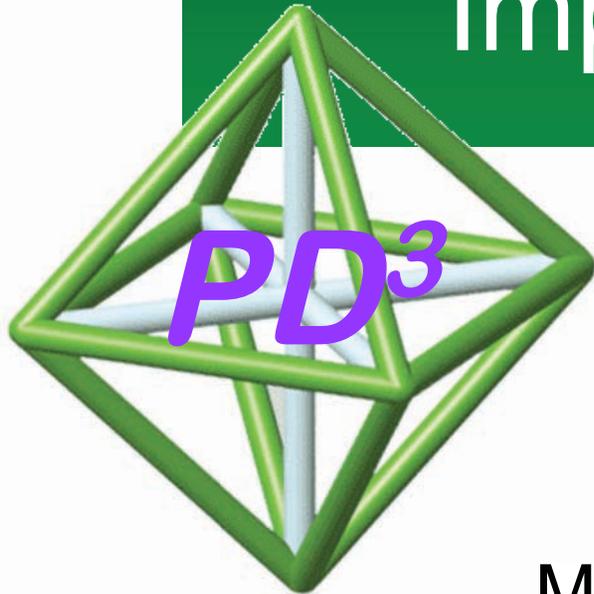


Deep Experience of Math: Impact on Teachers



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PCMI Programs

- Three-week residential Summer Session/Core Program & Cross-Program activities
- Publication series

Mathematics

Research

Graduate

Undergraduate

Undergraduate faculty

Mathematics Education

Secondary Teachers

International Seminar

Math Education Research

Cross-Program Activities



- International Seminar/SSTP participants
- Research mathematicians conduct discussion groups with SSTP participants
- Pizza and Problem Solving
- Clay Institute Lectures
- SSTP Working Group takes course for undergraduate math faculty

PCMI: Secondary School Teachers Program

- Three Week Summer Session for Secondary Teachers
- **MSP PD³**: PCMI and Districts Partner to Design Professional Development
- Professional Development Outreach Groups (**PDO**)

University of Minnesota

San Jose State University

Harvey Mudd College

St.Peters College, New Jersey

University of Washington

University of Utah

SSTP



55 to 60 Secondary Teachers from PD3, PDO and at large - selected through an application process

E-tables with PD3 sites

Groups of 5-6 per table, microphones, norms

Reflect on Practice



- Use artifacts of practice to ground discussion
- Work together to discuss and design problems and lessons
- Consider research related to teaching and learning mathematics

Working Groups

Investigating Geometry
Learning from Teaching
Cases

Visualizing Functions
Reasoning from Data and
Chance

Implementing Lesson
Study

Exploring Discrete
Mathematics



Produce a resource for colleagues

Deepen knowledge of mathematics

PCMI daily 2 hour course using materials prepared by EDC team



- Problem based approach using the Ross model
- Taught by former and current classroom teachers
- Work done collaboratively in groups consisting of 6th grade to calculus teachers

Deepen knowledge of mathematics

PDO groups

New Jersey Shore Summer Program

PD3 academic year activities

PDO leaders

Courses at Texas State, Harvey Mudd,
University of Washington

Other PD providers

PROM/SE MSP Summer Math Academy,
Honduras Summer Grad Class

Evidence Sources

Summer program exit surveys

Academic year interviews (TPC evaluation)

Site visits/baseline data about teachers' beliefs and practices (PD3 evaluators)

Anecdotal information from applications, PDO groups, activities report

PCMI Math Forum list serve

Components of the course

Content

related to high school math but not directly in the curriculum, emphasizing connections to a central math concept

Context

working in groups facilitated by table leaders (teachers and mathematicians)

Instruction

facilitated and managed not lecture

Content examples

2008: [*From Algebra to Geometry*](#) investigates number theory, algebraic geometry, and analytic geometry as a springboard into the structure of different algebraic systems and geometric curves. (Algebraic Geometry)

2007: [*Developing Mathematics: Probability Through Algebra*](#) explores and makes connections among questions about randomness, binomial expansion and the probability that two positive integers, chosen at random, have no common factor. (Statistical Mechanics)

2006: [*Some Applications of Geometric Thinking*](#) looks at basic geometric habits of mind like continuous change and things that don't change, and how these apply to a wide variety of situations. (Topology)

mathforum.org/pcmi/

Impact on teachers' math

changed 'habits of mind.'

- 1) learning to think in a new way,
- 2) developing the habit of questioning problems or concepts and asking how to determine if a statement was true and why,
- 3) seeing the elegance provided by a deepened understanding of mathematics, and
- 4) learning to stop and listen to others' ways of thinking (TPC survey)

Impact on teachers' math

Ratings consistently 3.8, 3.9 out of 4. 80% learned new content. Teachers

- Made connections did not know exist
- Increased depth of knowledge
- Learned things “I did not know I did not know”
- Learned new content - fundamental theorem of algebra, geometry of complex numbers, Farey numbers
- Learned that they “knew less mathematics than they thought they did”
- Had “forgotten how useful polynomials were” (Exit survey; interviews)

Instruction: Reaching all

Organization of materials

Important stuff, neat stuff, tough stuff

Training and at least weekly reflection for table leaders

Careful selection and regular rotation of groups matching both table leaders' strengths and participants' needs

Instructors key in supporting participants: listen, respond, highlight interesting strategies and struggles

Instruction

- Participants encouraged to take responsibility for their own learning
- Individuals' thinking nurtured while, at the same time, the daily work was collaborative
- Sufficient time for participants to explore the mathematics before a class discussion
- *While encouraging participants to work on the problems on their own first and rarely providing strategies to pursue, the instructors and the table leaders simultaneously provided guidance and helped participants deepen their thinking and expand their ideas.* (TPC interviews)

Impact on teachers' thoughts about instruction

- “How much learning can happen with so little instruction”
- “Learning by doing”
- “... both learning and doing”
- “Good to be reminded of what it means to be a student”
- Being challenged
- Learned to manage group work that is productive

Exit surveys

Reflected on practice

- all right for students to work alone
- students working on own and in groups leads to deeper learning than 'telling' them
- students who are quiet may know what is going on.
- begin learning in concrete ways before abstractions are introduced
- messing around with ideas and patterns important in learning mathematics
- Need experiences that lead to deep understanding (academic year interviews)

Approach to teaching

- Teaching for understanding
- More time for students to explore mathematics
- Less time at the blackboard as a teacher and more time walking around and working with students
- Ask students to write more to explain their thinking
- Used enriched problem sets with students who struggle
- More care with language (academic year interviews)

Context for learning: a community

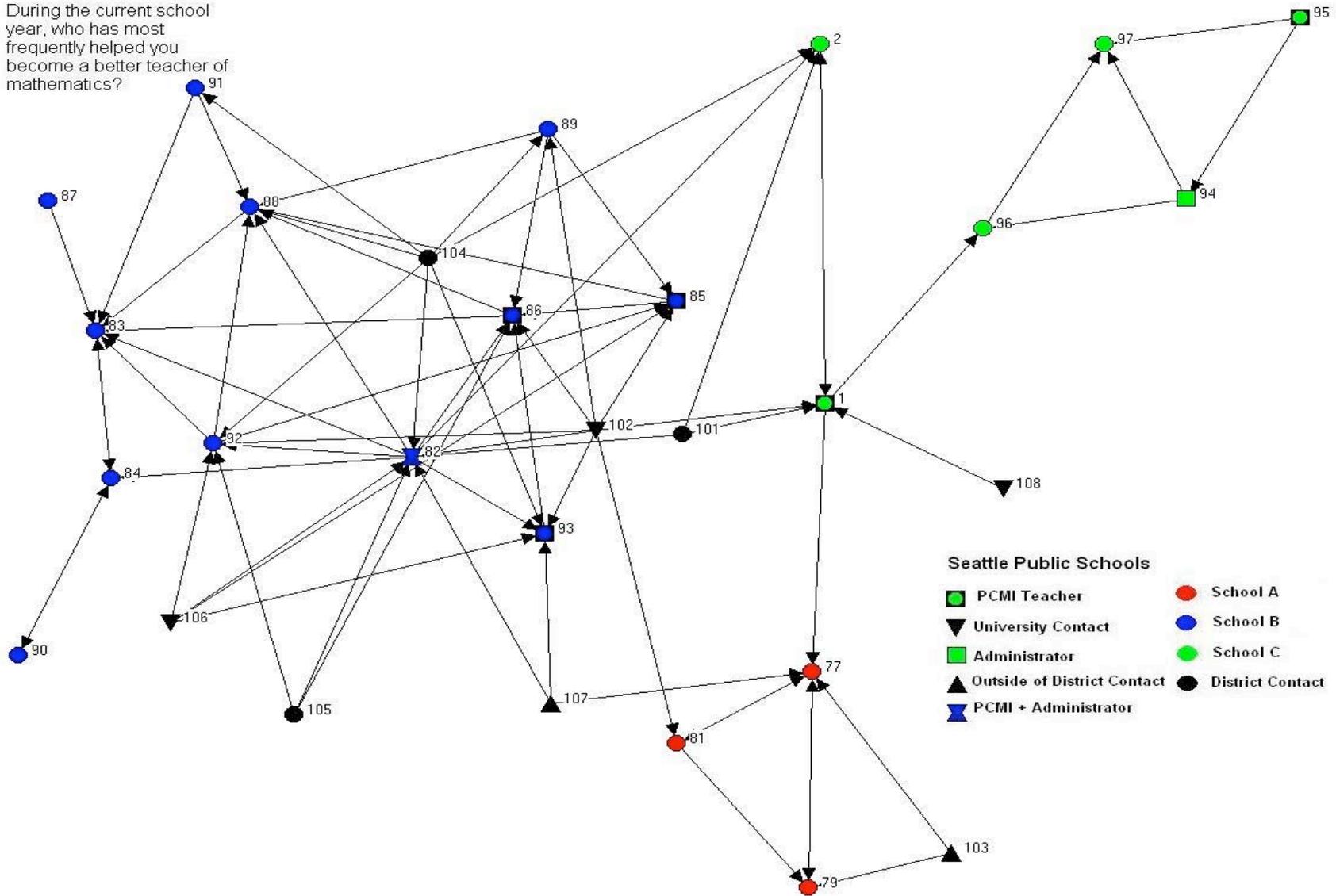
- 1) The table design and rotating assignments encouraged participants to meet and work with each other
- 2) The instructors and the table leaders referred participants to others working on the same questions/problems (exit survey)
- 3) Residence math nights
- 4) PD3 groups work on problems together sometimes led by mathematicians, sometimes by one of the group

Continuing the learning community

- Contact with other participants
 - at the local level through PDOs
 - at the national level to develop workshops or other materials
- Returning participants felt connections with staff and with other 'veterans.'
- With instructors to develop a seminar
- With table leaders
- Math Forum list serve
 - TPC survey/tracking list serve

Social Networks

During the current school year, who has most frequently helped you become a better teacher of mathematics?



Gathering Evidence: Challenges

- Volunteer/selection nature of participants and knowledge of status quo
- Lack of neutral follow up during academic year for at large and PDO participants
- Instruments
- Defining what to measure as success
- Measuring growth in content knowledge given nature of course