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Augsburg's Humanistic Curriculum Project

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AUGSBURG'S HUMANISTIC CURRICULUM PROJECT

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Summary: The Department of Mathematics at Augsburg College has embarked on a project to replace the traditional calculus/linear algebra sequence for mathematics and science majors with a curriculum more representative of the ideas and humanistic processes of mathematics.

Background and goals

This project grew out of several frustrations our mathematics faculty has had:

- We are not preparing most lower-division mathematics students to decide whether or not to become mathematics majors. They do not become aware of the breadth of mathematical ideas, and we do not teach them the logical or creative mathematical thinking mathematicians use.

- Nor are we preparing most lower-division mathematics students to major in the sciences. We do not give them a sufficiently deep understanding of the mathematical concepts they do encounter, nor do we introduce them to the breadth of mathematical topics now being used in the sciences.

- We are not teaching most lower-division mathematics students to read mathematics well enough to fill in these gaps in their mathematical knowledge. Nor do we teach them to write mathematics even well enough to communicate their mathematical results clearly, much less to use writing as a tool for better thinking.

- Numerous good, creative mathematics students drop out of our calculus sequence expressing a personal distaste for calculus, without realizing how broad the field of mathematics is.

- After one term, the non-science students in our "Mathematics for Liberal Arts" course know more about mathematics than our majors do. They are more aware of the processes involved in doing mathematics, and they understand more about the historical connections between mathematics and the rest of culture.

We want a curriculum that alleviates these frustrations, a curriculum to replace our traditional calculus/linear algebra curriculum for prospective mathematics and science majors.

What have we done toward that end? First, we talked a lot among ourselves, and with our science colleagues. We found ourselves in the unusual situation of having an entire mathematics faculty willing to work at this, and a science faculty supportive of experimentation in this direction.

Then, based on our conversations, we drew up a list of overall goals. We decided that the goals of this project are that science and mathematics majors

- achieve a deeper understanding of calculus and linear algebra concepts than they do now;

- encounter more breadth of mathematical ideas than the current sequence provides;

- think more logically about mathematics than have students in recent years;

- read and write mathematics better than they do now; and

- be more aware of the cultural roots and influence of mathematics.

Then we acted. We applied to the NSF calculus reform program twice, with negative results. The breadth of topics in our proposed program means that it is not just calculus. So we turned to FIPSE, the "Fund for the Improvement of Post-Secondary Education." It's the only part of the Federal government that we know of that

prides itself on sponsoring innovative, cutting-edge programs and on getting them institutionalized.

FIPSE funded a three-year project, starting this past fall. Most of the support is for released time for four of the mathematics faculty to prepare the new curriculum. We're in the first year of that project, getting ready to teach the first year of the sequence next year. Next year we'll prepare the second year of the sequence, and during the third year of the project we'll teach both years of the sequence, prepare teaching materials for others, and host a dissemination conference. All along we'll be evaluating the effectiveness of the results.

Implementation

What have we done so far? First we had to determine where to start. Should we begin by deciding on the mathematical topics? How? Should we start with the current sequence and decide what to eliminate, or should we build from scratch? Or should we come up with particular objectives first? Should we decide on an overall organizational approach to give continuity to the courses? Should we each draw up a proposal and then merge them, or should we work as a group? How should we make decisions? These were some of the many questions we had to deal with initially. Some of them are still being discussed.

Fortunately, FIPSE encourages groups to pay a lot of attention to process, reasoning that even if our results don't fit well at another institution, our process might inform that institution's faculty in designing its own curriculum.

We consciously decided that group ownership of the project was extremely important, perhaps more important than sticking strictly to the details of the proposal we made to FIPSE. Striking a balance is still difficult, however.

Helping us gain ownership was our common experience in teaching our "Mathematics for Liberal Arts" course. Working against us were some differences: in the goals we wanted to stress, in visions of the final courses, in length of teaching careers, in preferences for involvement in group work, and in teaching styles. We've spent a great deal of time getting to know each other better and learning to work with those commonalities and differences.

Through this process we've reached some decisions:

- We've come to accept that each of us will take a different approach to the ideas, some more historically-based than others, so that we will not be specifying a single day-by-day sequence, but rather several.

The disadvantage of this approach is that our list of topics and the written materials will have to be compatible with several sequences. The advantages, however, are that we won't have to come up with a single sequence of topics with which we all can live, and that the results should be more widely adaptable.

- We even have some tentative lists of mathematical topics for the first year. At this point it appears that about half of the class sessions will be spent on calculus ideas, with about the scope of (but with more depth of understanding than) a short calculus course for non-science majors. The other half will range through geometry, probability, combinatorics, number theory, matrices, graph theory, and simple algebraic structures. We expect that the third term will be a more abstract approach to many of the same ideas, with more of the calculus details.

Right now we envision a fork in the road after the third term. Replacing our differential equations course will be a course in applied mathematics, including not only differential equations but also, for example, more of the vector calculus used by scientists. For the more theoretically-oriented will be a course with more abstraction and rigor, answering many of the "how do you know you can do this?" questions that arose earlier in the program.

- Although we've listed traditional categories of topics above, and we'll be flexible in allowing a variety of approaches to these topics, none of us expects to consider the topics in traditional chunks. We ourselves are excited about connections among mathematical ideas, and we want our students to encounter many of those relationships. So each of expects to interweave the categories in some way.

This spring we plan to gather written materials from a variety of sources, get permissions to use those materials, and write a study guide to make connections among those various materials. We know that we'll have to write some materials ourselves, but we hope that we won't have to write too much, at least this year.

A plea for help

This all has been leading up to a plea for help along three lines:

- We want to know of excellent writing, expository and technical, about any mathematical ideas at all, but especially those we've listed above. We're very interested in writing that stresses the mathematical processes involved in developing ideas, not just the results.

- Along the same lines, we want to know your own ideas about approaches to mathematical topics that illustrate how scientists or mathematicians do mathematics.

- Finally, are you personally interested in eventually providing a section or two of a course that would follow these general ideas? If so, what kinds of evidence from the evaluation of our program would it take to convince you, or your department or dean or whoever, that this approach is worthwhile enough to try?

To give suggestions or receive more information, please contact the project director, Larry Copes, at Augsburg College, Minneapolis, MN 55454, 612/330–1064, or through e-mail at copes@augsburg.edu.