

TEACHING SECONDARY LEVEL MATHEMATICS: WHAT HAS CHANGED?



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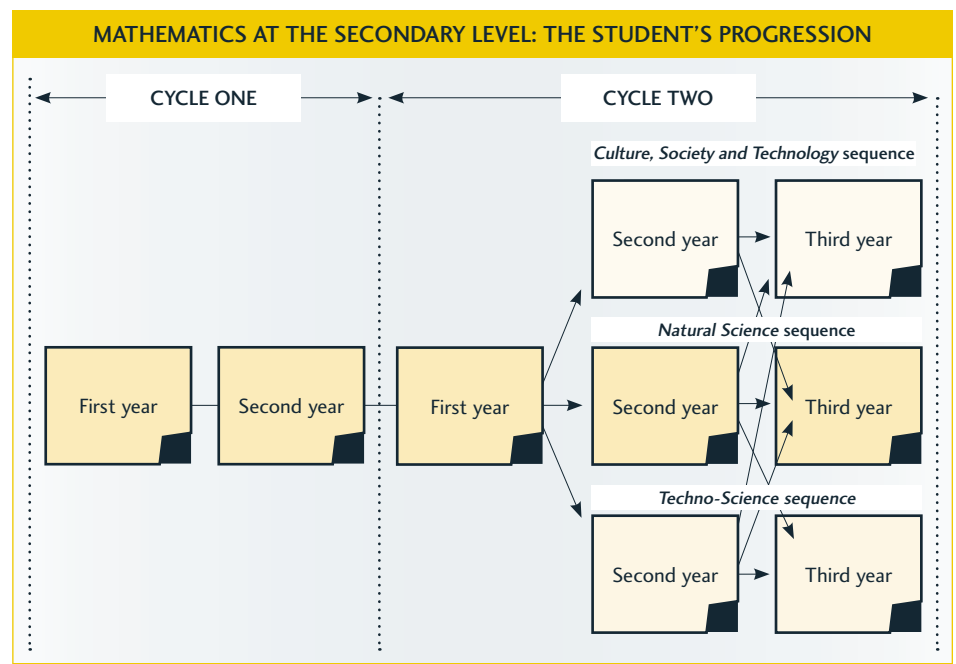
In order to take stock of what college students in 2010 will know, will know how to do and will know how to be with regard to Mathematics, Fanny Kingsbury of *Pédagogie collégiale* met with M^{me} Céline LEDUC, *Conseillère pédagogique de mathématique* for the *Commission scolaire de la Pointe-de-l'Île* in Montreal.

Before she assumed this position, which involves supporting and coaching Mathematics teachers in her school board as they appropriate and implement the educational reform at the secondary level, M^{me} Leduc taught this discipline herself for over 20 years in various regions of Québec: in both private and public secondary schools, to young students and adults, and to students experiencing difficulties as well as to advanced students. This varied experience and her extensive work in the field enable her to cast an expert eye on the learning of students who will be attending college next fall.

Q: ARE THERE MANY DIFFERENCES BETWEEN THE OLD AND THE NEW MATHEMATICS PROGRAMS?

A: Yes and no! Although the mathematical content is basically the same, there are obviously some changes, for better and for worse; but mostly there has been a redistribution of content between secondary levels with some content having been moved from one year to another. In terms of strict mathematical content, secondary-level students who have come through the reform will arrive at college with a body of knowledge similar to that of students from the past. What really will have changed is their way of learning and of using mathematics. The amount of content has not been reduced, but now there are also competencies to be developed. What is always somewhat difficult, for us, is that we have little material and few models to use for this purpose. This situation has led teachers to exchange more and to work in teams, with each other and with pedagogical consultants.

Furthermore, it is important to understand that the structure of the mathematics program has also changed: there is now a common core in the first cycle of secondary teaching (Secondary 1 and 2) and in the third secondary year (Secondary 3), then a choice of three sequences for the last two years of Cycle Two (Secondary 4 and 5). I stress: this is a choice that students must make based on their way of apprehending mathematics; it is not a classification that is made based on their “strength” or “weakness”. The sequences offer students different types of mathematics for different purposes.



Source: MELS, *Programme de formation de l'école québécoise. Domaine de la mathématique, de la science et de la technologie*, Chapter 6, p. 4.



The *Culture, Society and Technology* sequence is designed for all students who will use mathematics on occasion, as they would an accessory. This would be the case, for example, of someone in advertising who would need to be able to carry out and understand the results of a market research study in which this discipline plays a part.

The *Techno-Science* sequence is intended for students who are interested in “How?” and it presents them with situations that combine manual and intellectual work. This sequence presents a special challenge in secondary schools: we are ill-equipped to offer students situations in which mathematics is associated with the design, functioning or use of instruments relating to certain technologies. Let's just say that this sequence forces us to be creative! There is currently a partnership that brings together the school boards of *Pointe-de-l'Île, Montréal, Marguerite-Bourgeoys* as well as certain CEGEPs and the *École de technologie supérieure* so that experts can provide us with concrete examples of applied mathematical concepts or produce the objects or prototypes required for the understanding of Learning and Evaluation Situations (LES) that have been developed.

For its part, the *Natural Science* sequence is designed for students who are interested in “Why?”, who want to be able to explain a mathematical phenomenon, who are interested in research. There is a higher level of abstraction, even though this sequence and that of *Techno-Science* have been deemed to be equivalent by our college teaching colleagues.

That said, there are nevertheless a number of significant innovations in the Mathematics teaching program: the pedagogical contexts are more developed, the evaluation criteria are stipulated beforehand and we teach reading strategies in connection with the subject matter.

Q: CONTEXTS, CRITERIA AND STRATEGIES: CAN YOU TELL US MORE ABOUT WHAT IS NEW?

A: Before the reform, we used to teach Mathematics outside of its context of use, for its own sake. Now, students are presented instead with LES (Learning and Evaluation Situations) that allow them to see mathematics in action, in a realistic context. For example, an LES, which can consist of two pages that put a situation into context and provide information that students must read to understand what is being asked of them, can be to select the relevant information and then to process it in a mathematical way in order to resolve the problem presented in the LES. Actual LES examples which we propose for secondary students are available on each school board's website portal, although they are not accessible to the general public. However, recently I saw a document¹ offering LES examples on the website of *Collège Ahuntsic*.

Something else is new and related to the LES: since we teach Mathematics in context, to be logical, we must also evaluate it in context. In addition, obviously we cannot evaluate the development of a competency by giving students examinations that evaluate knowledge. Evaluation is a big challenge, in part because not all teachers who come to us with a university background have received training in the competency-based approach, something which is, after all, quite odd.

Evaluation is also a major challenge because now we have criteria that are stipulated beforehand; that is to say we use descriptive grids and we have to identify how students manifest their competency in relation to each of the criteria and to agree on a common understanding of which manifestations are to take priority and the meaning to give to each level of the descriptive grid. For example, the expression “in part”, what does that mean? These discussions and recourse to a descriptive scale now make it easier for us to target each student's particular difficulties, to intervene specifically where it is needed and to resolve problems. Certainly, the descriptive scale met with resistance at first: and even when this was not the case, some teachers found that the evaluation was becoming subjective. By holding work sessions during which teachers were asked to evaluate in a “traditional” manner and with the help of the descriptive scale, they soon came to realize that, on the contrary, the scale does allow for a more accurate evaluation. Another change linked to evaluation is the fact that we are no longer accumulating grades. We present students with tasks that gradually increase in complexity over the year, and we give greater consideration to year-end tasks.

So, it is not just a matter of proposing an LES to students: we must also show them how to use it, how to read it.

Q: DO STUDENTS WHO HAVE LEARNED UNDER THE REFORM HAVE DIFFERENT MATHEMATICS SKILLS?

A: Yes, but this is not only because of the reform: we are dealing with a new generation of students! As for changes that are specifically connected

¹ On-ligne: [http://www.collegeahuntsic.qc.ca/services/apprentissage/documents/midiconferences/comp_math_ex.pdf]



to the reform, I would say that, when it comes to Mathematics, some students who will be arriving next year will be more resourceful and independent, at least among students graduating from la *Commission scolaire de la Pointe-de-l'Île* because we are helping them to develop strategies for this very purpose and because we are also doing a lot to promote the development of their metacognitive skills. Compared to their predecessors, they are more capable of diagnosing their own learning, of asking us specific questions about what they do not understand and about what is causing them problems. Obviously, but this is not only true for Mathematics, because we favour cooperative learning, compared to their predecessors they are also more accustomed to working effectively in teams and they are capable of self-regulated learning.

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Q: BASED ON YOUR KNOWLEDGE OF COLLEGE TEACHING, WHAT CHALLENGES WILL COLLEGE MATHEMATICS TEACHERS HAVE TO FACE?

A: The big challenge facing college teachers will be, in my view, the need to contextualize everything they do: their students will have been used to Mathematics teaching in which context takes precedence over content and strategies which are covered in lecture format or in small groups. That said, it is possible that the situation will vary depending on where the college students come from: without implying that we are

ahead of our colleagues, in our school board, prior to the reform, our school board had already initiated some profound restructuring which proved to be “helpful” in the context of the reform. For instance, we had already implemented a training project in strategic teaching that helped to create a receptive environment and to mobilize the teachers around the reform. Of course, there was and still is some resistance, but less and less: teachers realize that their main fear connected to the reform, the fear of becoming “incompetent”, is unfounded.

There is another aspect of the reform that will probably pose a challenge for teachers of college-level Mathematics. As I mentioned earlier, students trained under the reform will have followed a sequence that is more adapted to their interests and it will no doubt be unsettling for them to be presented with a “uniform” style of teaching that does not take their interests into account.

In addition, although this is not specific to the teaching of Mathematics nor is it a result of the reform, CEGEP teachers in general will have to prepare themselves to see their authority called into question with regard to the discipline they teach. Increasingly they will need to answer the questions of students who are now demanding that we demonstrate everything to them. ◆

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