The YSU Center for Undergraduate Research in Mathematics

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History of Undergraduate Mathematics Research
at Youngstown State University

In the later 1970's Milt Cox at the Miami University of Ohio and I proposed to the Ohio Section of the MAA that a formal program of undergraduate mathematics presentations be established at the Spring Section meetings. before that time there had been a few student presentations but no formal structure. The program that Milt and I proposed required the Section to make the following commitments.

- There would be separate sessions for student talks, on late Friday afternoon, if possible, which would run parallel to faculty talks. Faculty were welcome to attend.
- A pizza party, or similar, would be held on Friday evening at no cost to the students.
- Lodging would be provided at no cost to the students.
- There would be no registration fee for students.
- Doughnuts, pastries, etc., would be available for breakfast at no cost on Saturday morning.
- Invited talks at the Spring meeting would be accessible to undergraduate students and have mathematical, rather than pedagogical, content.

There was some initial objection to the plan. There were faculty who felt that the Section meetings gave them a chance to, essentially, get away from their students and meet alone with their colleagues. The response to this objection was that they still had this opportunity at the Fall meeting. It was also pointed out that this argument would not likely hold much credence with their administrations who were subsidizing their travel. The second objection concerned the expense of the program to the Section. However, the expense would not be as great as it first appeared since the students could likely be accommodated in dormitories (times have changed somewhat), the breakfast entries were already being provided and generally subsidized by publishers, so the only substantial additional expense would be the pizza party. The point that Milt and I emphasized was that this program could be important for bringing new students into the profession, and that this was

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the likely market for future MAA members. The program was adopted, and by the 1980's the number of students at the Spring MAA Ohio Section meetings nearly approached the number of faculty.

Milt, who at the time was President-Elect of Pi Mu Epsilon, the National Mathematics Honorary, was very much involved with undergraduate student research and student presentations at the summer meetings. I was a recent past MAA Ohio Section Chair and interested in the program because I felt that the students at YSU needed to get away from the Youngstown area to see how they compared with other students in mathematics. YSU students generally come from the geographical region of Youngstown, Ohio, and traditionally commute to campus and hold part-time jobs off campus. Since they have also done their precollege training in the region, many of them do not have much contact with any other area of the country or even of the region. I was a product of this educational system and did not gain an appreciation of my abilities until a graduated, worked in the aerospace industry and then went to graduate school. What I found was that I was very well prepared relative to others at my level. My feeling was that if I could get our undergraduate students to see how they compared nationally, it might encourage more of them to do graduate work in mathematics or a related area.

In the Spring of 1982 Milt inducted the Pi Mu Epsilon Chapter at Youngstown State, and we established goals for the organization that included having at least one student speaker at the annual PME meeting, which was held in conjunction with the Joint Summer Meetings (the predecessor to MathFest). In the summer of 1982 I accompanied seven YSU students to Toronto where one of our students gave a talk. Since that time YSU students have given presentations at every annual PME meeting.

In the late 1980's PME was given a grant by the American Mathematical Society to award monetary prizes for Outstanding talks at the National Meetings. By that time YSU was taking at least 6 student speakers to each National Meeting, and quite a few of our students became award winners. The administration of the University was particulary pleased with this since it gave them something to tell alumni, and in consequence, the mathematics department became a model for undergraduate programs on campus.

In order to better prepare our students for their talks at MathFest, in 1998 we began the YSU Regional Undergraduate Mathematics Conference. This conference is held each year on the second Saturday after the COMAP Mathematics Modeling Competition. It is designed to attract students from about a 120 mile radius of Youngstown, which includes both the Cleveland and Pittsburgh areas, as well as Akron in Ohio and Erie in Pennsylvania. In total there area about 40 Colleges and Universities within this region.

In order to permit people to easily arrive and return on the same day, the conference does not begin until 10:30 in the morning and is finished by 3:00 in the afternoon. We provide coffee, juice, and doughnuts in the morning and pizza and sodas for lunch, which is the major expense. This has been defrayed at times by donations from the Giant Eagle grocery stores and Papa Johns pizza, and for the past four years has been supported by the MAA-NSF grant DMS-0241090, which gives support for regional undergraduate mathematics conference at which students give presentations. All communication at the YSU conference is done through e-mail and the web, so the cost of the conference is minimal. The conference is unique

in the sense that it is totally students speaking to students, and is organized and run by the students in the YSU PME Chapter. This gives our students experience organizing meetings in a manner that gives maximum effect with minimal labor.

The YSU Regional Conference annually attracts approximately 120 students and 40 faculty from about 15 of the schools in the region. The schools attending vary; about 30 schools have attended in the first 8 years of the conference. About 40 of the students give presentations, YSU students dominating with about 15-20 of the talks. Another dozen of so students are involved in the COMAP session that runs in the morning, which gives teams of students an opportunity to tell how they approached the solution to the problems that were recently given. I understand that these sessions can at times be quite animated, but I have never attended since I am a COMAP judge.

The expectation for our students is that they will give the first presentation of their talk at our conference in February, give a revised and improved version at the MAA Ohio Section Meeting in April, and then present a very polished version at the summer MathFest. By that time they will likely have additional material to discuss and be very comfortable with presenting the material. It doesn't always go according to plan, of course, but in the past decade YSU students have won 31 Outstanding PME awards for their presentations at MathFest of a total of 86 awards given, and an additional 8 awards at the MAA Student paper sessions.

Most importantly, all but one of the 19 YSU award winners in the period 1996 through 2003 have advanced degrees, 4 have received the Ph. D., and an additional 12 are currently at the dissertation level.

The Importance of Recognition of our Efforts

Faculty in mathematics often understate the importance of their accomplishments to the administration of their institutions. In mathematics we are accustom to making statements only we can back them with a logic that is irrefutable, and when all cases are known to be logically correct. We need to recognize that while this is the nature of our profession, it is not what the public, and in particular our administrators, are accustom to hearing. If we, and more importantly our students, are to gain the deserved recognition for our work we need to present our case to the our institutions in terms that are better understood. This does not have to come at the expense of remaining true to our profession and our consciences, although we might at times have to grimace at the way our Public Relations Offices presents what we have told them.

We need to develop better relationships with our Public Relations Office, our Development Officers, the upper-level administration, and the Director of any Foundation that supports programs within the institution. These people need to present the institution to their Boards and to the public in a way that is both complementary and understandable. They often do not have a sophisticated mathematical background so they cannot do this without our help, and we have found that at all levels these people have been extremely grateful for our efforts of communicating the success of our undergraduate students. It has helped our program in numerous ways, including helping us gain additional faculty over other programs for which they do not have the same level of respect.

In the next Section I will describe the latest effort that we are pursuing to bring credit to the program that we feel has made a great impact on our students over

the past two decades, and will hopefully ensure that this program and the respect it brings the Mathematics Department will continue.

Establishment of the Center

Because of the success and recognition of our students, it was decided to establish The Center for Undergraduate Research in Mathematics to ensure that this activity would continue beyond the tenure of those who initiated the program. The Center will have a Director with one course per term release time, a dedicated Undergraduate Mathematics Study Room, and a dedicated Undergraduate Research classroom with state of the art technology. An endowment was established at the YSU Foundation with current funding of about $125,000 and additional pledges of about $75,000. It is hoped that the endowment will eventually total $300,000, which will provide $15,000 annually for the operation of the Center.

The primary goal of the Center is to continue to provide opportunities for YSU students to work on undergraduate research in mathematics and to prepare high quality presentations, both oral and text, based on this research. A second goal of the Center is to attract high-quality undergraduate students to the program. Currently most of the YSU undergraduate mathematics majors initially enter the University intended to major in some other area. After they see the excitement of the upper-level mathematics students and the opportunities provided to them, they first add mathematics as a dual major, and then often switch entirely to mathematics. Of the 12 students from YSU who gave presentations at MathFest this past summer, for example, all were double majors except one, and that student was majoring in Mathematics Education. Since only one of these was a senior, a very strong double major in mathematics and physics who is doing graduate work in physics, there is ample time for the remaining students to consider mathematics as their primary endeavor.

An Oversight Board is being established for the Center that consists of alumni of the department, retired faculty who have been involved in undergraduate research activities, faculty from other institutions who have made substantial contributions to the Center, and some prominent members of the Youngstown community. The purpose of the Oversight Board is to ensure that any money directed to the Center is spent in a manner consistent with the goals of the Center, and that money directed to the Center not be used to support activities, such as student research activities and the presentation of this research at professional conferences, that are generally supported from other University sources.

Other mathematical activities that the Center intends to pursue revolve around increasing the written presentations of our students. We currently have a number of our students solving problems and submitting their solutions to various mathematical journals. We have also had students with published articles in the PME Journal, Math Horizons, and Mathematics Magazine, but very infrequently. Our students are generally LaTeX capable early in their first year, and they have creditable performances on the COMAP competition, so they have the writing skills that are required. However, if they are to be successful professional mathematicians, they need to better develop these writing skills so that they prepare written articles without undue strain.

Conclusions

The YSU Mathematics Department has gained a substantial reputation on campus, and I think off campus as well, by the involvement of undergraduates in mathematics research. For most of the faculty in the department the effort has been minimal. Undergraduate projects are required and faculty direct them. We require both oral and written presentations and most faculty require that the written presentations be done using LaTeX. From that point a rather small group of faculty (originally only one, last year three or four, next year about six) take over and work with the students to prepare their talks. There is a rather rigid scheme for this, which involves one person who is concerned with structure and clarity, others involved with technical details, followed by extensive peer review.

This has been a rewarding activity for me in the following sense. In my first 12 years as a YSU faculty member, I did not have a single student who eventually received a Ph. D. in the mathematical sciences, although I must admit that some of these did exceedingly well in other areas. Since 1982, when we established our PME Chapter and began taking students to the national meetings, more than 30 of our PME students have the Ph. D. degree in the mathematical sciences or a mathematics related area like quantitative economics, and an additional 12 are at the dissertation level. If you want to train mathematicians, this seems to be a viable way to start.

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