Ten Years of MCM: Reflections of a Coach

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Introduction

In the fall of 1984, our department received the announcement of the first Mathematical Competition in Modeling. Since I was the coach of our Putnam Competition teams, the information was thrown into my mailbox. The flyer stated that one of the objectives of the competition was to encourage mathematics departments to establish courses in mathematical modeling.

We then had already had a modeling/problem-solving course for seven years, serving as our capstone course and required of every mathematics major. Whenever we queried our alumni about our program and how well we prepared them for the real world, this course was always a runaway first choice. The emphasis on problem solving and communication skills were the most frequently stated reasons.

How did our modeling class stack up to others? I had the same problem back then that we run into today. Everyone has an innovative idea that they want to use in the classroom: a leaner calculus, fewer drill problems replaced by problems requiring creative thought, handheld calculators, and a computer at every desk with Mathematica (or maybe Maple V is better). But how do you evaluate any of these approaches? The MCM was just what I had been looking for. Our teams did very well the first year and have done well ever since; I had the information I needed.

Our original modeling course emphasized individual problem solving, with most of the problems possessing unique solutions. Since the MCM is geared to a team format and open-ended problems, I created a new course in which the students are put in teams and given problems of this type. I generally give them two weeks to get their solution papers back to me. Then I stir up the team memberships, give them another problem, and get to work criticizing the writing of their submitted papers.

How to Pick a Team

I firmly believe that the best way to select a team is to find three English majors, one of whom is working on a math minor. The writing is so important! In this respect, the contest really reflects reality. I think that in our classes in mathematics, we don't emphasize the importance of communication skills nearly enough. We require our students to take a lot of English and speech classes, but how often do they have the opportunity to use in a mathematical setting what they have learned in these courses?

Putting the students on teams in the modeling course lets me detect personality conflicts. Four days can be a long time to work under stress. Success on the MCM says as much about the personality of the contestants as their mathematical ability. I don't make teams out of friends. Friends look too much alike, and I have found that diversity is a key ingredient for a good team.

Each team needs one person who has what I refer to as a "terrier personality": someone who is jumpy, coming up with a new idea or approach every thirty seconds or so. You know the kind of student that I am talking about, the kind of person usually does well on the Putnam Competition. You can't have two of them on the same team, at least not for four days.

Then there has to be a member who can lend a degree of stability to the team—someone who can keep the terrier reined in, with a leash if necessary. This kind of student is easy to find. These are the ones who are in class every day with their homework done and know what they are going to be having for dinner two weeks from next Tuesday.

The third person has to have a personality that is a mix of the other two, and I generally choose a student who has already had most of the upper-division courses required of our mathematics majors.

One of the team members has to be a programmer, and one has to know lots about statistics. They all have to be sharp, they all have to be willing to work until they drop, and—once again—*they all have to know how to write*.

Some of our best results have come with students who are either double-majoring or taking a minor outside of mathematics. The more that the team members have seen, the better the odds of someone having some idea of what to do with the MCM problems.

One of the most difficult jobs that I have is to tell all but six class members that they are not being chosen to participate in the contest. These students work hard for a quarter in hopes of being one of the chosen few; and the disappointment on their faces is heart-wrenching. At least in the Putnam Competition everyone gets to play, whether they are on the team or not.

Support and Recognition

The easiest way to recruit new talent each year is to give a lot of recognition to the members of the current teams. Our display case, which contains several MCM plaques and records of MCM and Putnam results, is located in a high-traffic area. We have a department meeting each spring at which we present student awards, and we give the MCM team members their certificates on this awards day. We also take team pictures and put them in our annual alumni newsletter, along with an article about the contest and the results. Additionally, we have each team present its solution paper at a faculty colloquium and invite the rest of the students.

Our students get a lot of support from not only the faculty but the staff as well. We have a Division I sports program at Cal Poly; but due to financial problems in the academic area, our library closes at 5 P.M. on Friday and does not open again until Saturday at noon. Other than their own talents, the most important tool the students have for this contest is the library; and ours is closed at the most crucial time of the event. But our library staff has bent over backwards to help us. Every year, they have had someone either stay late on Friday night or open early on Saturday for the team members. For a few years, the library even remained closed on Saturdays; but the library staff came through every time, sending someone in to open up for the participants. One of the reasons that library staff are so cooperative is that there is a plaque, presented by the Mathematics Dept., hanging in the library thanking them for their continued support of our MCM teams. The best way to get someone to do something for you twice is to thank them the first time.

In 1985, no member of the Mathematics Department faculty had a computer in his or her office. The students used their own Macintoshes to do the writing and what little computing was needed on the problems that year. The next year, the university saw its way clear to buy two computers. On the Thursday before the contest, I simply went to the people with the machines and told them we needed them for a few days. No problem. Nowadays, each office is equipped with some sort of computing equipment and the faculty members use their machines every day: receiving and sending e-mail, looking up student and class records, writing exams, and even doing a little mathematics. It has become difficult for most of us to do without our computer for four days. However, the majority of the faculty do feel that this event is important enough to let teams borrow whatever is needed.

The Effect on Team Members

Over the years, many of our students who have participated in the MCM with success have been those whose academic record would not predict

this success. For some reason, even though they are bright, many of these students just don't seem to apply themselves enough to receive high grades. Yet some of these same students, when confronted with a problem that appears to have come from real life, will work their hearts out for four solid days. One of the most amazing things that I have seen over the years has been the rise in confidence that these students have when they receive the results of the judging of their work. Almost every one has decided to go on to graduate school, and they have done so successfully. With their academic records, these same students would probably have had trouble finding jobs as mathematicians; but with the confidence they gained through the contest, they have attained goals that they would not have dreamed possible before their participation. This fact alone makes it worthwhile for our school to field teams each year.

As I was just writing the above, I was interrupted with a phone call from a former student and MCM veteran. He has been working for a consulting firm for several years now and called to inquire about a recent graduate who had applied for a job. When I mentioned the fact that the young lady had received an A in my modeling class and that her team had received a Meritorious MCM award last year, he immediately decided to hire her.

A Few Misgivings . . .

There have been a few things that have disturbed me about the contest over the years.

- My primary gripe over the years was that, until recently, the cutoff time for the contest was dictated by a Monday postmark. Since our local post office closes at 5:30, I always had to impose a 5:00 deadline on our students. However, if we were located in a larger city, we could still get a Monday postmark at midnight. Ben Fusaro hated to see me approaching him at mathematics meetings, because he knew that before the conversation was over I would broach the matter of a common cutoff time. His response (always in jest) would be "Your teams don't need the extra time." Once he asked how far it is to the nearest post office with a midnight postmark. When I conjectured that it might be Santa Barbara, one hundred miles south of us, he said, "That would be twenty minutes in California time. Just drive down and mail from there." My message must have gotten through, because, under a change in the rules two years ago, all teams must now quit by 5:00 local time. Now I feel better, and Ben no longer has to try to hide from me at meetings.

  This might be a good spot to say how appreciative I am of the work that Ben has done with the contest. Even now that he is no longer its director, he continues to be involved in everything from finding problems to judging. It is still his baby.

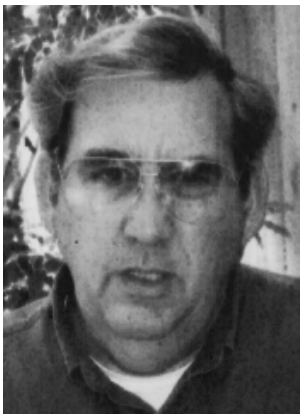
- A problem in the 1988 contest asked how to load as many boxes as possible, from a collection of boxes of various weights and sizes on a railroad siding, onto two flat cars. I have often wondered if the boxes that did not fit onto those two flat cars are still sitting on the siding. Why not make the problem realistic and ask for the minimum number of flat cars necessary to haul away all of the boxes?

- And then there was the 1992 contest with the air-traffic-control-radar problem. It was full of unrealistic information. One could smell a rat immediately upon looking at the figures that were given. One of these was the end view of an ellipsoid of revolution, looking down the axis of revolution. The figure was an ellipse! The students not only had to fight their way through the misinformation but also had to worry about whether they should be solving the problem as stated or to use more realistic data and solve their own improved problem. They ended up doing both, but not until after a lot of fighting among themselves. The Judge's Commentary published in *The UMAP Journal* includes a statement to the effect that this problem is realistic in that it is ill-posed, as are most problems that consultants are given. When I was in the industrial game, an engineer didn't leave my office after giving me a problem until we had discussed the problem and I had his phone number. If there were any questions, I called. These students do not have that luxury.

. . . but Rich Rewards

The personal rewards that I have received from being involved in the MCM all of these years far outweigh any of the aforementioned complaints. I have met a lot of people and have established many good friendships. When one of our students on an Outstanding team was interviewed by the campus newspaper, he attributed the team's success to a faculty whose only reward is the success of their students. A statement like that can't help but make you feel good. I would like to encourage anyone who likes to work with students to get involved. It is difficult to get old being around all of the enthusiasm of young people.

About the Author



Thomas O'Neil received A.B. and M.S. degrees from San Diego State College and a Ph.D. in mathematics from the University of Wyoming. He is currently Professor of Mathematics at California Polytechnic State University in San Luis Obispo, where he has taught since 1973. His current interests include problem solving, modeling, applications of mathematics, and the pedagogical issues associated with computing in the mathematical classroom. His background includes ten years of experience as technician and engineer in electronic research and development, with the U.S. Navy, General Dynamics/Astronautics, and The Boeing Company.