to encourage students to draw fresh insight from historical data.

Acknowledging that some of today’s students enter college with a weak background in mathematics, Little believes that “Introduction to History” represents an important effort to strengthen mathematics because it places math in a context that aids motivation. “[Many] students will sign up for history long before they’ll sign up for math,” Little said, indicating that with this course the students’ college experience offers them one more chance to improve their mathematical skills.

The 100-level course was offered for both history and math credit, although

Little said he and Sarkar tried to broaden its appeal by camouflaging the mathematics element of the course as much as possible initially.

The class of 25 students was composed primarily of high-risk freshmen--students who had little background in mathematics and whose motivational needs added an extra challenge for the instructors.

The introductory assignment, however, was drawn from an event garnering nationwide attention at that moment: the sinking of the Titanic. For their first assignment, students in the class analyzed passenger and crew records from the ill-fated ship--specifically focusing on the 15 members of the ship’s band.

Although the class kept its focus narrow, Little said that the Titanic exercise helped him to introduce students to the notion of historical debate. Debate about the Titanic, Little explained, has tended to fall into two camps. While some historians believe survival of the shipwreck depended on chance, others believe survival reflected a social hierarchy among the first, second, and third class passengers that reflected Victorian society.

Rather than have students read one



IUPUI History Professor Monroe Little

historian’s interpretation of the famous event, however, Little and Sarkar equipped students with the data and basic statistical skills to draw conclusions for themselves.

After completing this first assignment, the class moved on to more in-depth statistical studies of the 1860 census, provided by the IU Historical Society. This data, available to students through the course website, provided unusually detailed information about individuals included in the census-- information on a range of characteristics, from name, race, sex and marital status to the amount of

A Productive Year

NEW COURSES, EVALUATION, AND DISSEMINATION

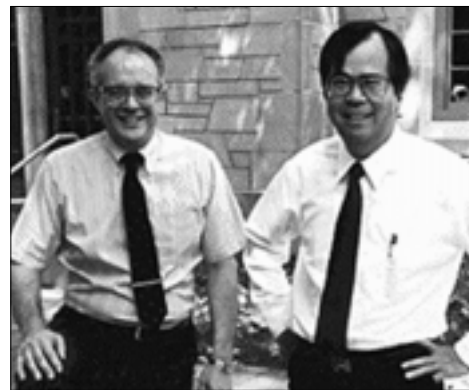
The academic year 1997-98 was a busy and productive year for the MTC (Mathematics Throughout the Curriculum) project. We introduced several new courses, including the courses on history with statistics and on mathematics for speech and hearing sciences, which are featured in this issue. We also carried out several evaluation and dissemination activities.

We are now concluding our second year, for a project that is funded for five years; and, although we will be continuing our development work with new courses, we also need to begin looking ahead to institutionalizing our curriculum changes which have been successfully implemented.

As part of this effort, we need to document our work for both internal use and for use in disseminating our curriculum changes to other schools. We now have drafts of materials for most of our courses; and, in a few cases, the materials have been reviewed and accepted for publication. In other cases, we need to carry out the work of revising and refining our course materials, so that they will be appropriate for use at other schools around the country.

In addition to reports on our new courses in history and speech and hearing, we also use this newsletter to describe our outside evaluation visit by an evaluation team hired by the National Science Foundation. Such visits will continue in the future, as NSF is mandated to carefully evaluate programs such as ours.

Looking ahead, on July 9-11, 1999, Indiana University and our project will host a national meeting at which all seven national projects on Mathematics Throughout the Curriculum will showcase their curriculum work. We expect to welcome several hundred university faculty members to Bloomington, all interested in interdisciplinary mathematics curriculum projects. We will give more details of this meeting in our next newsletter.



IU math Professors Daniel Maki and Bart Ng

We welcome people to contact us for more information or with suggestions for new courses.

Please see the back page for our mailing address, phone number, web address and our e-mail addresses.

We look forward to your comments.

Mathematical ‘Synergy’

NSF EVALUATORS OPTIMISTIC ABOUT INTERDISCIPLINARY EFFORTS

The Mathematics Throughout the Curriculum (MTC) Project passed a milestone earlier this year when evaluators representing the National Science Foundation (NSF) published an optimistic review of the project’s first year. The review was based on a site visit the evaluators made to Indiana University in the fall of 1997.

A three-member team was hired by NSF: Tania Madfes, of WestEd (a nonprofit research, development and service agency); Susan Millar, director of the University of Wisconsin’s LEAD (Learning Through Evaluation Adaptation and Dissemination) Center, and William Yslas Velez, a mathematics professor at the University of Arizona. The evaluators, forecasting an “optimistic” future for the IU project, critiqued MTC’s pilot programs and offered suggestions for the continuing development of the university-wide project.

Above all, the NSF team praised faculty collaborations: “There is a rich interplay between mathematics and science. In fact, in all of the new courses under development we saw evidence of collaboration. We were amazed by the high level of commitment and strong partnerships and wondered how [Directors Dan Maki and Bart Ng] could have possibly made it happen.”

The evaluators further elaborated that “this grant has allowed for a breakdown of barriers, and with this breakdown, the faculty have enthusiastically addressed pedagogical problems. We believe that this grant shows the great potential that exists among faculty.”

The NSF team assessed the MTC project according to three goals it set for itself in its initial project proposal: first, to create interdisciplinary courses that would provide a contextualized setting for the acquisition of new mathematical ideas and tools; second, to change students’ attitudes toward mathematics by emphasizing the link between mathematics and other sub-

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NSF Evaluation Report

jects; and third, to affect a positive change in the academic infrastructure as it related to mathematics on the eight IU campuses.

Of the three goals, the evaluators expressed most praise for the interdisciplinary cooperation of the faculty in course development. They singled out Maki and Ng, stating that the pair have “inspired commitment, enthusiasm, and respect from their faculty colleagues and strong cooperation from campus administrators.”

The team also identified Morton Lowengrub, Dean of the College of Arts

and Sciences at IU Bloomington, as a source of positive change: “This dean has worked at eliminating structural impediments to cross-disciplinary collaboration . . . He is fostering a culture in which faculty are expected to participate in interdisciplinary teaching and research.”

Some aspects of the program in which evaluators identified room for improvement related to the newness of the MTC project. Millar expressed concern that “the faculty at the small IU schools (which have no course development teams but are planning to adapt MTC courses) are completely out of the picture.”

Velez felt that diversity issues and the needs of minority students had yet to be adequately addressed.

Millar and Velez agreed that in the future the MTC project should more actively include the work of graduate students. This, they believed, would help train the next generation of educators and in new curriculum and teaching approaches being developed by the MTC program.

Millar emphasized the need to collect longitudinal data based on students’ registrar records so that the university “can track MTC student course patterns in comparison with non-MTC students.” Additionally, she said MTC should develop an internal method of overall project evaluation so that MTC participants would not have to rely so heavily on the NSF for

SYNERGY *cont. on page four*

SYNERGY

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feedback about the programs' strengths and weaknesses.

Project development for the future was also a point of discussion. "Most university faculty do not have expertise in creating course materials that can readily be used by others: they need help and guidance," Madfes wrote in the evaluators' report.

Madfes suggested that experts from IU's School of Education be recruited to design course templates and provide training for the multidisciplinary teams.

As for the MTC project's affect on students' attitudes toward mathematics, the evaluators believed it is too soon to tell. "The impact of the project is difficult to ascertain at this point, since many of the courses are under development. My opinion is that these courses will have a very positive impact on encouraging students to take more mathematical courses," Velez wrote.

Nevertheless, the team saw poten-

tial for the MTC project to eventually spread its influence beyond the eight IU campuses. Velez elaborated on this opinion: "I think that these courses have great potential at being adopted at other universities. If other univer-

sities can be convinced that they could introduce more quantitative reasoning in non-mathematical courses, then the courses developed at Indiana University will be most appropriate."

National Science Foundation RECOMMENDATIONS

- ▶ **Establish project priorities.** For example, the directors, in collaboration with the steering committee, should decide whether it is better to develop many courses, almost none of which are widely disseminated, or just a few, all of which are widely disseminated.
- ▶ **Produce annual budgets that clearly support project priorities.**
- ▶ **Develop and present to all participants criteria and procedures for course selection and development.** These might include the following: impact on graduate students, impact on the largest number of students with weak quantitative reasoning skills, culture change in the mathematics departments, impact on under-served students, impact on pre-service teachers.
- ▶ **Develop and implement a process for assessing and establishing quality standards for each MTC course, from pilot through to dissemination.**
- ▶ **Provide an ongoing program of faculty development.** This should include offering guidance on active learning pedagogical practices, curriculum design, and the development of curriculum materials that will be effective for disseminating these courses.
- ▶ **Make regular and authentic use of the multidisciplinary steering committee.**
- ▶ **Make better use of the project evaluators.**

HISTORY

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Students, who were required to develop research proposals for themselves, delved into the census data to find areas of personal interest. Little said the assignment offered students the opportunity to explore more specialized paths of research, such as African-American history and women's history.

The course's attention to diversity issues earned praise for its instructors from National Science Foundation Evaluators in their evaluation of the IU MTC program: "[Introduction to History]' at IUPUI stands out as a

way to enable a broad spectrum of students to utilize the tools of mathematics to interpret the data of the past, for themselves, in a new way. We believe that courses such as this can empower many students to reach new levels of understandings about themselves, the world, and academia."

Little believes that the second offering of the course this fall will be stronger than the first. "I don't think as many students as we'd hoped were more comfortable [with mathematics] at the end," Little said.

"This time around it's going to make a big impact. We're three-quarters of the way there," Little said.

Little explained that the course offered a unique opportunity to win students over to mathematics. "I'm happy teaching at the 100 level-it's a place to catch folks, to get them to want to learn on their own," he said.

At the very least, he views the renewed emphasis on mathematics as a "stop-gap measure" in the erosion of mathematics education.

The course, however, also has long-range implications within the field of history. "In the 70s, quantitative history died out, and research went more along the lines of cultural studies. I don't see why it can't make a comeback," Little said.

Visit the course website: <http://www.math.iupui.edu/~hist117/H117WEB.html>

A 'One-of-a-Kind' Course

SPEECH AND HEARING SCIENCES BOOST STUDENTS' ADVANTAGE IN FIELD

During his undergraduate studies, Speech and Hearing Sciences (SPHS) Professor David Eddins was a typical "math-phobic" student. He felt uncomfortable with mathematics and physics and avoided it whenever possible. Not until he was a doctoral student did he break down and take Calculus I, II, III, and mathematical statistics.

"I was in class with freshmen and sophomores, but I was probably the only one who knew how to apply what we were learning," Eddins said. Future generations of SPHS students may avoid the lag in mathematics education that Eddins encountered. Last fall he, along with IU Bloomington SPHS colleague Diane Kewley-Port and Mathematics Education doctoral student Paul Kehle piloted a course entitled "Mathematical Foundations for Speech and Hearing Sciences," which introduced principles of physics and statistics as applied to the students' chosen field.

SPHS spans two professions: speech and language pathology, and audiology. Entry-level positions for each require a masters degree. Although IU Bloomington's graduate program is highly competitive (40 of 275 applicants are selected), many of the students do not possess the mathematics skills needed to tackle the concepts that communications disorders require. The new course promises to correct for such deficiencies in new graduate students and prevent such obstacles for undergraduates.

Class participant Sneha Patel said that many SPHS students don't realize that mathematics is the basis of their field. "Everything is so computerized now," she said. Because of this, many students do not realize that they must grasp basic mathematical concepts themselves rather than

relying too heavily on tools such as computers. For many, this obscures future technicians' need to grasp underlying mathematical principals.

"The physics of sound is pretty complicated, so you must understand how production occurs," Eddins said. Sound is produced by the vocal cords, then the tongue, lips and teeth act as filters that modify the sound wave.

To help students understand the concepts involved in sound production, Eddins, Kewley-Port and Kehle employed the Excel spreadsheet program. Although more expensive mathematics software such as Matlab would have been easier to adapt to their needs, Kewley-Port and Kehle believed that a more-accessible program such as Excel would have a broader impact in the long run. Eddins said he and his colleagues hope to make the software they develop available over the Web or by CD-Rom, so students across the country stand to benefit from IU's SPHS mathematics course.

Using sound waves as examples for the Excel program, the instructors were able to present Fourier analysis--an advanced concept--to the introductory-level class.

To Eddins, the course could not have been as successful without the interdisciplinary aspect. He and Kewley-Port had never taught mathematics as a primary topic before and without the MTC project they would never have been able to collaborate with Kehle.

Eddins believes this "one-of-a-kind" course that presents mathematics within the SPHS context will make undergraduates more competitive in the graduate arena in



Course Instructors Diane Kewley-Port, Paul Kehle, and David Eddins

three ways: it will raise students' scores on the math component of the GRE, it will improve problem solving skills in upper-level graduate courses, and it will testify to strong mathematics skills on students' transcripts.

SPHS Department Chair Larry Humes said IU program is highly regarded because of the firm foundation it provides students. "We would like [the Mathematics Foundations course] to become a part of the required curriculum," he said.

The model course was not problem-free, however. Class-participant Shelly Godar said the computer programs developed for the nascent course resulted in many long, frustrating nights spent in the computer lab.

Additionally, because the course is not yet required of undergraduates, the target audience of sophomores and juniors was not met. Instead entry-level graduate students comprised most of the class.

Kehle said that although "the course still needs a lot of work, I think we've got a good rough draft." He is especially pleased with their efforts considering that the three had no model to work from: "We had to start from scratch."

Eddins, Kewley-Port, and Kehle are in the process of writing a textbook for the course, and expect to have a draft ready to present to publishers by the end of next summer.

Visit the course website: <http://www.indiana.edu/~hrgsci/s319f97/s319main.htm>

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PROJECT UPDATE

Sixteen MTC courses will be taught during 1998-99:

- ▶ Art and mathematics
- ▶ Business and mathematics
- ▶ Chemistry and mathematics
- ▶ Criminal justice and statistics
- ▶ Economics and game theory
- ▶ Economics and statistics
- ▶ Elementary biology and mathematics
- ▶ Experimental calculus
- ▶ Finance and mathematics
- ▶ Geography and mathematics
- ▶ History and mathematics
- ▶ Intermediate biology and mathematics
- ▶ Linguistics and mathematics
- ▶ Social and industrial problems and mathematics
- ▶ Social sciences and mathematics
- ▶ Speech and hearing and mathematics

Additional courses have been developed through MTC:

- ▶ Exercise science and mathematics
- ▶ Nursing and mathematics
- ▶ Physical systems and mathematics

Additional courses will be developed during 1998-99.

MTC Advisory Board

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Supported by NSF