

The UIC Algebra Symposium

John T. Baldwin, University of Illinois at Chicago

Here is an idea. Gather high school teachers and university mathematicians to discuss the problems of teaching algebra. Faculty should provide some mathematical ideas, problems, activities, and extensions. Teachers should provide insight on what actually is appropriate and interesting for their students.

At the University of Illinois at Chicago, we have tried to run such symposia, called the Algebra Symposium, in the Spring '04, Summer '04, Fall '04, Spring '05, and Summer '05. Seven university mathematicians (several of whom are emeriti) participated. One or two of the mathematicians led each symposium. Several other mathematicians from the group attended each session and participated in the same role as the teachers. In addition to their participation in the symposia, each of the mathematicians visited one or two Chicago high schools to observe math classes. Teachers received professional development credit and either a stipend (\$20 per hour) or university credit for their participation. We would like to see teachers continue to participate in the symposia as a regular program, rather than as a one-time semester experience but have had very limited success in this regard. Originally targeted at high school teachers, the last summer's symposium was largely composed of middle school teachers.

Organization and content of the symposia

The first Algebra Symposium in Spring '04 was offered as a semester-length course meeting weekly for a three-hour evening class. Subsequently, the Algebra Symposium has been organized as a program of three-hour workshops, which are scheduled about every six weeks during the academic year and in a condensed schedule in the summer. The most successful format was the workshop program in the summer of 2004. There were 10 workshops; 8 organized by the same team of a research mathematician and a high school teacher. Two sessions consisted of short presentations by teachers of "good lessons." One of these lessons presented by Elaina Gile a teacher at Lincoln Park High School, who learned about it when she was student teaching in Australia, was so impressive that it was later used both in the department's methods course for pre-service high school teachers and the following summer's workshop.

Gile's lesson illustrated one of the main themes that we tried to stress throughout the workshops: Students should see that formal mathematical manipulations are a way of abstracting from a concrete example. The problem, which

has to do with finding the cost of items on the McDonald's menu, introduces the substitution method of solving a system of linear equations through a specific situation. The students are first given the following problem:

There is a new meal at McDonald's called the "Happy Couple" meal. This meal includes two burgers and one large drink for \$4.30. How much is a burger and how much is a drink?

After the students determine that there is not enough information, they are told:

McDonald's added a second new meal called the "Light Eater" meal. It includes one burger and one drink for \$2.95. If burgers and drinks cost the same in both meals, how much is each burger and each drink?

Gile related that the students quickly see that the "Happy Couple" meal has one extra burger and costs \$1.35 more than the "Light Eater." After further thought they decide a drink must cost \$1.60. Then the students are asked to formalize this argument by writing and then manipulating equations. The strength of the approach of abstracting the algebraic procedure from a concrete situation was emphasized when another teacher explained his approach to the same problem:

Spend several days explaining the substitution, addition and subtraction, and graphing methods of solving a pair of linear equations. Then apply these to a word problem.

The previously involved group of teachers in the symposium fell into a slumber.

Other sessions did not go so well. One mathematician provided what seemed like a brilliant lesson: *Consider problems of the rate of extinction. How fast did the dinosaurs die out? How can the rate of extinction be explained?* Amazingly, the mathematics is not calculus but methods of summing infinite series that were worked out in 13th century Oxford. But the lesson didn't work. The group of mostly 9th and 10th grade teachers were not sufficiently familiar with geometric series to follow the reasoning, and the session became too much of a lecture.

We focused the second summer on issues around understanding variables and used the following problem in

advertising the program:

I went to the Pompeii restaurant and bought the same number of salads and small pizzas. Salads cost two dollars each and pizzas cost six dollars each. I spent \$40 all together.

Assume that the equation $2S + 6P = 40$ is correct.

Then,

$$2S + 6P = 40:$$

Since $S = P$, I can write

$$2P + 6P = 40:$$

$$\text{So, } 8P = 40:$$

The last equation says 8 pizzas is equal to \$40 so each pizza costs \$5.

What is wrong with the above reasoning? Be as detailed as possible. How would you try to help a student who made this mistake?

The teachers who came to the symposia found the problem very stimulating and kept referring to it all summer. But the problem didn't seem to serve to attract teachers in the first place.

Faculty visits to schools

A fundamental intent of the program was to acquaint faculty with "real life" in Chicago Public Schools by visiting classrooms. All the participating mathematicians felt the visits were valuable. Comments from three of the mathematicians who observed three different classrooms illustrate the variety of the classes they observed. One mathematician noticed "surprisingly traditional instruction"; another was surprised at the integrated nature of a reform course; still another complained, "there was no sense of mathematics as a subject that developed over time." As valuable as these visits were, the logistics in getting faculty to schools proved incredibly difficult. A person who could dedicate time each week to organizing these visits was needed.

Where we are?

We have had a problem recruiting teachers for the Algebra Symposium. We would like to have 25 teachers in the program at any time. However, only 6 teachers enrolled in the first Algebra Symposium in Spring '04. One complication was that the program was not officially approved until a week before classes started. In the Summer '04 we were successful in getting the full cohort of 25 teachers. In academic year '04-'05, we tried scheduling the project as monthly meetings, but attendance remained about 10-12 teachers per meeting, with perhaps only half of the teachers attending regularly. The following

summer brought out only 10 teachers. Of those teachers, nine were middle school teachers and only one was a high school teacher, the intended group for the program.

In contrast, a five-semester program that the department runs for middle school teachers has been much more successful. The middle school program leads to a Middle School Mathematics Endorsement from the state. In the year and a half that the program has been offered, 50 teachers have been in or are currently enrolled in the program; nine have completed the program and eleven have enrolled in or completed our MST-elementary program. Note, there is no state requirement providing a credential for studying the teaching of *high school mathematics*.

We have yet to build a base of teachers for the Algebra Symposium. There are a number of possible reasons. (1) Teachers are not familiar with the format for a university topics seminar. (2) Having university mathematicians and high school teachers share their areas of expertise relating to the teaching of algebra is a novel concept for teachers and mathematicians. Bridging the gap between mathematicians and teachers is difficult. (3) The role of teachers as contributors was acknowledged, but there was no real input from teachers in designing the programs. We are going to survey teachers in order to rethink our plans.

Reference

Words to Algebra: Mending Misconceptions, Jack Lochhead and Jose P. Mestre, in *Algebraic Thinking, Grades K-12: Readings from NCTM's School-Based Journals*, 1999, pp. 321-328. The article originally appeared in *Ideas of Algebra, K-12, NCTM 1988 Yearbook*. ■

The Chicago Alg Init: Issues of Teaching Teachers

continued from page 9

laboration. It has been an energizing project, and we look forward to its continued development.

Footnotes

¹ Website of the Chicago Math and Science Initiative (CSMI): <http://www.csni.cps.k12.us/>

² Smith, J.D. Does an extra year make any difference? The impact of early access to algebra in long-term gains in mathematics achievement. *Education Evaluation and Policy Analysis*, 18(2), 1996, 141-153.

³ *Principles and Standards of School Mathematics*. National Council of Teachers of Mathematics, 2000, Reston, VA.

⁴ *Mathematical Proficiency for All Students: Toward a Strategic Research and Development Program in Mathematics Education*. Rand Mathematics Study Panel, 2003, Santa Monica, CA. ■