A Forum for Action - Effective Practices in Mathematics Education

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Toronto, December 11th, 2013

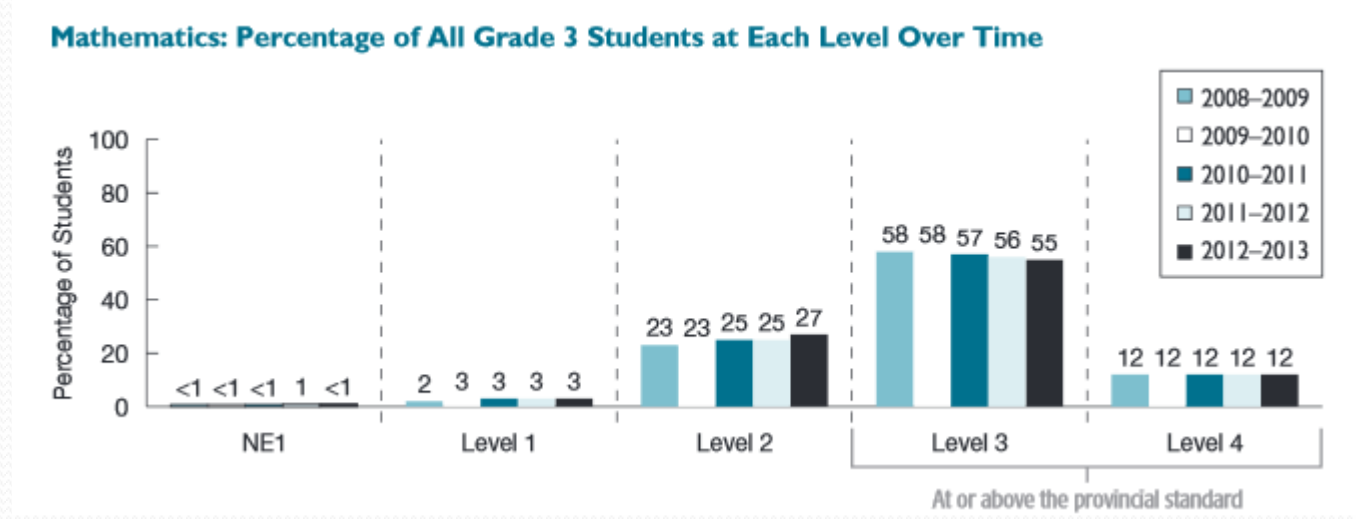
Overview

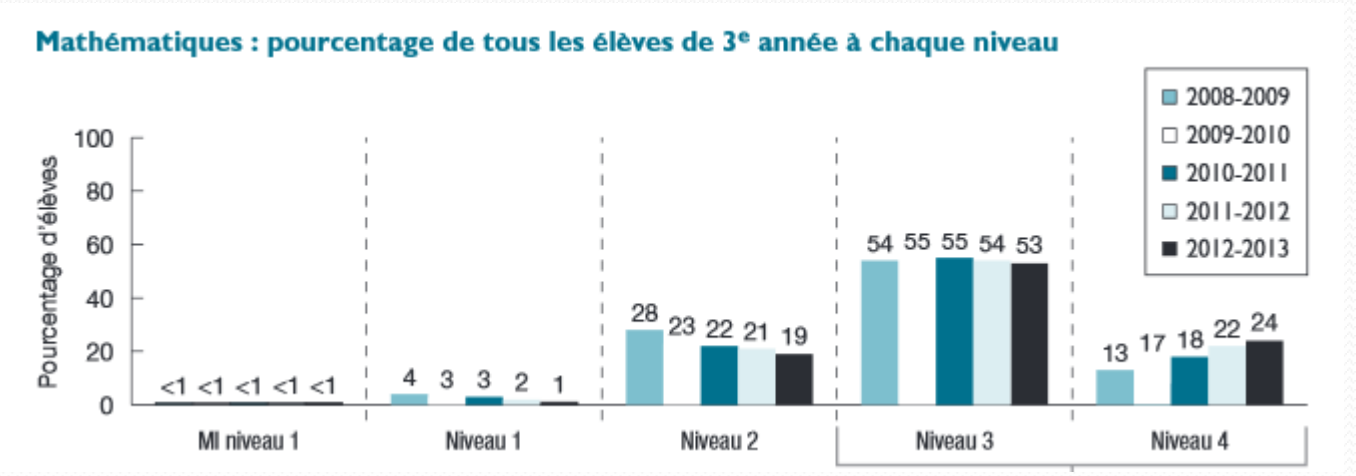
- Context
- Underlying Questions
- Communication
- Abstraction
- Performance issues
- Conclusions

Context

- EQAO results for Francophone students are better than Anglophone students for Grade 3 and Grade 6, and has been this way for years
- Results for Francophone students have a huge dip between Grade 6 and Grade 9
- There are 12 Francophone school boards in the province. The EQAO scores are based on roughly:
  - 6500 to 7500 Grade 3 students
  - 6300 to 6500 Grade 6 students
  - 1450 to 1525 Grade 9 Applied students
  - 3900 to 4100 Grade 9 Academic students

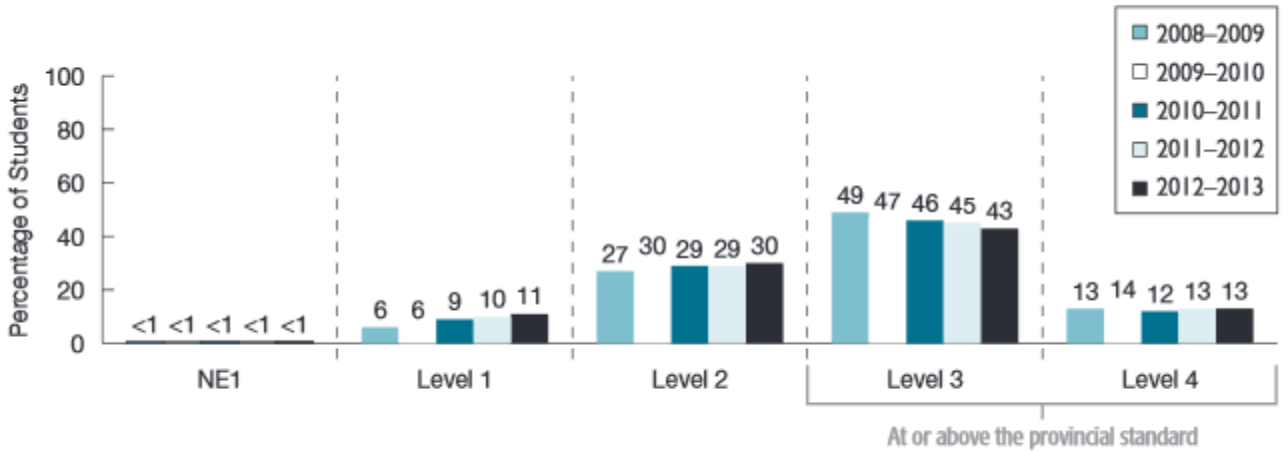
EQAO Results – for context





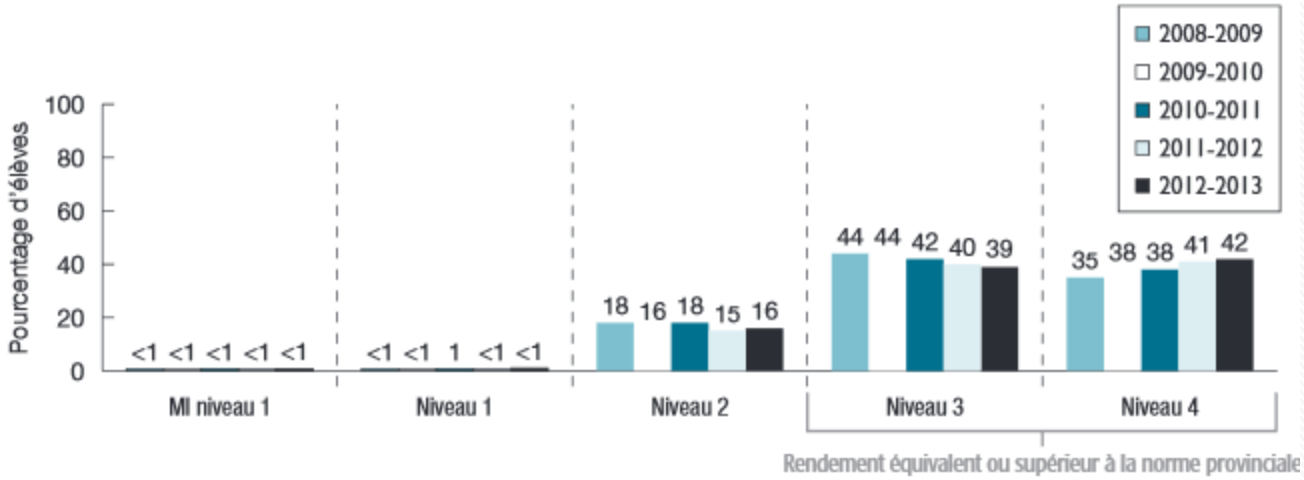
EQAO Results – for context

Mathematics: Percentage of All Grade 6 Students at Each Level Over Time

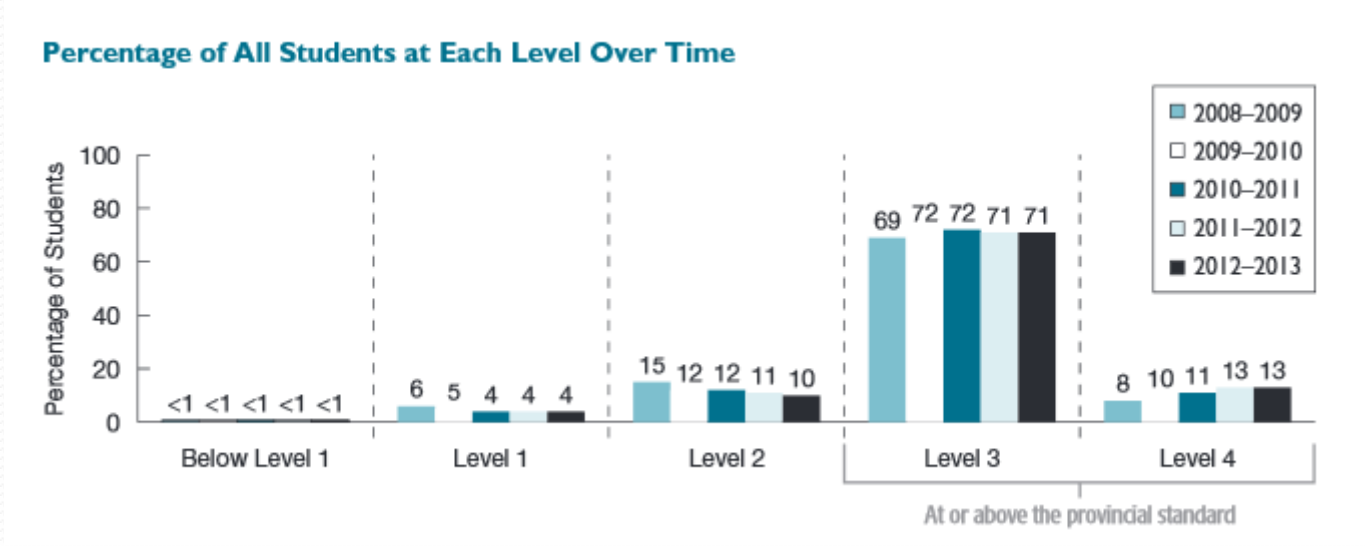


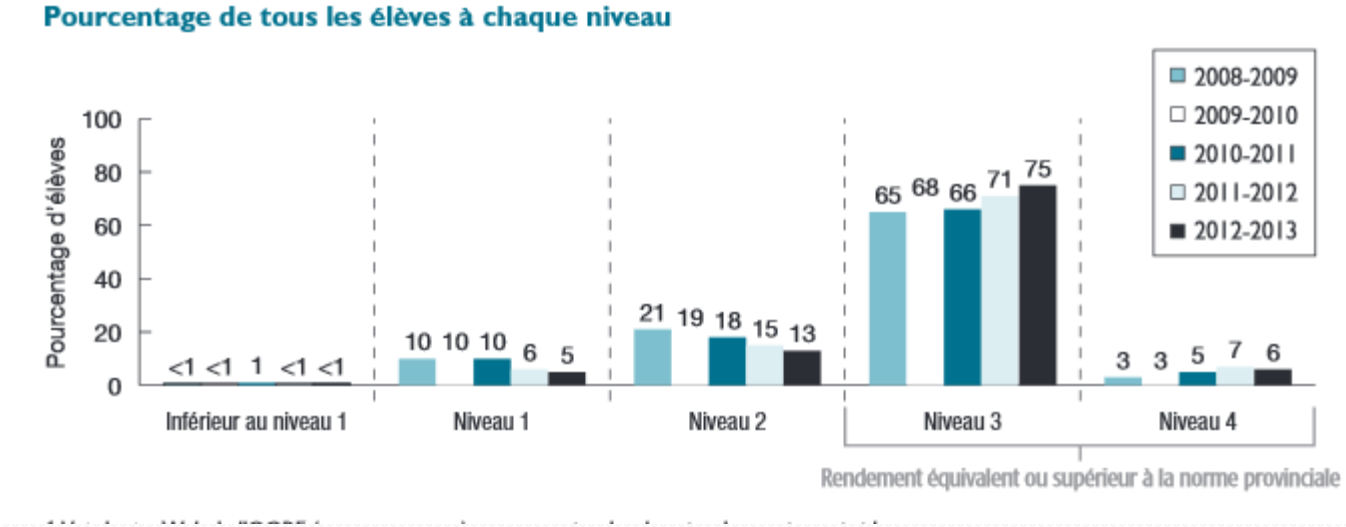
* Because percentages in tables and graphs are rounded, and because graphs do not show all reporting categories, percentages may not add up to 100.
† These percentages are based on the actual number of students and cannot be calculated simply by adding the rounded percentages of students at Levels 3

Mathématiques : pourcentage de tous les élèves de 6e année à chaque niveau

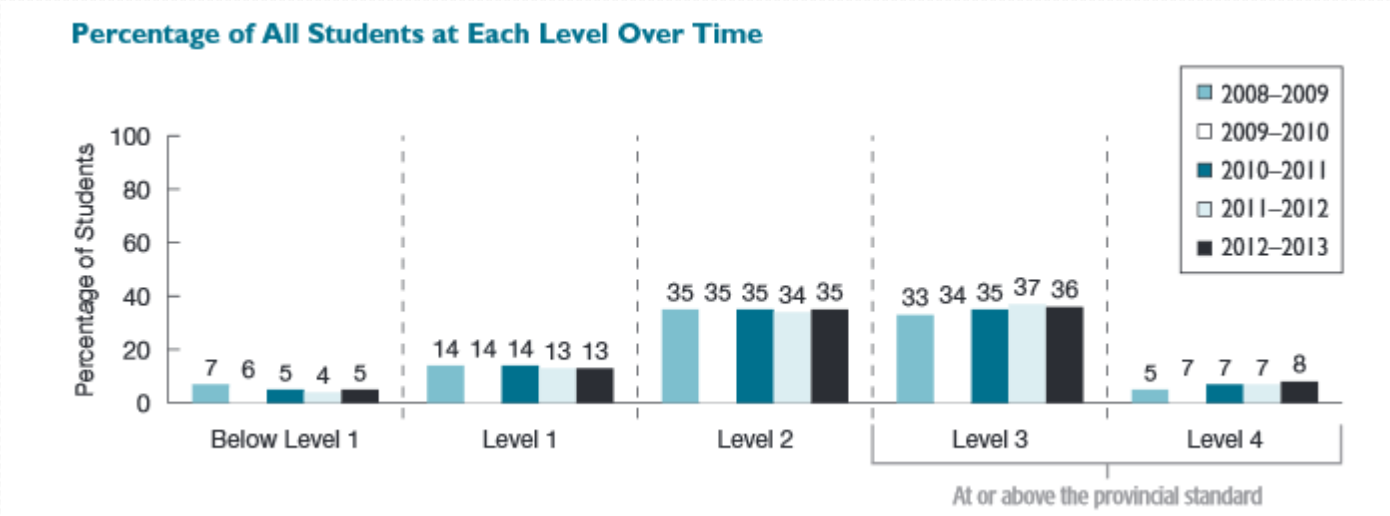


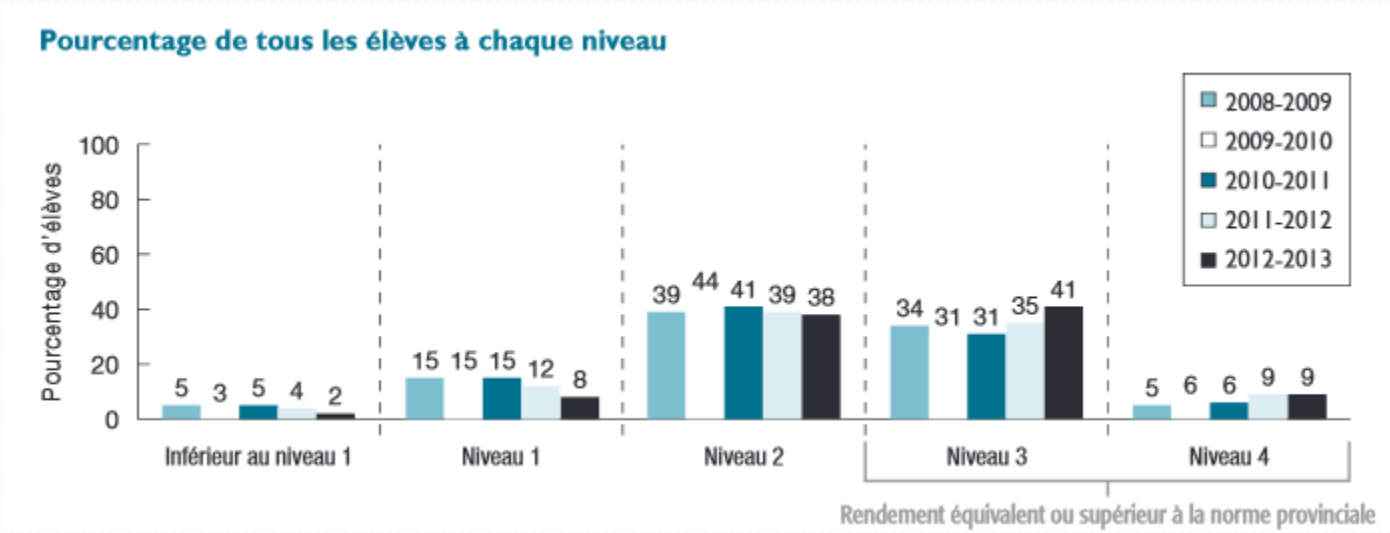
EQAO Results – for context





EQAO Results – for context





The studies I have been involved in

- Over the years, a variety of studies and contexts
- Ranging from JK to Grade 12
- Spanning the province
- Most of the studies were conducted WITHIN classrooms

The underlying questions

- How do students from all levels communicate in Mathematics, how to quantify it, and how to develop capacity
- How do students at the intermediate level manage to develop abstract thought, and move from concrete to abstract back to concrete in mathematical contexts
- What are factors that would explain the differential performance of Francophone students on the Grade 9 test

Communication

- All students, no matter their grade level or ability, are able to communicate mathematically
- Communication is not just talking, but also listening to another's arguments, distilling them, and reacting if they conflict with our own
- Students in fairly homogeneous groups of 3 managed to generate rich discourse when the problem they faced was challenging.
- With Radford, produced the book *Communication et apprentissage. Repères conceptuels et pratiques pour la salle de classe de mathématiques*.

Abstraction

- Based on our study of communication, we targetted intermediate level students
- We built a conceptual model of how students move from concrete to abstract, and then through problem solving in small groups, were able to see this in action in students
- We did see that abstraction is not solidly gained in these students, and that they can easily fall back to the concrete representation
- With Radford, produced the book *Processus d'abstraction mathématique*

Performance issue

- In the last years, have worked with a number of boards on a collaborative inquiry model, mostly at the intermediate level
- The inquiry model is found to be highly engaging and effective in moving teachers' approaches from traditional to student focused
- As teachers have few opportunities to share – given the size of the school – these initiatives permitted true professional learning communities
- Even if a lot of effort has gone into this age group, there is still a large gap in performance between Grade 6 and Grade 9

Conclusions from 10 years

- Students have the most success when they worked on problems as a group rather than individually.
- Meaningful discussions by students are critical
- Discussions need to occur both between the teacher and students, but more importantly space and time is given for students to discuss between themselves.
- Teachers need to give students open-ended questions, or questions that can be solved in a number of different ways.
- The use of manipulatives helps students bridge the concrete-abstract divide

Conclusions from 10 years

- The use of technology (read 21st century tools) was shown in our various studies as being a very helpful tool to visualize mathematical concepts.
- An environment where the teacher lets students discover concepts, but also know when to intervene and teach the concept is key to good development of mathematics
- But most critical of all….
  - Teachers must strike a balance with all of the above parameters
  - Discovery vs teaching
  - Technology vs no technology
  - Manipulatives when most appropriate