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Canadian school mathematics forum

Working group 13: Rethinking math thinking in secondary maths classes

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Chairs:
Ed Barbeau, Professor of Mathematics, University of Toronto
Peter Taylor, Professor of Mathematics, Queen's University
Denis Tanguay, Professeur Département de mathématiques, UQAM

Other participants:
Donna Chanasyk, Alberta Teachers' Association; Grades 10-12 mathematics teacher and deparment head at Paul Kane High School in St. Albert
Stewart Craven, Mathematics Coordinator, Toronto District School Board
Mihran Djiknovorian, Responsable des programmes de mathmatiques aux primaire et au secondaire, Ministère de l'Éducation du Québec
Robert Morewood, Secondary Teacher of Mathematics Burnaby South Secondary School, Vancouver
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Following a brief discussion led by Ed Barbeau of the environment of secondary school mathematics teaching and learning, which included such points as the greater emphasis on "destination-based" programs for college, university and the world of work, evaluation, pressures of a crowded curriculum, the spectrum of student preparation, ability and attitudes and the tyranny of fostering procedural skill, the group focussed the role of teachers in secondary school in implementing a curriculum meaningful for the students. The challenge is to produce problems that have some authenticity, challenge and depth, while fitting in with the curriculum. However, these must be presented in an environment where students are willing and able to take the time to develop deeper understanding rather than merely memorize and practise prescribed procedures.

Peter Taylor led the second session, whose focus was the need to construct or find new types of problems for the mathematics curriculum and to find ways of introducing and effectively implementing such problems. These problems would be narrative and investigative, leading students and teachers to confront important mathematical ideas and techniques.

Peter began by describing a problem at the Grade 11/12 level called "Jacqueline and the beanstalk" in which Jacqueline climbs a beanstalk (at constant rate) which at the same time is growing (at constant percentage rate) and the problem is to find whether she will ever get to the top. The problem can be modelled as one of solving a simple first-order linear (inhomogeneous) recursion. Interestingly the problem is mathematically equivalent to the "scholarship problem" which is often a standard problem at that level. One has a capital endowment which grows during each year at a fixed percentage rate but from which a constant amount is deducted each year to award a scholarship. The problem is to find how the capital changes. This equivalence shows how the Jacqueline problem can be modelled and solved as an annuity problem, thus providing some rich connections between different parts of the curriculum.

Finding such problems is challenging enough, but that is only the beginning. The final session, led by Denis Tanguay, considered other factors that must be handled:

1. Teacher training and professional development. It is not easy to work with such problems. It requires a sound knowledge of the underlying mathematics, flexibility and creativity. Teachers who have experience with certain pedagogical techniques must be supported as they modify these to meet new demands of the curriculum.

2. On-going support networks. The teacher must know how she and her students are doing. She needs the ability to interact with other teachers, directly or through web-based support.

3. Curricula are typically described as lists of technical skills. The teacher must be able to see that such skills can be effectively covered through work with such investigative problems. It is not necessary, nor even feasible or desirable, to separate out the two components of the curriculum.

However, putting these questions aside, the initial focus of the working group will be on finding or constructing such problems. It was observed that there are large numbers of such problems in the literature, but many of these involves topics such as geometry, counting, probability, number theory, that are (alas) only a marginal part of the standard curriculum, which tends to largely concentrate on the mathematics required to do calculus. We need problems which fit the curriculum; Peter Taylor observed that this is the biggest problem that he faces.

The committee decided to undertake the work of distributing examples of possible problems and investigations among themselves, with a view to seeing that some are tried out and preparing a dossier of critical comment on their effectiveness.