MATC Workshop:
IU BLOOMINGTON HOSTS NATIONAL PARTICIPANTS OF NSF PROGRAM

Preparing a resume or a similar presentation can be a revealing experience when we suddenly realize how much we’ve accomplished. Such was the experience of the MATC consortium when its participating institutions met last July 9-10 in Bloomington for a workshop which showcased the results of their first three years of interdisciplinary course development.

MATC (Mathematical Sciences and their Applications Throughout the Curriculum) is comprised of seven projects: Indiana University’s MTC project, and similar projects from Dartmouth College, Rensselear Polytechnic Institute, the U.S. Military Academy, the State University of New York, the Oklahoma State/University of Nebraska partnership, and the University of Pennsylvania. More than 120 faculty from more than 50 colleges and universities participated in the workshop, seeking ideas, materials, and inspiration for curriculum development and improvement of mathematics education.

In addition to attending an introductory session, a session on obtaining funding, and a poster session, participants selected from 23 hands-on mini-courses taught by MATC course developers. The mini-courses were designed to enable and encourage participants to help in the ultimate goal of the MATC project, namely, spreading the interdisciplinary teaching of mathematics across the nation.

Active learning, the order of the day, became extremely active at times.

After his keynote address, Hampshire College President Gregory Prince, Jr. (left) confers with MTC co-PI’s Dick Patterson and Bart Ng.

Alex James and Gabriel Skidd, students of Professor Peter Hamburger at Indiana Univ. Purdue Univ. Ft. Wayne, pose by their geology and chemistry projects, which were aided by Fourier analysis.

Top: Several mini-courses used computer labs. Middle: Dr. William Velez’s address included a video interview. Bottom: MTC Project Evaluator Diana Lambdin discusses teaching strategies with Math & Art mini-course instructor Marc Frantz.
FROM THE DIRECTORS

Spreading the Word
FOCUS ON MATERIALS AND DISSEMINATION

Last July, IU's Bloomington campus saw the arrival of more than 120 faculty from more than 50 colleges and universities across the nation. The occasion was a two-day workshop showcasing interdisciplinary courses developed by members of the Mathematics and its Applications Throughout the Curriculum (MATC) initiative, of which MTC is a part.

The MATC workshop is the topic of the cover article of this issue, and a second article highlights the keynote address by Hampshire College President Gregory Prince Jr.: "Seek Nothing Less than Radical Reform."

That challenge is sufficient to remind us that, with less than two years left for our project, there is still much to do. Indeed, it is the very nature of our innovative reforms which makes our courses potentially more difficult to disseminate than more traditional ones. And disseminate we must, if we are to fulfill our goals and those of the National Science Foundation.

To that end, we must now focus more than ever on high-quality course materials. Forthcoming articles in this newsletter will discuss some of our finest products to date, so that the rest of us can learn from (and perhaps be inspired by) them.

However, when reform is truly radical, good materials may not be enough. Manageable but nonstandard pedagogy can appear forbidding to prospective teachers, unless they try it hands-on, with expert guidance available. This has been the lesson of several of our course developers who have given (and attended) dissemination workshops.

Thus, July's MATC workshop should not be thought of as a finishing touch, but as a beginning which will lead to more in-depth, course-specific workshops—workshops which will give others the enthusiasm and confidence to adopt our reforms and put them into practice.

The next issue of the newsletter will highlight MTC workshops for Summer 2000, including Mathematics and Art, and Mathematics and Finance.

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.
Seek Nothing Less than Radical Reform
KEYNOTE SPEAKER OFFERS CHALLENGE, ENCOURAGEMENT TO MATC

The challenge above, which was also the title of the keynote address at MATC’s July workshop, is indeed a tall order. Gregory Prince, Jr., the keynote speaker, is quite familiar with the difficulties and rewards involved in meeting such challenges. Dr. Prince is President of Hampshire College, which could fairly be described as one of the most interdisciplinary colleges in the United States.

Founded in 1965 as an alternative to traditional liberal arts education, Hampshire has schools, but no departments. Hampshire students work closely with faculty to design their own interdisciplinary programs of study. Before presiding at Hampshire, Prince served for 19 years as Dean of Interdisciplinary Studies at Dartmouth, and is well aware of the practical aspects of initiating and sustaining interdisciplinary programs in various settings.

Not surprisingly, Prince expressed enthusiasm for the MATC initiative, saying, “MATC...is designed to create exactly what is needed—courses that will expose students to quantitative and mathematical dimensions of a range of subjects...” However, he went on to say, “...as much as such courses are needed, their existence will have little impact unless they generate a genuine, permanent, cultural shift among faculty and students. They are necessary tools, but certainly not sufficient, and, without a larger context, they are not likely to make a difference.”

The challenges of that larger context, said Prince, include demystifying science, mathematics, and technology; making the most of active learning strategies; and making a greater commitment to interdisciplinary teaching and organization. Interestingly, Prince’s suggestions for addressing these challenges revolve around a single idea: active learning focused on unsolved problems chosen by the students themselves.

“I think that most in this room would agree that active learning environments are more successful than passive learning environments, but not all who support active learning embrace one of its fundamental characteristics—that the students are working on real problems for which no one yet has found an answer,” Prince said. He suggested that active learning is most effective “when students have a chance to select a problem about which they care deeply and use the math or science they are studying to try to solve the problem.

The key to active learning pedagogies rests with having students work on real problems that no one yet knows the answer to, and for which there is an audience that wants to find out the answer.”

While many MATC courses employ this strategy, Prince emphasized the importance of extending it to a larger context: “If active, problem oriented learning is to be the model, then we must rethink the current hierarchical structure of introductory and advanced courses where the problem solving is delayed until the junior and senior years.”

And what about the greater commitment to interdisciplinary teaching and organization? According to Prince, commitment to the active learning model is again the place to start. “I would argue that one need not eliminate the traditional departmental structure to make the kind of interdisciplinary work needed possible. The students themselves will generate that interdisciplinary teaching and interaction if they are allowed to generate the problems that are to be solved.”

In closing, Prince described the MATC initiative as “one of the most critical of ventures. Embrace fully its breadth and challenge your colleagues and your administrators to back the effort. As resistant as some may be, I believe most will embrace the need if it is presented in the broad context it deserves.”

Visit the Hampshire College Website: www.hampshire.edu
MTC at IU Southeast:
BUSINESS, PSYCHOLOGY, AND BIOLOGY MOTIVATE MATH

The pride of consulting for a real business, a running start at a tough statistics course, and a quantitative understanding of living systems are some of the benefits offered by MTC courses at Indiana University Southeast (IUS).

Located in New Albany, IUS is a campus of more than 5,000 students, offering 40 degree programs. Like students everywhere, IUS students look for relevance to real life in their classes. Three MTC courses which offer them that are “Applied Math in Business,” developed by Professors Kathy Ernstberger (Business) and Chris Lang (Math); “Basic Statistics for Psychology Majors,” developed by Professors Mary Anne Baker (Psychology) and Dylan Shi (Math); and “Applications of Mathematics to Biological Problems,” developed by Professors David Taylor (Biology) and James Woeppel (Math).

“Applied Math in Business” closely follows the MTC prototype course “Analytical Problem Solving,” developed by business Professor Wayne Winston and MTC co-director Dan Maki at IU Bloomington. “Applied Math” is cross-listed as both a mathematics course and a business course, and its main feature is a final project using data from a real business.

In the first semester of the course, a bagel & doughnut shop contributed sales data, and teams of students worked in a computer lab, using Microsoft Excel to analyze the data and make forecasts. One consulting team used time-series methods and another used multiple regression to make their forecasts. In the end, the two forecasts were in close agreement.

The client came to class to hear the students’ presentations, and found them a useful service. More importantly, the students were exhilarated by the opportunity to present their results to a real business.

Providing students with such experiences is not easy, report instructors Ernstberger and Lang. They say the most difficult task is finding a client who is willing to share real-life data. Some are concerned with confidentiality, while others do not have complete data in a usable form. Struggling to obtain such data is necessary, however, because the use of such data is the main selling point of the course.

Real-life data is also used in “Basic Statistics for Psychology Majors.” For example, the course uses IUS student statistics such as ages, grades, etc.

This course, A118, is essentially equivalent to the standard finite mathematics course M118, with linear algebra deleted to put more emphasis on statistics. Though the course is designed mainly for psychology majors, it is taken by majors in other social sciences and biology.

Like “Applied Math,” “Basic Statistics” uses Excel to analyze data, and Professor Shi has been sufficiently satisfied with the results to begin using it in his other statistics classes.

Baker and Shi choose problems of the type that will help prepare students for the statistics course K300, which they must take later. This later course is quite difficult. One of the main benefits of “Basic Statistics” has been its success in preparing students for K300.

The third course, “Applications of Mathematics to Biological Problems,” also employs computers for mathematical modeling, using the program Matlab. Aspects of this course are detailed in a separate article on Page 5. All three courses are being taught in the Spring 2000 semester.

Visit the IUS Website:

www.ius.edu
When Mathematics Professor James Woeppel was Dean of Indiana University Southeast (IUS), he was approached about creating a course combining mathematics and biology. He enthusiastically supported the idea; he already knew that Biology Professor David Taylor used innovative methods, including problem solving, in his teaching. After visiting a few of Taylor’s classes, Woeppel saw that the students were learning while having fun—a desirable trait for any course, mathematics courses in particular.

Woeppel and Taylor set out to discover if it was possible to take upper-level, fairly complex mathematical concepts and get students with a background in college algebra to do various levels of calculus as well as matrix multiplication.

Putting together an interdisciplinary course was a challenge for the two scientists, coming from such different fields as mathematics and biology. “That first summer, when we were setting up the course, we had to spend a lot of time reading over stuff, [Woeppel] asking me biological questions, me asking him mathematical ones,” Taylor said.

The course that evolved is one that not only teaches mathematical modeling, but also conveys a healthy skepticism of the models themselves. The instructors have been pleased by the success of this endeavor. In solving their problems, the students have been alert to notice when their answers don’t make sense biologically. The instructors are encouraged by this, because one of the dangers of doing mathematical modeling is that people nearly always tend to believe the answer.

The students began asking themselves: What if we change these numbers? And if we push the numbers, can we really believe what is happening here? They were solving the problems using math as a tool, rather than an oracle. In one case, biological data was analyzed using a continuous model and a discrete model. It turned out that there were discrepancies between the results, and this provided an excellent opportunity for a comparison of the two models.

The class meets three times each week, with one of the sessions held in a computer lab. Mathematical topics are chosen from matrix algebra, probability, game theory, logistic equations, and Lotka-Volterra equations. Problems are derived from biochemistry; ecology; evolution; genetics; and human, molecular, and population biology. The software package Matlab is used extensively. Some students have learned Matlab programming beyond the requirements of the course, in order to make their models more effective.

Group projects are also a part of the course. “This class taught me that collaborative learning is an important thing,” Woeppel said. “The students often learned more from other students than they did from the faculty members. We, after the initial, introductory part, really almost were facilitators and a resource. We gave them the material, looked at the problems they had, and answered any questions.”

Visit the course home page: homepages.ius.edu/AK/JWOEPPEL/web_docs/M218.htm
MTC 2000 Summer Workshops
Course developers in Mathematics and Art, and Mathematics and Finance, will hold workshops this summer in Pennsylvania and Indiana. Learn the details and get ideas for your own workshops.

Catch the Wave to Calculus
Learn how IPFW Professor Peter Hamburger teaches calculus using Fourier analysis and interdisciplinary projects, mentored by collaborating instructors from various disciplines.

Mathematics and Journalism
IU Bloomington Professors Chuck Livingston (Mathematics) and Paul Voakes (Journalism) have teamed up to create an interdisciplinary course which will soon become the required means by which journalism students acquire competency in reporting on quantitative issues.