

Mathematics for Active Citizenship

Nadine Bednarz, Richard Pallascio, CIRADE, UQAM

Geoffrey Roulet, Queen's University

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“To explore what we don't know with the help of that which we do know, a pleasure divine “(Paul Valéry)

Session 1: Development of Critical Thinking in mathematics, prepare active citizens for tomorrow (Geoffrey Goulet)

The question was “How can we prepare each student to explore mathematics within social/values contexts, and thus help prepare the engaged citizen of tomorrow?”

Democracy can be maintained only if the citizenry is actively involved in studying and discussing the issues of the day. Mathematics has come to be an essential tool for the conduct of this public debate. Popular media regularly present us with messages such as:

In a study on the cost and benefit of implementing the Kyoto Protocol, Nordhaus found the benefit-cost ratio of Kyoto is 1/7. That's right, even if global warming is really happening we stand to gain \$1 in benefits for every \$7 we spend. (Green, K., Crunching Kyoto numbers. Toronto Star, August 27, 2003)

and

An Ipsos-Reid/CTV/Globe and Mail poll conducted between June 10 and 12 found a slim majority (54 per cent) of Canadians said they were in favour of same-sex marriages, while 44 per cent said they were opposed. The poll is considered to be accurate to within plus or minus 3.1 percentage points, 19 times out of 20. (Americans favour law barring gay marriage. Toronto Star, August 19, 2003)

What do these figures really mean? How were they determined? Can we be sure they are accurate? Classroom activity needs to be expanded to include an examination of the mathematics behind such statements and a careful critique of the messages delivered.

Recent changes in secondary school curricula, nationally and internationally, have increased the opportunities to explore political and social issues while studying mathematics. New curriculum documents call for mathematics study to be placed in context and driven by the exploration of real problems. Statistics has been given more prominence in school programs and mathematical modelling is a growing curricular theme. Although the mathematics routines involved in these topics are quite precise there is still room for much debate. Were all significant variables included in the development of the model that led to the quoted Kyoto cost-benefit study? Are the results of the same-sex marriage poll strong enough for parliament to use as a basis for a decision?

Research into the moral development of children and young adults shows that secondary school students are typically passing from a stage of ideological experimentation into a period of ethical consolidation. They are individually constructing personal ethical codes that will guide their future behaviour. At this period in their lives they are ready and eager to be engaged in

debates involving serious values issues. Textbooks, in the application settings they present, often link mathematics to science and technology. Bringing more people oriented issues into the mathematics classroom can help motivate a wider cross-section of the student population. The challenge for teachers is to develop methods to blend these social issues discussions with the study of mathematics and to manage classroom conversations to permit all students to present their views in a rational and respectful manner. These tasks are often not easy for mathematics teachers.

School and undergraduate mathematics study often presents the subject as a body of absolute truths and infallible routines. This distorted image of mathematics is attractive to individuals who wish for a world where issues can be seen as black and white. Many mathematics teachers are found in this group and with such views they have difficulty dealing with lessons involving wide ranging student debate. They have trouble relinquishing control of a lesson and providing space for students to voice their views on potentially controversial subjects. There is a need for pre- and in-service activities that allow future and present mathematics teachers to personally engage in discussions that involve both mathematics and current social issues. This implies changes in courses provided by university mathematics departments and faculties of education.

Providing teacher support for “active citizenship” mathematics lessons is difficult. Course topics may remain relatively stable year to year, but political and social issues change. Social issues often have a local flavour and the most effective introduction is usually found in the news media that students are personally experiencing. Thus a textbook unit looking at a model for the propagation of SARS in Toronto during the spring of 2003 may not generate strong student interest in 2005 or in classrooms in British Columbia. The course of individual lessons

or units of study can not be firmly fixed in advance if students are encouraged to identify and mathematically explore related issues of personal concern. Thus resource materials can not provide teacher scripts, precise timing guides, or sample solutions to problems. What is required are stories of sample successful lessons that provide models for teachers and a pool of issues that might be explored in similar ways. The need for up-to-date materials suggests that the Web may be the best mode of distribution. Teachers and mathematics instruction could benefit from a Web site that held a data bank of issues hyperlinked to two sets of resources: 1) sites providing data, news media reports, and commentary on the issues and 2) pages that provide support related to the mathematics involved in an exploration of each controversy.

2nd session - Different mathematics for a modern school (Richard Pallascio)

The proposed question was : « How can the curriculum be adapted to all students and contribute to prepare engaged citizens for tomorrow? »

Many mathematics program for the high school lead to propose more or less complex contents, for example : enrich, regular or lightened mathematics :

" On the one hand, this classification is discouraging to the students in the basic program, and is hardly a motivating factor, especially if we consider that performance is often confused with motivation. While it is true that not everyone has the same ability to learn mathematics, it is equally clear that students do not study mathematics for the same reasons or with the same level of interest. Instead of motivating students, differentiation by content difficulty actually discriminates against certain groups in a negative way." (A question of motivation : different students, different programs, Commission des programmes d'études, MEQ, juin 2002 : www.cpe.gouv.qc.ca)

Other programs have titled their different courses with a less negative manner, like "Advanced functions and introductory calculus", "Mathematics for college technology", "Mathematics for everyday life"... But are the pupils mystified? Others named them in relation with the contents and the future professional choices : "Functions and relations", "Mathematics of personal finance", "Mathematics for everyday life"...

Actually a team work on an original concept allowing first an exploratory phase on different themes, (by example, one by semester in secondary 3rd or 9th degree), a phase on the experimentation of a theme (by ex: science and technology or social sciences, or arts, letters and communications, in secondary 4th or 10th degree) and finally the investigation of a theme with full knowledge of the facts (in secondary 5th or 11th degree). The goal of this temporal display, in the sense of a guiding school, would prepare the pupil to get decisions by the way of her or his mathematical activity, while developing her or his critical and creative thinking. At last, we must retain that differentiation and motivation can proceed from a pedagogical as much as a didactical diversification.

Session 3: Teachers training in the perspective of engaged citizens for tomorrow (Nadine Bednarz)

The proposed questions was “ How can we prepare teachers in mathematics in a perspective of mathematics for everyone and engaged citizens for tomorrow?”

Or “ How can we contribute in teachers training to a significant learning of teachers so that they can intervene, in a plurality of contexts (students with difficulties, immersion classrooms, young adults who return to schools,...) in a perspective of preparation of active citizens for tomorrow?

A brief presentation of the teacher training program in mathematics for high school teachers in UQAM had been presented. It was the starting point for a discussion of the group.

Different components have been pointed out in relation to the preparation of an active citizen:

- The importance, in the teaching of mathematics, of the learning of democracy (respect of the other in a classroom, and for a student-teacher, of his point of view; capacity to

listen to the point of view of the other..)

- Debate in mathematics is a good occasion to practice this democracy
- Suppose a different way to see mathematics (culture of mathematization, knowledge, cultural activities, opening to interdisciplinary)
- Reflexive attitude

Mathematics appears there as a tool of “prise sur le réel”, language and knowledge)