

Starting an Undergraduate Research Program

Julie C Jones and Jacqueline A Jensen

Shortly after we started working at Sam Houston State University in the fall of 2002, we learned that SHSU would be hosting the annual Texas section meeting of the MAA in the spring of 2003. We also learned that there were no SHSU students planning to give talks. This fact disturbed us. So, we decided that we should try to find students who would be willing to give talks.

We attended a few math club meetings, asking for volunteers. We hoped to get two or three willing participants, but instead we got nine. Here we were, first year faculty members with nine students to advise and not a clue as to how to proceed. Of these nine students, four were sophomores. While we were thrilled that so many underclassmen were interested, this presented another challenge. Advising students with such little mathematical background is difficult, but we were, and still are, confident that getting them involved in the mathematical community is the right thing to do.

At this point, math history became our best friend. Our four sophomores talked about “Three Hundred Fifty Years of Proving Fermat’s Last Theorem”, “Fractals Based on Pascal’s Triangle”, “Heron’s Formula and His Proof”, and “Martha Euphemia Lofton Haynes: the First African American Female Mathematician”. None of these topics require much mathematical maturity, but they are interesting topics that are appropriate for students to present. Furthermore, it was an opportunity for our students to learn about people like them, including women and minorities, who are often omitted from the history of mathematics.

Two of our more senior students had just completed their first abstract algebra course and were intrigued with some of the ideas presented in that course. One of these students became interested in cryptography and gave an expository talk on RSA cryptography. Her new-found self-confidence, gained from her research and presentation experience, has encouraged her to explore graduate programs where she can study cryptography. Another student decided to combine her interest in abstract algebra with her minor program in the physical sciences to investigate the symmetry groups of molecular and crystallographic structures.

Clearly, each of the students picked topics that were most interesting to them. Because of this, we were sometimes advising students who knew substantially more about the topic than we did. Even topics that initially seemed uninspired were shaped by the students’ enthusiasm into presentations that were informative for us, as well as for their peers. In this way, we learned as much as the students.

In the months before the Texas section meeting, we had many meetings during which the students practiced their talks. We encouraged the students to critique their peers’ talks, but we made sure that this was done in a constructive and respectful manner. We also

learned that often what we say is not nearly as important as how we say it. For example, if the conclusion of a student's talk needs improvement, it is not constructive to say, "Your conclusion stinks." It is more useful to say something like, "Your talk was really good, but I think that we need to work on that ending," and give suggestions for improving it. It is also important to find some good things in a student's talk, even if the talk is largely a "crash and burn."

It took a couple of these "crash and burn" talks for us to remember that our students had never seen math talks. We, therefore, offer the following advice to people starting similar programs at their schools:

- Students who have never seen talks don't know not to say things like "Sierpinski was a Polish dude" or "That guy was a little wacko". Having your students practice their talks in front of their peers will help this; students realize that they need to be more formal when their peers get the giggles. It takes some practice for them to realize that they are presenting information, not talking to their friends.
- Most students have never made slides to accompany their talks, and they do not have any idea how much information to put on their slides. Again, practice helps here, as does a large budget with which to buy transparencies. We now encourage our students to practice with paper versions of their slides. We copy their work onto transparencies only after they have worked out all of the kinks.
- Students will be very nervous, even in front of their peers. The environment of the practice talks needs to remain supportive, and any non-supportive behavior needs to be stopped immediately. All comments and criticisms are welcome, as long as they are offered in a supportive manner.
- Some students will have minor (or major) meltdowns at some point in the process. Remind them that they know more about their topic than anyone else in the room and that they should be confident in their abilities.
- Some students tend to procrastinate. We know that this is an obvious point, but don't let students who put off the preparation of their talk or the making of their slides make you too nervous. Usually they will come through, sometimes making a far better presentation than you expect.

While we wanted our students to all give great talks, the most important part was that they did their personal best. They did not let us down! Our students put a great deal of effort into their talks, and they made their talks their own. Their efforts were rewarded, as two students won the award for best paper in their sessions at the Texas section MAA meeting.

Attending the Texas section meeting was an incredible experience that truly changed our students. We have seen a dramatic increase in their self-esteem. When they talk about mathematics, they are confident about their abilities. They were always talented, but it took something like presenting a paper at a meeting for them to realize it. It has also produced an enormous change in our department. The students held the First Annual SHSU Geek Week in April, 2003, which was an opportunity for the mathematics and statistics majors to flaunt their "geekiness". This is the beginning of a tradition which

will continue to be sponsored by the math club and the SHSU Student Chapter of the MAA. Their excitement has been transferred to many other students in the department and several more students have indicated an interest in presenting papers at the next Texas section meeting of the MAA.

Attending the Texas section meeting also broadened their horizons. Most of our math majors are from rural parts of east Texas. Until the Texas section meeting, most of them planned to go back to their hometowns and teach at the high school level after they finished college. They did not know what other options they have. Now, they are all talking about graduate school! We are not trying to stop anybody from teaching high school, but we want them to make informed decisions.

Sometime after the section meeting, we mentioned Math Fest to them. Five of the students, all women, including two of the sophomores, decided that they wanted to attend this annual meeting of the MAA in Boulder, Colorado. Of course, we supported this. Some of the students recycled their talks from the Texas section meeting, but others undertook new topics. One student even ventured into the uncharted territory of undergraduate research. Again, the students did not disappoint us! They all did a great job, and one student won the award for best paper in her session.

Before going to Math Fest, the students decided that they needed matching t-shirts. They decided on a design that had Steven Wright's saying "A black hole is where God divided by zero" on the back of the shirts. They wore the shirts at the student reception on the first night of Math Fest, at which time they became known as the "black hole girls." Their enthusiasm was unbridled and contagious.

Advising students has been a major undertaking that is very demanding, but it is incredibly rewarding. It has been amazing to see our students change, knowing that we have played a small part in that change.