CMS 2005 FORUM

REPORT OF WORKING GROUP 3C: **Supporting Teacher Success**

Working Group Leaders

Brent Davis, University of Alberta, Alberta
Lisa Lunney, We'koqma'q Secondary School, Nova Scotia
Eric Muller, Brock University, Ontario

Participants

Lorraine Baron, British Columbia
Chantal Buteau, Ontario
Sharon Compton, Saskatchewan
Malgorzata Dubiel, British Columbia
George Gadanidis, Ontario
Barbara Graves, Ontario
Denis Hanson, Saskatchewan
Ann Kajander, Ontario
Marylou Kestell, Ontario
Kathy Kubota-Zarivnij, Ontario
Caroline Lajoie, Québec
Petra Menz, British Columbia
Martina Metz, Alberta
Joyce Mgombelo, Ontario
Martin Muldoon, Ontario
Carole Saundry, British Columbia

Our Foci

The work of our group was oriented by the principal question, "How do we support teacher success?" More specifically, our initial interactions were organized around the following questions:

- What sorts of support are needed by the mathematics education community at the elementary and secondary levels?
- How can these issues be addressed at the national level?

Not surprisingly, we encountered difficulty almost immediately around the word 'success' in the first of the above questions. The following supplementary questions were thus posed by the group:

- What mathematics is important for teaching? and
- What criteria might be used to define 'successful' programs of support for teachers in their development of this mathematical knowledge?

The Structure of Our Interactions

As is often the case with such working group structures, our opening discussions were given over to introductions and attempts to identify issues and to establish a common vocabulary. As might be anticipated, the resulting lists were extensive and diverse. Yet, despite our collective inabilities, for example, to define 'success' or to identify necessary mathematical knowledge for teachers, it was clear that there were profound, shared beliefs about the sorts of support that are needed by mathematics teachers.

Our sense of deep agreements, however, did not emerge around our efforts to be explicit about what we believe—in large part because it was quickly evident that there is no one-size-fits-all structure to support mathematics teachers. Rather, it arose as we began to recount experiences with various projects in various contexts. A vital issue proved to be a capacity for flexible and appropriate responses to local situations.

For that reason, a large portion of our time together was taken up with the presentation and discussion of exceptional projects, programs, and events that were designed to support teachers. Several examples are included in the appendix to this report, and they included innovative structures for pre-service teacher education programs, collaborative approaches professional development studies, and websites intended to support teachers' and students' investigations of mathematical topics.

We then turned to an examination of the elements that were common across these exemplars, the details of which we present in the next section. Finally, we discussed recommendations and meaningful courses of action, which are presented in the final section of this report.

Features of Effective Support Structures for Mathematics Teachers

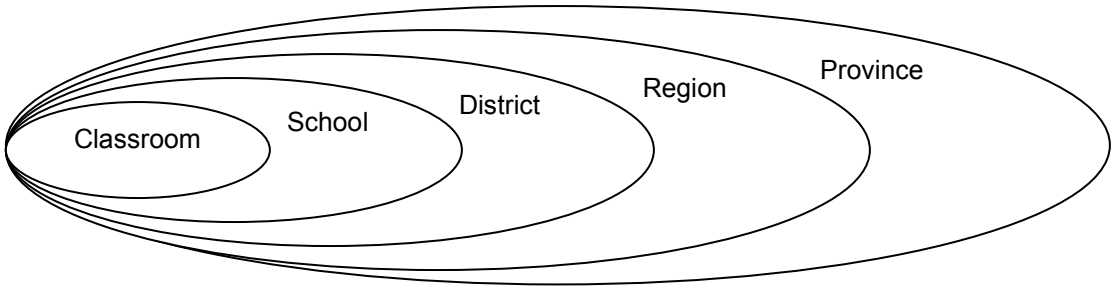
By way of brief, orienting summary, the following were identified as qualities that were common across most or all of the exemplars discussed:

- inter-group collaborations;
- sustained engagement over significant periods of time;
- in-person, face-to-face interactions;
- response to a recognized need;
- engagement with substantial mathematics;
- trans-level (e.g., addressing issues in elementary, secondary, and/or post-secondary education simultaneously);
- a new role for communication technologies;
- availability of resources and other forms of ongoing support.

Inter-Group Collaborations

Perhaps the most obvious feature of the programs and activities identified as exemplars is the fact that each involves more than one interest group, and these groups usually operate in deeply collaborative ways.

Three principal sorts of partnerships were identified: first, among levels of organization within the schooling system; second, between school-based groups and faculties of education; and, third, between practicing teachers and university-based mathematicians. With regard to the first of these, stakeholders include practicing and pre-service teachers, students and their parents, and school administrators (school-, district-, and ministry-based). Significantly, these groups were discussed in terms of co-implicated responsibilities and nested organizations, rather than discrete duties and hierarchies. The following diagram was offered to illustrate the point:



As for associations between school-based groups and faculties of education, innovative structures for pre-service and in-service (or, alternatively, undergraduate and graduate) education were central to several of the exemplars. A very prominent theme here was around the development and demonstration of effective mathematics lessons, and a number of structures were mentioned (including lesson study, lesson labs, live-feed observation of lessons, cognitive coaching, intensive programs, and summer institutes).

Some of these structures were also employed in collaborations among teachers and mathematicians, along with activities such as ‘math camps’ for teachers, ‘math in the mall,’ interactive websites, mentorships, and university-level courses in the sorts of mathematics that are relevant to classroom teachers.

The working group agreed that the necessity for inter group collaborations and the need to develop mathematics education communities were of such great significance in supporting teacher success that it chose the Mi’kmac word ’mawkinutimatimk’ (“coming together to learn”) as the title of its summary report at the Forum’s closing session. Despite our mathematics educational backgrounds and experiences we all have something to learn and something to contribute.

Sustained Engagement over Significant Periods of Time

Of course, there is no shortage of partnerships and collaborations among various stakeholder groups. Yet few such associations would be held us as exemplary.

In particular, it was noted, ‘one-shot’ events with little or no follow-up seem to be ineffective and a poor use of limited resources. Across the examples discussed during our working group sessions, a shared and essential feature of effective support efforts was a commitment to long-term, on-going efforts to learn together. Regardless of the

specific activity, effectiveness seems to be hinged to the maintenance of relationships among parties.

The manner in which such relationships are maintained varies dramatically. Some take advantage of regular in-service sessions, of structures built into teacher education programs, of summer refresher courses (or institutes), and so on.

In-Person, Face-to-Face Interactions

It goes without saying that there need to be extensive opportunities for interaction in order for projects and programs to be effective. In this era of enhanced connectivity, then, one might expect that the issue of communicative interactions would be easily addressed.

Yet it was readily apparent in our discussions that, although various technologies (e.g., email, video-conferencing, live webcast lessons) can certainly be useful in efforts to support teachers, there is simply no substitute for the live, face-to-face interaction. In-person conversations and collective explorations of mathematics provide much richer, more productive spaces for the negotiation of meanings and the elaboration of understandings. (Indeed, gatherings such as the CMS Forum represent an explicit recognition of the importance of meeting together.)

In this regard, it was noted that educational systems have a number of 'built-in' structures to support collaborative meetings, including staff meetings, after-school sessions, lunch gatherings, and non-instructional (professional development) days. Some systems also structure collaborative planning time (in-school, by grade level, and between schools) into their schedules. These opportunities to co-plan, co-teach, and co-assess are invaluable, although limited.

As well, several of the exemplars were organized around cohorts of teachers and others (e.g., educational researchers, university course instructors, or mathematicians) who met regularly around issues of shared concern. Once again, although various communication technologies tended to be used to support these collaborations, the face-to-face meetings were cited as the critical aspect in the shared work.

Response to a Recognized Need

Many recent educational innovations have been prompted by 'needs' that were perceived by a select few. New curricula and novel teaching emphases seem to appear—and vanish—with a certain predictable regularity.

A quality that distinguishes the exemplars from many efforts at educational renewal is that they were organized around a shared concern. Some projects arose in a collective recognition of an issue, others were prompted by a particular person's or group's efforts to alert others to an emergent matter. The critical factor was that care was taken to ensure that those involved and those affected were part of the process of identifying the concerns and developing a response.

Further to this point, effective support structures share the quality that they are attentive to teachers' questions, needs, and concerns, especially around topics of content, lesson structures, and pedagogical action.

Engagement with Substantial Mathematics

Mathematics teachers, considered collectively, are often suspected of lacking a sufficient subject matter knowledge—and, perhaps worse, of being uninterested in learning more about the discipline. The exemplars challenged this perception. Consistently these programs and projects are organized around substantial mathematics.

This is not to say that projects intended to support teachers in their work should focus on *more* mathematics. Rather, the point is that teachers require—and are interested in developing—*more nuanced understandings* of curriculum topics. Mathematics teachers must be adept at interpreting concepts for learners, making sense of learners' varied understandings of topics, selecting suitable questions, and recognizing relevant associations among ideas. Such competencies require knowledge of how mathematical topics are connected, how ideas anticipate others, what constitutes a valid argument, and so on.

In other words, teachers' subject matter knowledge is not a watered down version of formal mathematics, but a serious and demanding area of mathematical work.

Trans-Level

Further to the previous point, very often pre-service and in-service work tends to be level-specific, focused on the grade or grades that teachers are or will be expected to teach. Such emphases are clearly important, but as evidenced by the exemplars, so are discussions and investigations that span grades.

In particular, it was noted that the commonplace separation of elementary topics and teaching methods from secondary topics and methods has given rise to a number of problems, not the least of which is a fragmentation and compartmentalization of mathematics competencies. It was noted that teachers appreciate opportunities to study and interrogate the ways that topics and concepts are elaborated across the K–12 curriculum. Such trans-level emphases have a number of advantages. For instance, in pragmatic terms, an attentiveness to how concepts will be elaborated or an awareness of how concepts were introduced can contribute to a more effective pedagogy. In more personal terms, a better sense of how one's teachings are fitted into the grander scheme of things can contribute to an enhanced sense of the collective nature of the educational project.

Further, as demonstrated in several of the exemplars, a trans-level emphasis on K–12 topics can support a shift from thinking about curriculum in terms of linear progress through a subject matter to terms of extended engagement with 'big ideas.' By consequence, such an emphasis can support new ways of thinking about such emergent educational issues as inclusion/diversity, combined-grade classes, and stransitions between educational levels.

A New Role for Communication Technologies

In a number of locations throughout Canada, communication technologies are used to enable ongoing interactions of mathematics communities. Unfortunately, it appears

that such technologies serve strictly as complements to face-to-face meetings, employed only after a community has been established.

The Canadian reality is one of large geographical distances, of Provincial responsibility for education, of board substructures for schooling, of universities located only in the more densely populated areas, of multicultural areas with students whose first language is neither English nor French, of sparsely populated regions in need of mathematics educational support and leadership, and so on. Thus, although we foreground the importance of in-person, face-to-face meetings (as noted above), we also acknowledge the fact that many mathematics teachers find themselves in situations that do not support the development of a mathematics education community that would meet their specific needs and that can gather together.

Unfortunately, there is little knowledge or experience on how to prompt communities using only communication technologies.

Availability of Resources and Other Forms of Ongoing Support

It is often tempting to think that projects and programs that emphasize teacher knowledge of mathematics and pedagogy are sufficient to prompt substantial educational change. Such foci are of undeniable importance, but the simple reality of classroom life is that teachers require ongoing support in the form of ideas and resources.

Caution was expressed around this point in our discussions. In particular, it was noted that the “BFB” (big fat binder) approach is both expensive and ineffective. Teachers require more flexible, readily accessible, and interactive sources of ideas. Among the means identified as effective in this regard, participants noted several on-line resources (specific examples are identified in the appendix) including websites devoted to open-ended problems, lessons and lesson study, and pedagogical strategies. Of critical importance, the most effective websites tend to offer more than access to sets of resources. They also present opportunities for teachers, students, and others to connect with one another around topics in mathematics.

Recommendations

To re-emphasize an earlier point, a clear conclusion of our discussions is that programs and projects intended to support teachers must be attentive to the particular circumstances and issues that particular teachers and groups of teachers are facing. The specificities and contingencies of these issues mean that grand, overarching structures will likely be ineffective.

This is not to say, however, that large-scale initiative and broad funding would be inappropriate. Quite the contrary, significant resources must be made accessible. The critical issue seems to be that such resources should be directed toward initiatives that embody the sorts of qualities identified above.

Further, it would seem that some resources and support structures require more extensive funding and extended collaborative efforts. For example, a potential resource that was mentioned several times during our discussions was a web-based bank of

videos of model lessons. The sort of project would require considerable investments of time and materials.

In a related vein, recognizing the particular conditions and constraints of Canadian schooling, it would seem that it is time support a national initiative that would assist 'isolated' teachers in their efforts to establish teacher communities using communication technologies.

With regard to the role of the Canadian Mathematics Society, in addition to acting as a catalyst in the establishment of a network of mathematics educators, it would seem there is an important role to be played in lobbying governments, industry, and educational institutions for significant contributions.

APPENDICES

These appendices were developed by individual members of the Working Group. They reflect activities, emphases and accomplishments that support Teacher Success in their area of Canada.

Appendix 1: What Teachers Need in K-12

Lorraine Baron
SD23, Kelowna, BC
barongrodzki@shaw.ca

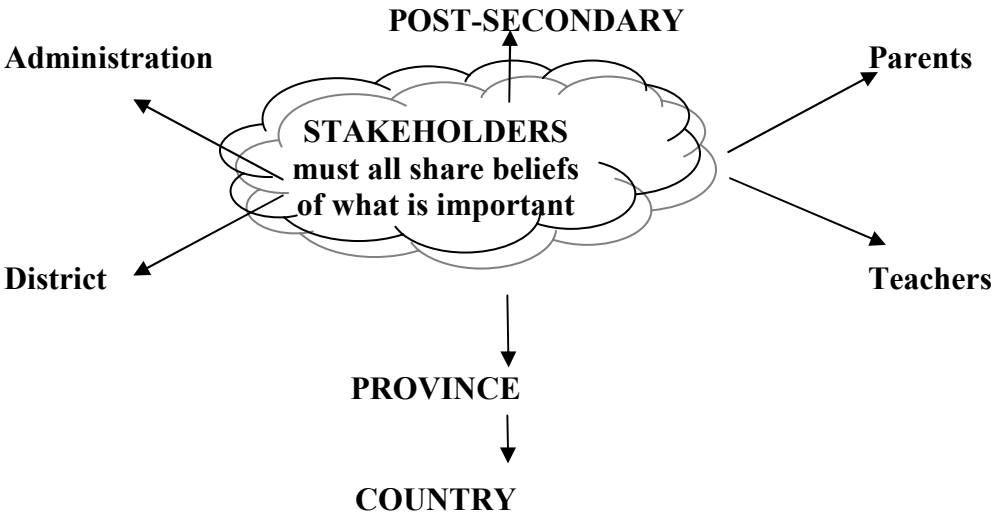
- KNOW math
- UNDERSTAND math
- SEE the transition from previous grades and KNOW where students are going
- KNOW how to practice good math lessons/teaching
  - have models of good instruction
  - have mentors to work with
  - have continuous opportunities to share and learn for a long term
- FEEL POSITIVELY about math
  - have good experiences with mathematics
- Study Groups – Book Clubs

-focus should be on pedagogy rather than on quick tricks or "activities"

- Need "Atmosphere for Learning"
  - professional learning communities, cognitive coaching, collaboration AS A MODEL for what needs to happen in the classroom, i.e. student-centered learning, etc.

** Takes time to develop collaborative culture – Depends on local factors and environment.*

- Work needs to be intensive – long-term
- Reality of having to "get through" curriculum
- Reality of teaching middle and secondary school discourages problem based learning due to time constraints
- Need to train mentors/facilitators
- Support from University/In-Service Teacher
- Parents have to be "on-board" in every way



Appendix 2: Learning Objects

Chantal Buteau
Brock University
cbuteau@brocku.ca

Within our mathematics program MICA (*Mathematics Integrating Computers and Applications*), MICA and particularly BSc/BEd students develop in their first year MICA I course computer programs to investigate or, in particular for BSc/BEd students, to teach mathematical concepts. For most BSc/Bed students it is their first teaching experience. Many of them realize for the first time that teaching basic concepts of mathematics is actually quite difficult, or at least more difficult than they would have thought, since for them, doing mathematics has always been an "easy task." The learning objects (computer programs) can be found on a website and can therefore be accessible from everywhere in Canada. These can be used as material for elementary and high school classes.

Here are in summary some interesting facts:

- Can be easily spread on a *national* level. Best learning objects can be posted on the internet, therefore are accessible by any teachers and students.
- Can be integrated in the BSc/BEd programs pre-service courses (see Appendix 13)

Good *`doing maths' experience* for future teachers that very often have anxiety with regards to mathematics.

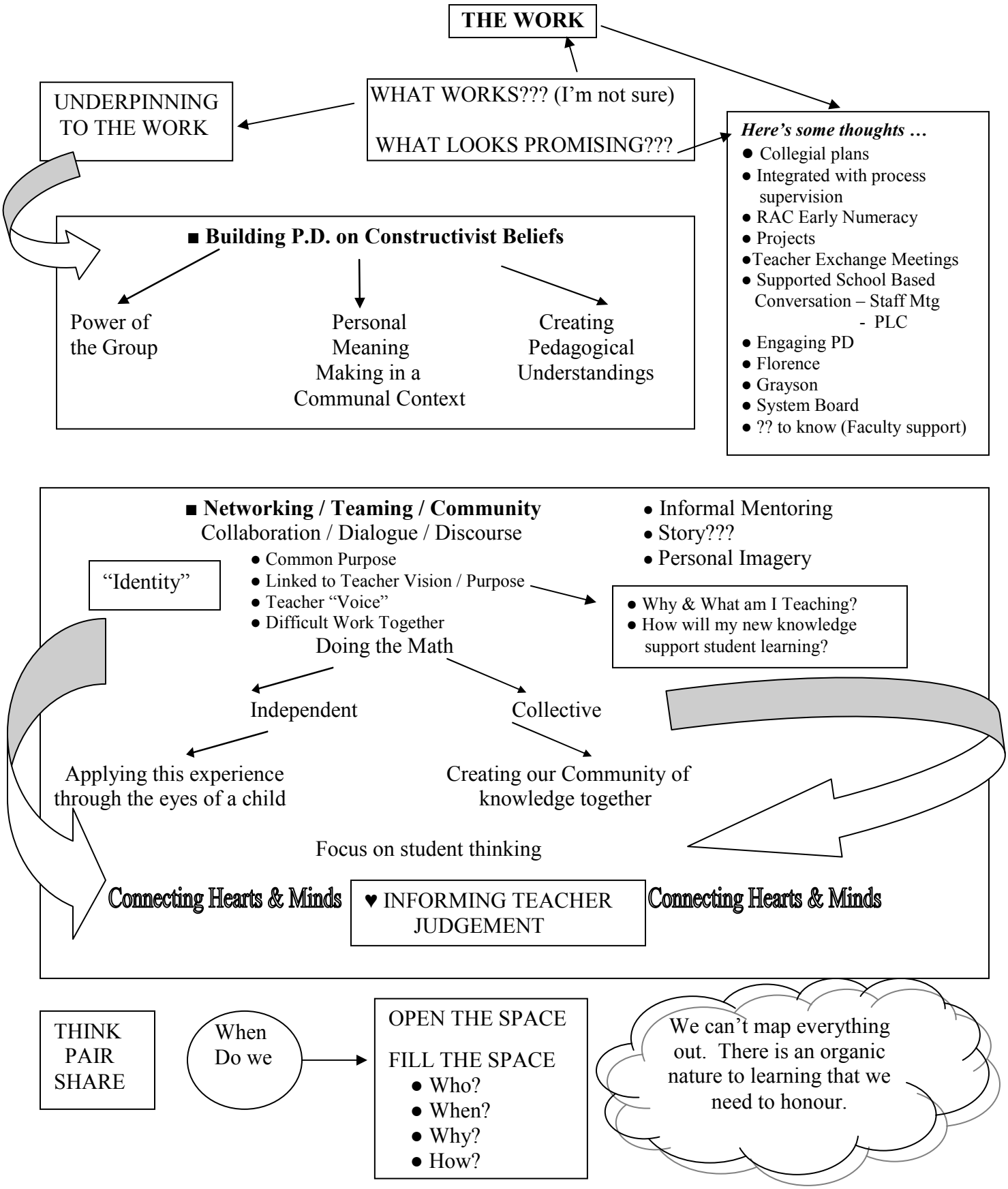
- Developed at Brock University by BSc/BEd students (starting at their first year).
- Is successful: Students get involved and completely dedicate themselves.
- For most of them, it's their first "teaching experience".

They experience, before any didactic course about mathematics, that teaching basic concepts of mathematics is actually not an easy task, whereas for them, doing mathematics has never been a problem.

- Opens possibility for collaborative projects with pre-service students and also teachers in the high school and elementary levels: it is '*mawkinutimatimk*'
- Can be used in classes by teachers.

Appendix 3:

Sharon Compton
Saskatoon (East) S. D. #41
scompton@sesd.sk.ca



■ **The Conversation Continues …** Growing & Learning over time. It is essential that we find ways to support this.

Appendix 4:

Malgorzata Dubiel
Simon Fraser University
dubiel@cs.sfu.ca

1. Simon Fraser University has a Masters in the Mathematics Education Program, offered jointly by the Mathematics Department and Education Faculty. It is cohort based, intake every 2 years.
   - 6 courses: 3 Math, taught by Math, 3 Education, taught by Education + Master's Thesis
   Contact: Tom O'Shea (oshea@sfu.ca)

2. Peter Liljedahl, Faculty of Education, SFU (liljedahl@sfu.ca) has initiated a project with the District of Coquitlam. One of the key issues: looking at longitudinal coherences. Teachers are asked to think of 3 things/competences they wish students coming into their classroom would have, and how would they assess them.

3. Linking teachers, people from math and math education at universities, people from colleges. One of the venues, "Changing the Culture" – annual conference sponsored by PIMS, which has as a goal bringing all these together. Information is available at our website: www.pims.math.ca/ctc
   Contact: Malgorzata Dubiel (also for other such initiatives in works)

Appendix 5: Summer math program for prospective elementary teachers: Building a community of mathematical inquiry for prospective, pre-service and beginning teachers

Barbara Graves
University of Ottawa
bgraves@uottawa.ca

The initiative. The Summer Mathematics Program for prospective teachers was initiated during August 2004 as a pilot program and research project to assist beginning elementary and secondary teachers deepen their understanding of mathematics and mathematics teaching. Designed and implemented by Christine Suurtamm and Barbara Graves, this initiative invites prospective elementary teachers to explore mathematics before they enter their teacher education program with the goal developing a deeper and more open-ended understanding of elementary mathematics. The intensive one-week program consists of in-class problem solving experiences in a supportive and collaborative learning environment centred on foundational domains of elementary mathematics. The math facilitators for the program are recruited from the newly graduated secondary mathematics teacher candidates from the Teacher Education Program at the University of Ottawa. Each facilitator is responsible for a group of 15 prospective teachers. This

arrangement provides the facilitators with an opportunity to experience teaching mathematics in an inquiry learning environment. The program will be offered again in August, 2005.

The research: The Summer Mathematics Program also serves as a research site and invites both prospective teachers and the secondary math facilitators to participate. Working within a sociocultural theoretical framework we are interested in understanding how these beginning teachers construct themselves as learners and teachers in mathematical inquiry through their discourse in joint problem-solving activities. Designed as a qualitative three-year longitudinal study the research focuses on the experiences of the elementary teachers during the summer math program, and as they move through their pre-service program and into their first two years of teaching. Similarly it examines the experiences of the secondary mathematics instructors during the summer program, and as they move through their first three years of teaching. Through journals, questionnaires, informal meetings, as well as focus group meetings at regular intervals throughout the duration of the study, we are exploring what experiences help develop their understanding of mathematics and mathematics teaching. Specifically we are asking whether learning and teaching mathematics in communities of inquiry are enough to transform beginning teachers knowledge of mathematics to enable them to create learning environments which support mathematical inquiry.

Appendix 6: Math Central Website: www.mathcentral.ca

Denis Hanson
University of Regina
dhanson@math.uregina.ca

- Quandaries & Queries - question area (not homework); a number of respondents (not enough teachers)
- Resource Room – for teachers and pre-service teachers; a place to share lesson plans, ideas of any kind (bilingual)

This was set up between our math department and the Education faculty intending to focus on Education students initially and then out into the work force. It gets 40-50,000 hits/day. Clearly we've heard about a number of sites over the last two days – can there be some national "marriage" of these?

It surprises me that very few people at the conference seem to know about math central – strange when a query to *Google* would bring it up. Similarly, I'm not familiar with most sites I've heard of in the last two days. We're clearly not communicating as well as we could. This could be a national objective.

Just an aside, Math Counts from the U.S. has recently priced us out of the contest ($25 U.S./student). In B.C. and Saskatchewan, new contests (developed locally) have been introduced this year (Grades 8-10). We find the contest a good way to involve our department with teachers and students (and student teachers). If a group (paralleling the NCTM) of math educators grows in Canada, then our own "Math Counts" might be a worthwhile exercise.

Appendix 7:

Ann Kajander
Lakehead University
Ann.kajander@lakeheadu.ca

Lakehead University - Faculty of Education
Now: Creation (and validation) of a graphic 'Profile' of teachers' knowledge and beliefs about math, so pre-service teachers can reflect on where they are now, and how they want to focus their own development …. Followed by research on how these 'Profiles' change after various experiences in mathematics learning themselves.
Future: 'Pi in the Sky' … getting pre-service teachers more involved with interacting with a parent and kids in a non-school space, eg. mall.

With Lakehead Public Schools

Now: Following groups of teachers experiencing different types of in-service to see what effects these might have had on teacher knowledge of math, and teacher beliefs … see what effects emerge.
Future: Following these teachers more individually to look for any change in their practice, as a result (next few years).

Appendix 8: Ontario Ministry of Education Literacy and Numeracy Secretariat

Mary Lou Kestell
Literacy and Numeracy Secreteriat
MaryLou.Kestell@edu.gov.on.ca

With the beliefs that
- all students can learn to do math at a high level given enough time and support
- all teachers can teach math with deep understanding given appropriate and effective support

We are supporting tri-level change in teacher practice which proves to be useful in raising the bar and closing the gap (between top performing and the rest of the students) in student achievement

We are working to further the learning about mathematics and mathematics pedagogy by extending and supporting the learning begun by the lead teachers by
- providing support for another teacher to be trained so they can work together to improve student achievement
- connecting lead teachers, principals, board trainers from remote areas across the provinces to form online inquiry groups where they read together, train, share, plan and talk about their math learning

- organizing Provincial conferences with leaders in math education from around the world and hosting them in small communities around the province
- video taping learning of all sorts – teachers, children, parents, superintendents, directors
- Webcasting once a month into every school across the province on all learning goals ** there will be a specific one for math – we jut have to plan it.
- Planning to bring parents in to get them to put training, advertising, reading material for other parents
- Forming partnerships between researchers and practitioners to share and report on the important part of research and what it means for teachers – or at least involving them in the conversation thru video conferencing and webcasting
- Running Summer Institutes for Primary & Junior teachers on Whole Number Operations and Fractions
- Involving Directors, Superintendents & Principals in the target setting; building commitment to reading the data and to making improvement plans that respond to the data

Truly forming professional learning communities where the people involved are setting questions to study and using data to set plans and moving on plans to address the issues.

Appendix 9: Toronto Catholic District School Board – Mathematics Professional Development Schema

Kathy Kubota-Zarivnij
OAME, TCDSB, Literacy and Numeracy Secreteriat
kathkubo@edu.yorku.ca

Context

- math is not the only professional development that teachers are engaged in
- 169 elementary schools (ranging from 1 to 4 same grade level teachers at each grade) and 33 secondary schools
- influx of Ministry of Education materials and money

Aim

- Change the Culture of Teaching and Learning through deliberate and explicit changes in structures of Math PD using 5 conditions outlined in JRME article

Redundancy – Ideas Out There

- key readings – The Teaching Gap by Stigler and Hiebert, Emergence by Stephen Johnson, Brent and Elaine's JRME article, Liping Ma's Knowing and Teaching Elementary Math, MOE Expert Panel Reports (K to 3, 4 to 6, 7 – 12), board wide K to 8 math program and its relationship to these readings
- instructional materials – common K to 8 mathematics textbook program materials, manipulatives, access to technology
- learning goals – math content, pedagogy (processes for critically reading and enacting instructional materials as they relate to evidence of student learning and achievement); pedagogical content knowledge, building community, reflections about self and others (cognition and relationship to emotions) – always based on teacher's current dilemmas, queries and upcoming content for classroom teaching

Diversity

- inservice context – use of instructional materials, curriculum continuum coherence (grades 7 to 9), math and technology, combined grades and mathematics, special education (differentiated program) and mathematics
- types of teacher inservice – within CPD lesson study, pedagogical study, CPD curriculum development, and outside inservice (AQ and ABQ primary (Part 1, 2, specialist) and ABQ Intermediate math course, math conference support
- participants in terms of school responsibilities, math education experience - classroom teachers, special education teachers, administrators (need more work there)
- classroom supervision approaches to enable teacher participation in job-imbedded inservices
- differentiation of solutions to math problem and differentiating math problems for specific learning – how communicate with the schools;
- enacted knowledge that developed in relation to the professional learning communities

Decentralized Control

- Nested learning systems – board, regions, family of schools, schools, classes by division, classes by grades
- Math Dept and lead regional teachers, teacher and administrator participants in many professional learning communities, contexts – interrelationship of learning communities and participants is developed through the local needs of the family of schools in relation to the board and Ministry of Education math initiatives

Organized Randomness

- Professional Learning Community structures – family of school clusters (8 to 12), 12 professional learning centres with .5 elementary, 16 grades 789 learning communities with .5 secondary teacher, superintendent regions (45 schools), math reps, math heads, 12 board lead primary, 12 board lead junior, 12 board intermediate teachers
- Principal and teacher choice of inservice dates, times, school and classroom locations for sites of lesson study
- Choice of math content in relation to upcoming content for teaching

Neighbouring Actions

- Discussions and actions the math program implementation through lesson study, pedagogical inservices for teachers teaching the same grade or in the same division across a family of schools for K to 9
- school schedule of teacher planning times are coordinated for same grade teachers
- monthly divisional staff and whole staff meetings – math inservice activities discussed
- board wide conferences – over 6 full days – 1000+ classroom teachers, special education teachers, vice principals, principals; to engage teachers in regional discussions across grades 7,8,9, and 10
- different projects – e.g., elearning, Laptops Integrated for Teachers – for grades 7, 8, 9, and 10

Appendix 10 : Je comprends que je dois écrire ce que je retiens à venir jusqu'à maintenant …

Caroline Lajoie
UQAM
lajoie.caroline@uqam.ca

What does a successful support program look like?

Un premier élément qui me vient en tête : ce programme doit répondre aux besoins des enseignants. C'est un des points qui fait qu'un tel programme serait difficilement généralisable! D'un milieu à l'autre les besoins diffèrent.

Différentes personnes avec différentes expertises doivent être impliquées.

Il me semble que l'idée de « lesson plan » est une idée prometteuse. Elle rejoint un peu certaines intentions visées par les recherches collaboratives.

Pour moi, la recherche collaborative demeure une des meilleures initiatives possibles. Cependant, elle est difficilement généralisable.

Au niveau du contenu mathématique, je crois qu'il faut là encore y aller selon les besoins. Parfois les besoins ne sont pas exprimés en terme de contenu mais celui-ci s'impose en cours de route. Par exemple si les enseignants se montrent intéressés à parler de la manière dont on peut amener des élèves à construire leurs algorithmes personnels, on peut s'attendre à ce qu'on traite des opérations, des sens de ces opérations, etc.

Appendix 11:

Petra Menz
Simon Fraser University
pmenz@sfu.ca

Experiences as a High School Teacher in Richmond, BC
Annual BCAMT Conference
- great resource
- place for conversation
- networking
- inspirational
- reflective

In-Services from School Board
- Professional development days - assessment oriented
- chance to get math departments together to define and work on common goals

- District workshops – "hot topics

Experiences as a Lecturer/High School Liaison at UNB, Fredericton, NB

Mandatory math course for pre-service K-6 teachers that focuses on math rather than the methodology:

- stressed doing of math, construction of a knowledge base, observations of themselves and others doing math and finding a voice to express that
  - reflective in nature, opportunities to change
  - using the language of mathematics
  - broad overview of math, vertical approach
  - biggest obstacle: anxiety, not trusting own "math instinct"

Invitations to high school teachers in the province to use us as a resource for whatever needs that teachers have:

- initially only done with one math teacher at a local high school, supplied material on specific topics, clarified or taught topic to teacher and/or class.

***** *This was the single most satisfying experience that was effective and had long-term impact.*

- second high school joined in, and by fax and other high schools that were further away

---

Appendix 12: Combining Professional Development & Pre-Service Education

Martina Metz
Calgary Science School
martina.metz@calgaryscienceschool.com

Overview

At the Calgary Science School, we are experimenting with ways to integrate our work with pre-service teachers with the professional development of our own teachers. In the past, we have hosted groups of student teachers at the school and hosted weekly classes where the university students meet with their field advisor. We are currently refining structures that will encourage meaningful dialogue among students, student teachers, and partner teachers.

Past Success

The most successful experience that we have had with this method involved a group of student teachers who were placed in our school and several groups who were placed in neighbouring schools, all of whom had a common university advisor who met with them every Friday morning at our school.

A very successful practice that developed during this time was having one of the partner teachers teach a lesson while the student teachers watched via live-feed video in a neighboring classroom.

Prior to the lesson, the teacher met with the student teachers to share a bit of history to the lesson and the purpose of the day's lesson. As the lesson progressed, the student teachers were able to watch and discuss events as they unfolded. These discussions focused on teaching methods, student responses, and the mathematics content of the lesson. The partner teacher joined the group after the lesson to answer questions and engage in discussion regarding the lesson.

During these lessons, the teacher presented a problem and allowed the students to offer various perspectives and solutions. They discussed their ideas and attempted to determine which answer(s) were most justifiable. As one student finished speaking, he or she would call in another student who was waiting to speak. The teacher intervened from time to time to highlight relationships between different students' ideas, to ask for greater detail, or to challenge entrenched views. These elements of the lessons were important, as they shook up assumptions about seemingly simple math content as well as about how math is taught (and ultimately what the pursuit of mathematics is about). A summary of the key arguments in one such lesson is presented in *Figure 1* (although the ideas emerged in a conversational manner that the summary doesn't capture). In this case, the students' confusion about remainders being bits vs. remainders being wholes also sparked doubt in the minds of several student teachers who then entered into a lengthy discussion about their own understanding of the lesson content. This type of doubt was common in lessons where students were required to justify and negotiate meaning; even students who were very confident in their OWN solution found rich challenges in trying to understand why other seemingly reasonable solutions produced incompatible answers. In turn, this provided rich ground for the partner teacher and student teachers to deepen their own understanding and to develop strategies to help the students navigate the territory.

Is 1 R2 = 1.2?

Yes!
$12 \div 10 = 1R2 = 1\ 2/10 = 1.2$

No!
R2 = 2 WHOLES
0.2 = 2 BITS
They can't be the same!

No!
$5 \div 3 = 1$ R2 = 1 2/3 (NOT 1.2)

Sometimes
$(x + 2) / 2 = 1\ 2/x \neq 1.2$ unless $x = 10$

The class ended with an apparent paradox: students (and several of the student teachers) could see the logic in incompatible explanations! Beautiful! The students who developed the "sometimes" argument, although they were correct, had not yet developed an adequate explanation to refute the bits vs. wholes dilemma, so this was left for another day.

Figure 1

After the lessons, the partner teacher had the opportunity to meet with the student teachers to answer questions. This provided opportunities for the teacher to reflect on her practice with the benefit of many different perspectives to help frame how she understood the lesson. It also offered a model of reflective practice for the student teachers, and it gave the student teachers the chance to participate in a lesson that for many challenged their perceptions of teaching, learning, and mathematics. Conversation about the mathematics was also prominent. As the students engaged in problems in new ways, the conversation often opened up territory that was challenging students, student teachers, and the partner teacher. When the job of the teachers was to find effective ways of challenging answers without resort to authority, they had to develop deep understandings of the methods students were using to approach the problems.

Patterns emerged in the student teachers' questions. Common questions included:

1. What do you do the kids who get "THE" answer right away?
2. How do you push dialogue to depths that challenge rote understanding?
3. How do you get all kids involved?
4. How do you ensure that you cover the curriculum?
5. Where do rich questions come from?

These questions formed the basis of many rich discussions both within and beyond the case classroom. These discussions were of great benefit to both the student teachers and the partner teacher.

Future Plans

In the upcoming year, we plan to host a full cohort of students (the full university case class, as opposed to having some students at neighbouring schools) to allow deeper and more ongoing involvement with topics taken up during case classes. Our teachers will work with the university field advisor to prepare case classes that allow greater interaction between student and partner teachers. Student teachers who take part in the Friday case classes will be able to go into the week at the school and be involved in the follow-up activities.

We plan to involve more partner teachers in the case classes (voluntary participation) and to develop smaller teams of student / partner teachers at each grade level who can meet at various times throughout the week to do the ongoing work of understanding student ideas and preparing follow-up activities to help them deepen their understandings. We anticipate that this will benefit the partner teachers in that they will now have someone else in their classrooms who can help to appreciate where the students are coming from and how best to navigate the sea of possibilities that this opens up.

Summary

By providing opportunities for student and partner teachers to work together in developing deeper understandings of the ways that students approach mathematics, rich dialogues ensue that help pre-service teachers appreciate how children develop mathematical understanding. At the

same time, partner teachers have the rare opportunity to engage in ongoing reflection with someone who is fully involved with the same children and the same mathematical content.

Appendix 13: Brock University – Faculty of Education - Preservice

Joyce Mgombelo
Brock University
jmgombel@brocku.ca

Context:

1. Teacher candidates have "negative" experience with Math
2. Not enough time for Math Methodology course: 20-hours
3. Teacher candidates spend substantial time in schools – observation, Practicum

Strategy? How to maximize time for teacher candidates' engagement with mathematics, pedagogy, etc.

1. Structure an assignment that teacher candidates might implement during their teaching practicum – potential for collaboration with teachers (practicing).
2. Collaborating with Dept. of Mathematics (MICA) projects by using the learning objects in the course – potential for further collaboration with schools where students and practicing teacher might get involved with the learning objects.

Appendix 14: The Graduate Program in Mathematics and Statisticsat York University has a longstanding MA Program in Mathematics for Teachers

Martin Muldoon
York University
muldoon@yorku.ca

It is a part-time program aimed especially at practicing High School teachers and requires the completion of 6 6-credit courses or equivalent. It is worth recording some recent changes in the program which help to make it more useful as an in-service device.

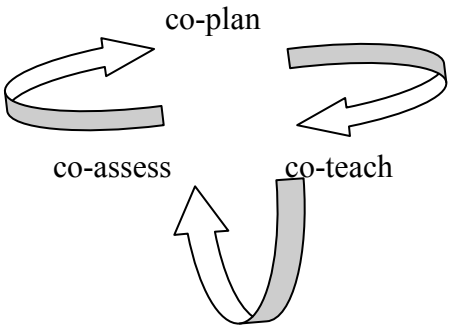
1. Originally conceived as appropriate for possessors of an Honours Degree in Mathematics, the Program increasingly admits students with much more modest preparation (in Mathematics) on the grounds that these are the people who need it most.
2. Several courses in the program incorporate discussion of recent curricular changes in school mathematics and uses of technology.
3. Some courses in the Faculty of Education have been cross-listed by the Program and other appropriate outside courses can be taken by permission.
4. There is now the possibility of students also getting a Diploma in Mathematical Education. This requires some extra work and is appropriate for the small number of students intending to pursue doctoral work in Education.

Appendix 15: Models for Pro-d

Carole Saundry
Richmond School District & BCAMT
csaundry@richmond.sd38.bc.ca

Our district (and whenever possible, our association, the BCAMT) believes that professional development is on-going and requires collaboration. Professional development that includes:

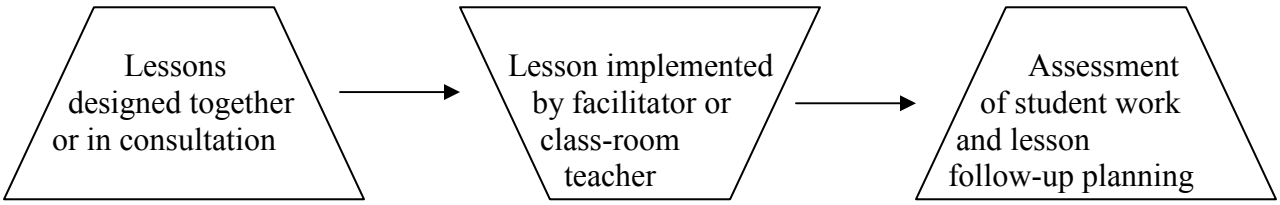
which lead to a cycle of



This means that, no matter what the topic as related to math, there is continuous conversation, opportunities to practice and to reflect on learning.

We begin conversations around assessment (what kids know and can do, and how to recognize it in classroom practice and artifacts) and move from there.

Sometimes, the implementation of this professional development includes demo-teaching/lesson study.



This is a rich learning opportunity for all – 5-10 people observe as lesson at once and are involved in reflective conversations afterwards. All involved are invited to try the lesson in their own classrooms and to share back how it went.