

# The Teacher's Circle

## -an AIM initiative

Imagine the following situation. For twelve years you are forced to acquire skills in using some tools that become more and more intricate, complicated and finally utterly unwieldy – like some gardening tools – trowels, shovels, rakes, hoes, all the way to combines. You practice using them in a gym, with a patch of soil about 1 foot by 1 foot in size and about 1 inch deep, and you are NEVER EVER allowed to get to a real garden and use your tools and skills there. Would you love and cherish your tools? Would you strive to learn and perfect your skills? Preposterous as it sounds, this is exactly what our K-12 math education currently is. Kids are forced to learn algorithms and techniques without ever being allowed to apply them to a situation for which these algorithms and techniques were invented. We believe that this is a main cause of the present crisis in math education, and the only way out of it is by opening the doors of a real and beautiful garden and letting our students do their best in cultivating it. This is what problem solving is about: give the students an interesting and challenging problem and let them use their mental powers to battle it. We math teachers are by their side with helpful tools that will allow them to conquer the beast.

Kids are naturally curious, they love being challenged and they avidly learn things whose usefulness they have ascertained by their own experience. We have witnessed this time and again in the San Jose Math Circle (SJMC) (*see article on page 10*) that we have been running since 1998. However, the number of kids directly affected by the math circles is very limited. Is there a way to overcome this limitation?

It took a master middle school teacher to come up with the idea of a math circle for teachers. Mary Fay-Zenk had been a superb middle school math teacher for more than 20 years and she now serves as the Vice Principal of Miller Middle School. For many years she has been advocating enrichment, specifically problem-solving classes, for all middle schools in her district. She has also encouraged scores of her students to attend the SJMC and has seen the resulting intellectual growth. It was her idea to organize The Teacher's Circle where middle school teachers would practice problem solving and discuss ways to incorporate it into their classrooms. In January 2005, several mathematicians and teachers came together to begin the 18-month process of careful planning the first Teacher's Circle, which was held in August, 2006.

*Tatiana Shubin of San Jose State University describes the Teacher's Circle Program from the perspective of a founding organizer.*



The purpose of The Teacher's Circle is to equip educators with an effective problem-solving approach to teaching mathematics. This style of learning is based on the Math Circle's environment that has proven to be successful for students around the world. Therefore, the Teacher's Circle model immerses a group of middle school math teachers in engaging mathematics and exposes them to a dynamic style of classroom presentation. Participants come away with a variety of resources, lesson modules, and a renewed sense of appreciation for the fascinating world of mathematics.

The Teacher's Circle program started with a summer workshop sponsored by the American Institute of Mathematics (AIM) with some support from the Mathematical Sciences Research Institute. It was held at AIM in Palo Alto during the week of August 14–18, 2006 with more than twenty local middle school mathematics teachers and administrators in attendance. There were also four external observers from St. Louis, MO, Chicago, IL, and Charlotte, NC, three of whom were professional mathematicians.

### Workshop Activities

The daily schedule revolved around active problem-solving sessions, led by one of the five instructors for the week (Tom Davis, Tatiana Shubin, Sam Vandervelde, Paul Zeitz, and Joshua Zucker). During these sessions, a variety of problem solving techniques was presented in the context of problems in the areas of number theory, Euclidean and combinatorial geometry, elements of topology, the fourth dimension, symmetry and visualization in algebra, and probability. Less formal hour-long sessions were held in the evenings after dinner.



One of our goals was to demonstrate that problem solving is an effective mechanism for learning, since we believe that it provides the strongest motivation for studying mathematics. We also wanted to free teachers from the fear of tackling difficult problems: that failing to solve a problem in a very short time is a positive rather than negative thing. By thinking hard about a problem for a long time, students of any age learn material at a deeper level. The more often this occurs, the better they are able to absorb new and more complicated concepts.

This notion seems to have been successfully conveyed. “I hope to introduce many of the problems I learned during the week to get my students to think more deeply about problems rather than just calculating an answer,” said one participant. This sentiment was echoed by all, along with a commitment to adjust their teaching style to include more open-ended problems for their students, provide more group problem solving time, replace repeated drills with good problems that require patience, and illustrate different methods for approaching a problem.

*Working groups during the Teacher's Circle Workshop at AIM.*

### **Collaboration is Essential**

A recurring theme in our teachers' responses was that of collaborative learning. Teachers appreciated the collaboration that they experienced at the workshop and how this teamwork enhanced their own learning. They perceived this as the true essence of a math circle, and they are ready to implement more collaboration in their classrooms. Some of their responses were, “I will allow more thinking and collaboration time,” and, “I hope that I will be able to integrate more ‘student circle’ opportunities for kids to be talking to each other while tackling problems.”

Teachers also pointed out the positive effect of experiencing different teaching styles from the group leaders. They admitted that even though the instructions were fast-paced and covered many topics, leaving them behind at times, this experience, in itself, was valuable for them. One teacher wrote, “Some of the problem solving was way over my head. Even so, I learned—if only to understand what my students' experience was when lost or overwhelmed.”

Another commented, “Some of the topics required us to struggle, but it was a good reminder of how our students might feel, so even that had value.”

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# The Teacher's Circle *(Continued from page 9)*

## The Many Benefits of the Teacher's Circle

Among the aspects of the workshop that participants found to be particularly valuable they mentioned the variety of educators present (middle school teachers, college professors, etc.), the opportunity to work with other teachers that allowed them to weigh and solidify ideas, the time to explore and work on mathematics with a partner or small group, the developing network of teachers with whom they are now able to share ideas, the discovery of new materials and resources, and the compatibility of 'hard' mathematics with a middle school curriculum.

At school, mathematics is often taught as an unrelated collection of facts. At the workshop, teachers were able to see a more coherent picture. Our hope was that our activities and discussions will encourage teachers to begin revealing this interconnectedness of ideas and underlying mathematical structure to their students. We were pleased to read in the final evaluations that teachers said that they would begin "discussing a given topic from as many angles as possible."

The workshop clearly showed that one of the greatest deficiencies in professional development for middle school teachers is the lack of solid mathematical content. All the participating teachers thoroughly enjoyed and valued the mathematics that was offered. Evidently, teachers are starving for mathematics, and math circles for teachers may help to alleviate this problem.

## The Teacher's Circle Continues

The summer workshop launched the beginning of The Teacher's Circle's year-long program. An equally important component of the program consisted of seven follow-up meetings, which occurred once a month throughout the school year. Every month from September to April (except December), The Teacher's Circle organized an evening event for middle school math

teachers interested in exploring accessible, exciting topics in mathematics and learning about problem-solving approaches to teaching math. We also spent some time discussing what had and hadn't worked in classes and brainstorming about possible problem-solving approaches that could be used for topics that were coming up in the teachers' curriculum. These meetings have been very popular: most of the teachers who participated in the summer program also attended these sessions and even brought colleagues who have since become new members of The Teacher's Circle.

## Spreading the Word

We hope that the Teacher's Circle described above will serve as a model for similar circles around the country. To that end, in June 2007, AIM ran a workshop, "How to Run a Teacher's Math Circle." Its participants came as seven teams, each from different cities around the country – Salt Lake City, Tucson, Lincoln, St. Louis, South Bend, Boston, and Charlotte. Each team consisted of middle school teachers, research mathematicians, and school administrators from the district. These teams were selected from among a pool of applicants on the merit of their strong potential for starting teacher's math circles in their own communities. During the mornings of

the week-long workshop, participants were able to sample the essence of the Teacher's Circle model by participating in mathematical discussions and working solving related problems. The afternoons had participants working on developing detailed plans of how they would start, run, and sustain their own circles. The workshop organizers, along with AIM's Brian Conrey and David Farmer, assisted the teams by sharing their own experiences in areas including recruitment of teachers and mathematicians, fundraising, finding a venue, and the like.

AIM also invited a panel of local business leaders and prominent fundraisers who provided much relevant advice, stressing the fact that there is a growing awareness of the absolute necessity to drastically change mathematical instruction in all schools, and, particularly, middle schools. This was very encouraging for all, including the organizers, as we feel that the Bay Area needs more Teacher's Circles.

On the last day of the workshop, each team presented their program, complete with the vision and the details of its implementation. There is a firm basis to believe that during the next school year our Teacher's Circle will be joined by several sister circles. It is our hope that AIM will serve as the national center for the Teacher's Circles, and that the number of such circles will grow rapidly and steadily. ■

