WORKING GROUP 4 REPORT
LEARNING IN THE PRESENCE OF TECHNOLOGY

WORKING GROUP

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We had representatives from BC, Atlantic Provinces, Québec and Ontario. Our group focused mainly on secondary education.

ISSUES DISCUSSED

Definition of Technology

The working group agreed that technology included hand-held technology, computer software and web-based environments.

Why Technology?

The group explored possible reasons for integrating technology in mathematics learning for students and teachers. Some themes that emerged included learner:

- **autonomy in the mathematics classroom** - learning mathematics without direct assistance from the teacher,
- **autonomy in using tools** - knowing what technology to invoke, when to invoke it and how to invoke it in mathematically powerful ways, and
- **mathematical autonomy in a technological world** - understanding the mutual contributions, place and roles of mathematics and technology.

These themes call for a rethinking of our mathematics curricula and pedagogy - mathematics being taught, learned and assessed.

The Canadian Story

Based on the stories shared by the members of the working group, it was clear that diversity in the tools being used and in the degree of technology integration exists across provinces, districts within the same province, across schools of the same district, across teachers of the same school, and across streams of a given provincial curriculum.

What Technology?

The specific technologies referenced in the working group included graphing calculators, dynamic geometry software, and dynamic geometry software. Graphing calculators, in particular the TI83Plus, seem to exist across all provinces, school districts and most

schools. Dynamic geometry software exists in the form the Geometer's Sketchpad (version 4) in Ontario and BC and in the form of Cabri-géomètre in Québec. Dynamic statistics software exists in Ontario in the form of Fathom software. It should be noted that only Ontario has universal access to dynamic geometry and dynamic statistics software through provincial licenses. Other provinces have school or district licenses.

Because of the difficulty of ensuring universal access to computer and hand-held technology, we have observed relatively low impact on the use of technology on either the math curriculum or on assessment practices. Provincially-driven curriculum and assessments allowing or requiring the use of graphing calculators seem to have provided some push in some jurisdictions to adopt the use of technology. Ontario seems to be unique in mandating the use of dynamic geometry and dynamic statistics software in its curriculum.

It should be noted that allowing the use of technology on assessments does not imply that the problems students solve require technology and therefore cannot be done without those tools. It would be a worthwhile task to compile images of curriculum and assessment that require the use of technological tools that would not have been approachable without those technological tools. An example would be the introduction in the New Brunswick curriculum of linear and non-linear regression and modelling with the graphing calculator.

<u>Preparedness, Equity and Impact</u>

1. In general, **new teachers** seem **better prepared and more inclined towards integrating technology** in their teaching of math.

2. **Equity may not have to mean equality**. The different needs and interests of students and teachers should be taken into account.

3. Despite its richness in mathematical resources, potential for developing critical thinking, and attributes that could help resolve some of the equity issues, **internet has had low impact** on math teaching and learning, except for:

    - "Independent study" projects in Grade 11 in New Brunswick

    - Projects based on large sets of data in the Data Management course in Ontario

4. Despite their characteristics that could be used to help understand the many linkages between math and technology (discretization, algorithms, etc.) and open to more active technological constructions (e.g. simulations of dynamic systems), **spreadsheets are rarely used** in the teaching of mathematics, and when they are, the mathematical depth of their use is very limited.

5. We need to clearly articulate the skills and concepts that can be enhanced through the use of the different technologies. Development of **critical thinking should be a key objective**. A repository that would point to the best practices would be useful.

RECOMMENDATIONS FOR ACTION

Before the 2005 Forum

1. Develop a more comprehensive image of the technologies being:
    a. referenced in provincial curricula,
    b. referenced in provincial assessments, and
    c. used by teachers and students in the classroom.
2. Explore possible national collaborative projects that model the effective use of technology (e.g. Census at School - www.censusatschool.com).
3. Compile examples from jurisdictions of curriculum and assessments that use graphing calculators, dynamic geometry software and dynamic statistics software in powerful ways.

At the 2005 Forum

- Develop a strand that brings mathematics education researchers and mathematics educators from across Canada together to explore how research, practice and products can combine to ensure that learning does in fact take place in the presence of technology.
- The absence of and hence the opportunity for learning in the presence of technology in elementary classrooms may warrant a dedicated focus.
- Technology-rich curricula – what should it look like?
- Articulate the skills and concepts that can be enhanced through the use of the different technologies (e.g., critical thinking).
- Explore the issue of equity in access to and use of technologies to learn mathematics.
- Explore effective teacher professional learning models to support the effective use of technology for new and existing teachers of mathematics.
- Explore what role technologies might play in elementary mathematics education.