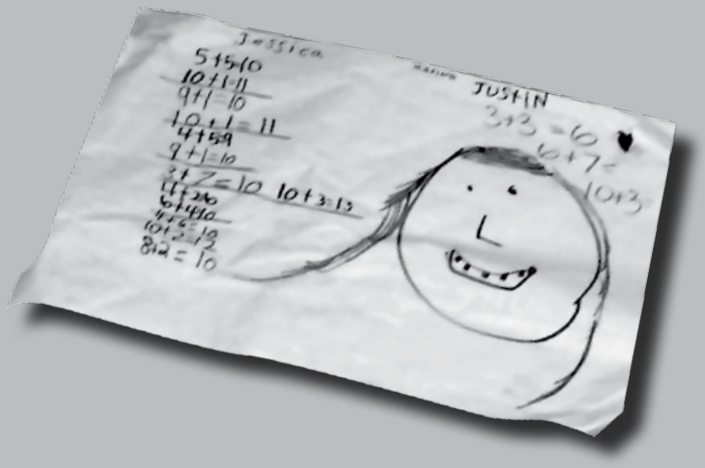
Collaborative Inquiry for Learning Mathematics for Teaching (CIL-M)



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During the 2008-09 school year, staff and students from St. Gerald Catholic School in the Toronto Catholic District School Board (TCDSB) were involved in one of the Literacy and Numeracy Secretariat's (LNS) projects that engaged all of us in a very rewarding opportunity. The project, known as *Collaborative Inquiry for Learning Mathematics for Teaching* (CIL-M) was headed by the LNS and included twelve school boards across the province. The aim of the study was to develop regional capacity and leadership in mathematics education, in order to improve student learning and achievement in mathematics. More specifically, the purpose was to refine and examine evidence-based teaching strategies and an implementation framework that would engage a diverse community of learners in learning mathematics for teaching within both a school-based professional learning community (PLC) and a professional learning network (PLN).

Our particular study was conducted in collaboration with the Toronto District School Board (TDSB) and participants included grades 2 and 3 students, teachers, math resource teachers, principals, School Effectiveness Framework (SEF) leads, LNS Student Achievement Officers (SAO) and supervisory officers. Six two-day sessions took place from December 2008 to April 2009. Three of the sessions took place at John Wanless Public School, the TDSB lead school, and three at St. Gerald Catholic School, the TCDSB lead school. Some of the sessions were videotaped for the purposes of a future LNS webcast. For many of us, it was the first time collaborating with colleagues from our co-terminus board and the first opportunity to take part in a study of this length. Both were welcomed opportunities and we came away with a solid basis for examining our practices at the board, school and classroom level.

Our session goals were clear and remained the same throughout. Together we studied mathematics content and instruction by developing, planning and implementing mathematics lessons within numeracy learning blocks, using evidence-based teaching strategies. We focused on teaching through problem-solving as the vehicle for addressing the grades 2 or 3 curricula that the classroom teachers were delivering to their students. In order to develop students' ability to understand and solve a problem in different ways, we focused on the three-part mathematics lesson. We familiarized ourselves with the evidence-based strategies that fostered an understanding of the big ideas in mathematics, the ability of students to solve a problem in different ways and the students' mathematical communication of their ideas. As we studied mathematics for teaching, we participated in teacher moderation (assessment for learning) of students' work for professional learning.

As educators, co-teaching and the use of a Bansho framework were key elements to our experience and learning in this project. Bansho is Japanese for board writing and in this context refers to the recording on the board of the thinking and solutions that summarized the day's lesson from beginning to end. Co-teaching is a process whereby teachers collaboratively analyze student work samples by identifying the mathematics evident in student solutions to a lesson problem, and discerning the mathematical connections between the solutions, so teachers can plan the next steps for instruction during the lesson and for the next day.

The three part problem-solving approach or Bansho framework, was organized around *before* (activation of prior knowledge and experiences pertinent to the day's problem), *during* (problem) and *after* (consolidation – highlights and summary, and practice) activities. Within our numeracy learning block, ideally 60 to 75 minutes in length, we explored the purpose and duration of each of the components of the three-part problem-solving approach. We came to understand the reasons for the timing of the lesson and for the teacher's and co-teachers' roles during each one.

The *before* activities are allotted five to ten minutes. They are intended to activate the students' mathematical knowledge and experiences that directly relate to the mathematics in the lesson problem. The teacher can use a smaller problem similar to a previous lesson problem. Student responses should be used for class analysis and discussion to highlight key ideas and/or strategies. The activation activity should be a brief opportunity to highlight what the class has already discovered in previous work and act as a launching pad for the day's problem. The teacher is always encouraging the communication of strategies used by the students and their understanding of relationships in the problem. At times, it was a challenge for us to choose an activation problem that met the above criteria and could be completed within the allotted time.

In the *during* time, students work on the day's lesson problem. In choosing the problem, we always began with the grade's curriculum expectations in the Ministry's mathematics document, in order to ensure that the problem was appropriate. Sometimes we used a problem directly from a classroom textbook. At other times we adapted questions from the text or worked collaboratively to develop a question that was suitable. This phase of the lesson was allotted 15 to 20 minutes. It began with reading the problem together, in order to fully understand the question being asked so that the children could make a plan and carry it out. The teacher asks the students, "What information from the problem will we use to make a plan to solve it? Explain." Below the question, the teacher records the information the students identify in a list. The information remains on the board for the children to refer to as they solve the problem in pairs or small groups. Once the children began to carry out their plan to answer the problem, the teacher and co-teacher(s) had some very specific roles to carry out.

While walking around the room, the teacher and co-teacher(s) had three key questions for analysis.

- What mathematical understanding is evident in the students' communication (oral, written, modeled)?
- What mathematical language should we use to articulate the mathematics we see and hear from students? (e.g., mathematical actions, concepts, strategies, tools)
- What mathematical connections can be discerned between students' different solutions?

This analysis of student solutions and the mathematical connections between the solutions informs planning and next steps during the lesson and for the next day's lesson.

This may be a good time to explain the role of the co-teachers and of teacher moderation before moving on to the consolidation phase of the lesson. In our sessions, the co-teachers were the study participants mentioned above. We often had two co-teachers and their role was to assist the teacher with analyzing the students' responses by answering the three questions posed above. The co-teacher was not an extra set of hands in the class that worked with a small group of students. In fact, we came to appreciate that it was best for the teacher and co-teachers to confer with one another, but to leave the children to work through the day's problem with their peers, using their prior knowledge of strategies and tools. The co-teacher(s) alerted the classroom teacher to conceptual misunderstandings regarding the day's problem and noted students who might need greater scaffolding to be successful. Deciding how to differentiate the instruction for struggling students became an important part of our conversations. Providing hints for solving problems was not successful, inadvertently curtailing the students' own engagement with the day's problem.

Most importantly, however, the co-teachers collaborated in teacher moderation (assessment for learning) aimed at choosing solutions from the student responses and identifying the mathematics that was evident in them. The process was repeated for the various responses that the children had generated. A second key role was in comparing the responses to each other, in order to determine how they were similar and how they were different and which solution should be shared first, second, third, etc. As we examined student answers, articulated the mathematics in them, and compared and contrasted the various answers, we were preparing the Bansho presentation of answers. The co-teachers were crucial for making these decisions, because in the hustle and bustle of a busy class, the order of presentation of the solutions and the ways in which they were similar and/or different were not always apparent.

The *after* part of the lesson consists of consolidating the learning that has taken place. The teacher selects the two or more solutions noted while the students were working and invites the students to present their solutions to the class in the order that shows the mathematical elaboration from one solution to the next, towards the lesson learning goal. It is important to note that the teachers do not level the responses, but annotate them to make mathematical ideas, strategies and tools explicit to the students for their learning. In our study, we came to realize that this was the time when new learning occurred and, as such, 20 to 25 minutes of the lesson was dedicated to this part. An additional five minutes was allotted for a highlights or summary time where the teacher revisits the different solutions, pointing out the key ideas, strategies and models of representation that are related to the lesson learning goal. The summary list makes explicit the key ideas that have resulted from the lesson, based on the range of student solutions. The last five to ten minutes of the lesson are dedicated to practice. The teacher

chooses one to three problems, similar to the lesson problem, for students to solve individually or in pairs, as a scaffold. The students might be given the challenge of solving the problem using a strategy different from the one they used in the lesson.

In order for this approach to mathematics to work in a school setting and in order for the principal to be an active participant, it is crucial to establish a climate of trust and collegiality. Within a climate of trust, ideas, successes and struggles can be discussed openly. My participation as a co-teacher allowed me to be an informed participant in the professional dialogue about mathematics, to be much more aware of the students' learning processes and to learn a great deal about the challenges and rewards of implementing a problem-solving approach to mathematics.

Going forward, providing release time for teachers to participate in co-teaching and valuable follow-up conversations is a key consideration. Co-teaching offers many benefits for students and teachers, but finding ways to release teachers to complete this important collaboration is not always easy. For the purposes of our study, the co-teachers had time to be present before, during and after the lesson, but logistically this might not always be possible in a regular setting where the amount of release time for the co-teacher might be limited. In co-teaching occasions outside of the formal LNS sessions, co-teachers were not always part of the planning process of the lesson and might only be able to join the class for 15 or 20 minutes. By focusing on the three key questions for examining student work, we found that we could achieve fruitful dialogue, even within a limited amount of time. Providing job-embedded opportunities for teachers to meet for professional dialogue, for teacher moderation of student work and for setting next steps are on-going concerns in Mathematics and other curriculum areas. Our positive experiences with the CIL-M study have renewed my interest in exploring creative ways to find suitable solutions.

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