PEDAGOGICAL REFORM IN SECONDARY SCHOOL: HOW HAS THIS IMPACTED THE TEACHING OF SCIENCE AND TECHNOLOGY?

An interview conducted by Christian Morin, Educational Advisor at *Cégep de Sainte-Foy* and member of the Editorial Committee of *Pédagogie collégiale*.

Mélanie RHAINDS has been an Educational Advisor in Science and Technology for the *Commission scolaire de la Capitale* in Quebec City since 2007. Her functions therefore place her at the centre of the reform at the secondary level. Holder of a bachelor's degree in teaching secondary-level science from l'*Université Laval*, she taught for seven years, still at the *Commission scolaire de la Capitale*. She has also been a member of the *Commission de l'enseignement secondaire du Conseil supérieur de l'éducation* since 2007. Within the framework of its cross-curricular file on the college students of 2010, *Pédagogie collégiale* met with Mélanie Rhainds to inquire about any major new developments in teaching science and technology in secondary school.

CHRISTIAN MORIN:

Can you tell us if the old and the new secondary-level science programs are different and if so, how they differ?

MÉLANIE RHAINDS:

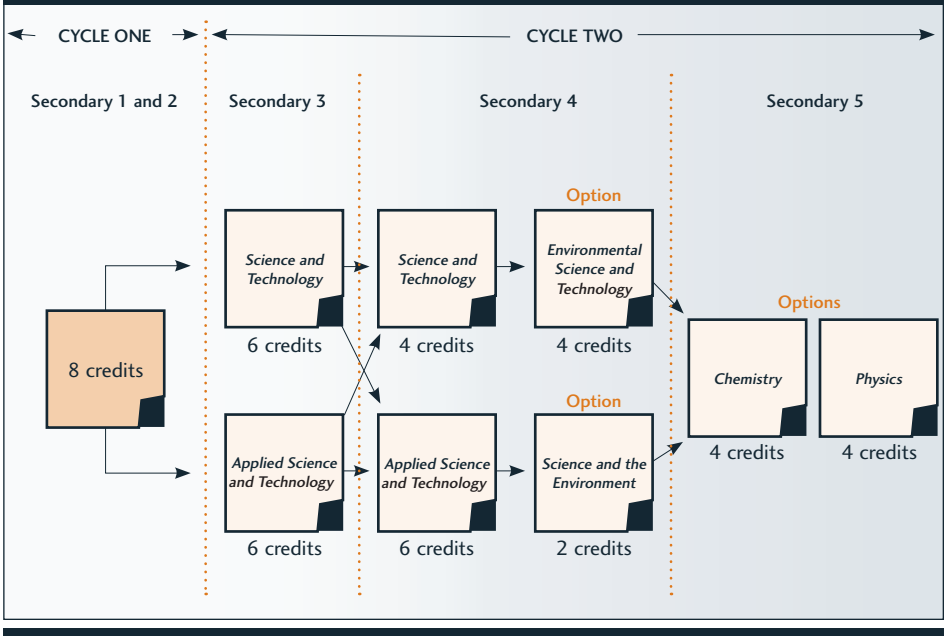
They are very different. Here is how.

- Like all secondary school programs, the science and technology programs are designed around the development of competencies rather than around the achievement of specific and terminal objectives, as was the case in the past.
- The specific disciplinary concepts, which are substantially the same as before, have been merged into four major areas: The Material World, The Living World, The Earth and Space, and The Technological World, and this for Secondary 1 through Secondary 4.
- The Technological World is integrated into the science courses given from Secondary 1 through Secondary 4 rather than being taught specifically in a single technology course taught in Secondary 3 as was the case before.
- Two paths of training in Secondary 3 and 4 now characterize the science and technology programs. One is the path of general training which revolves around a Science and Technology program with training centred on scientific and technological problem-solving; the other is the applied general training path built around an Applied Science and Technology program with practical training which uses concrete applications to introduce concepts.

These two paths lead to the same secondary studies diploma (*Diplôme d'études secondaires, DES*) and provide access to professional training (*Diplôme d'études professionnelles, DEP*) or to pre-university or technical college training (*Diplôme d'études collégiales, DEC*); but they are based on different approaches to science and technology.

As for Secondary 5, there we find a chemistry course and a physics course, both organized using the normal disciplinary approach.

SECONDARY–LEVEL SCIENCE AND TECHNOLOGY: The Student's Path



How do the old and new programs compare with regard to content?

mr The old secondary-level science courses included disciplinary approaches associated with various specialties in science such as ecology, biology, technology, chemistry or physics. Now the concepts relating to all of these disciplines can be found in a more global approach based on four worlds (The Material World, The Earth and Space, The Living World and The Technological World) found in Secondary 1 through to Secondary 4. This new way of dividing up the concepts ensures continuity from Secondary 1 through Secondary 4, it allows for teaching the sciences as a group and it integrates the technological world into the science curriculum. This being the case, the disciplinary content of the new program covers that of the earlier program almost in its entirety.

In your view, when the new program has been fully implemented at the secondary level, will the students' training be different and what will be the science exit profile for the secondary school graduate?

mr The training should indeed be different. The development of the disciplinary competencies can show us where the difference lies.

For disciplinary Competency 1[1], we require that students develop the protocol for certain experiments by themselves and that they control the variables. These requirements go beyond the guided lab work that we were familiar with in the old programs and they should develop a greater mastery of the scientific method as it is now applied in post-secondary studies.

For disciplinary Competency 2, the transfer of the training content is no longer measured exclusively by essay questions and multiple-choice questions as it was in the old programs. Rather, the mobilization of knowledge in context requires that students develop scientific explanations for a certain phenomenon, that they respond to case studies and that they do comparative analysis. This competency takes on its full meaning in the words, "makes the most of his/her knowledge of science and technology" when concepts, strategies and processes are used in order to identify the issues involved in a decision dealing with science and technology or to formulate an opinion on a problem that involves an interrelation between social, economic, environmental contexts and individuals. Since short-answer questions, essay questions and multiple-choice questions do not cover all the evaluation criteria for this competency and since they are not sufficiently open-ended to evaluate the competency as a whole, students trained under the reform may not have the same work habits or strategies when faced with this type of evaluation as did their predecessors.

Disciplinary Competency 3, in addition to giving importance to the production of messages of a scientific and technological character and to the respect for rules and for terminology, it also prescribes the interpretation of scientific and technological messages. In this respect, the science program contributes to the development of language competencies.

SCIENCE AND TECHNOLOGY: Program Competencies for Cycle 2 and their Key Features*

Competency 1: ***Seeks answers or solutions to scientific or technological problems***

- Defines a problem
- Develops a plan of action
- Carries out the plan of action
- Analyzes his/her results

Competency 2: ***Makes the most of his/her knowledge of science and technology***

- Puts scientific or technological issues in context
- Understands the scientific principles underlying the issue
- Understands the technological principles underlying the issue
- Forms an opinion about the issue

Competency 3: ***Communicates in the languages used in science and technology***

- Participates in exchanging scientific and technological information
- Interprets scientific and technological messages
- Produces and shares scientific and technological messages

[1] See the box on opposite side.

* MELS, *Quebec Education Program*. Field of Mathematics, Science and Technology, pages 15-24.

According to your knowledge of training programs offered in colleges, will college students of 2010 be more or less prepared for college studies in science or, generally speaking, how well will they be prepared for studies in higher education?

mr I believe it is still too early to rule on whether these students will be more or less prepared for studying science in college and higher education. However, given the main axes of the program that I just mentioned, you can see that their preparation will be different and that their training should be richer, especially when it comes to know-how. It must not be forgotten that overall, the reform constitutes a more demanding training than the old programs. Furthermore, the presence of technology in all the disciplinary competencies adds a dimension of applied science which was not required in the old programs.

The study of technical subjects, the design of prototypes and concepts related to engineering or to biotechnologies all build bridges to several technical fields in college and applied science. For this type of training, students coming from the new training programs in science should be better prepared.

In your opinion, according to what you observe in the field, will the first cohort of post-reform students be different from their predecessors when it comes to the scientific disciplines?

mr I estimate that a change in the pedagogical practices of teachers requires at least three years. Since secondary-level teachers experience a certain amount of assignment mobility between Secondary 1 and Secondary 5 and since post-reform students are presently in Secondary 5, it will be undoubtedly in the fall of 2012 that the changes will be noticeable in students entering college. The requirements relative to technology have slowly been implemented in the milieux and we are still in the process of appropriating this aspect of the program. Furthermore, the secondary sector is experiencing adjustments regarding ministerial guidelines dealing with the evaluation of learning. So the constraints relating to changing practices for the evaluation of learning have not yet had an impact on all teachers.

[...] it will be undoubtedly in the fall of 2012 that the changes will be noticeable in students entering college.

Based on your observations in the field, will post-reform students be accustomed to specific pedagogical methods in science, although in principle none are prescribed? Is the lecture format of teaching still being used? Beyond the projects carried out by the students, is there still formal, traditional teaching in science?

mr Learning and evaluation situations (LES) are the preferred ways to develop competencies. They relate to the interests of the students, they present students with challenges within their grasp and they can bring out the usefulness of knowledge. They are analogous to a series of classes made up of complex tasks and learning activities related to knowledge. A teacher must therefore make sure that students have the essential knowledge, techniques and strategies they will need to help them resolve the complex task that will be given to them. Lecturing, formal or traditional teaching, combined with other methods, are ways of contributing to the development of competencies. It is up to each teacher to decide on how he or she wishes to characterize a given learning and evaluation situation: supervision, research, theme differentiation, exploration by the student, induction and the place of teaching. In the field, this type of teaching is always present. To what extent? It is hard to say precisely because of the range of choices that teachers can make in this matter.

According to what you observe, according to your reading of the secondary-level program and according to what you know about teaching college-level science, what are the major changes that college science teachers may have to bring to their practice in anticipation of the arrival of these new post-reform students in their classes?

mr If they want to appreciate the differences in training and the new skills that these students have, I would suggest that they implement pedagogical practices that are in keeping with those in the secondary school program — insofar as their training programs allow it — that is to say practices that aim to: "provide students with frequent and varied opportunities to demonstrate their competencies" (MELS).