

The math knowledge of Education Reform students

This report will present the most recent results of the analyses conducted for the ERES Project. The main goal is to compare the math knowledge of students exposed to Education Reform (ER) to that of pre-ER Secondary V students. The descriptive data from our samples infer that more students are now registered in higher-level math options (Technical and Scientific and Science) than before (Mathematics 536). However, over all, students exposed to ER scored slightly lower on our math test than students who weren't exposed to ER. The statistical difference is small, but it was greater for students in certain Québec regions and students from schools in underprivileged areas, and depending on the math course the Secondary V student was taking.

The math program under Education Reform

The new math program under Education Reform offers students more hours of instruction with enriched content. So students finish Secondary III having completed 50 more hours of math than before.

Starting in Secondary IV, students can choose from three options: *Cultural, Social and Technical (CST)*, *Technical and Scientific (TS)* and *Science (SN)*. The choice must be based on students' reflection process rather than academic results and the school's ranking, as was the case prior to ER. The choice must be as consistent as possible with their aspirations (learning needs), interests and aptitudes. The math options were developed with the intention of giving students access to the largest possible number

of programs. The TS and SN options have equivalent levels of requirements, and both provide students with equal access to all programs offered at the college level, whereas before, access was possible only through the 536 program. The CST option is considered the basic option, and its content is enriched when compared to the old 416 program.

The CST option is worth four units per year, and the TS and SN options are worth six per year. Depending on the program they choose, students receive 200 hours (CST) or 300 hours (TS and SN) of math instruction, while prior to Education Reform, students received 250 hours (514) or 300 hours (526 and 536) of math instruction.

Methodology

As the content of the department's math test has changed since ER was implemented in high school, we chose to assess math knowledge using a new test, created by our research team, including 25 questions from exercises taken from the Programme for International Student Assessment (PISA).¹ Our assessment is therefore based on the math expertise of the people who developed the questions; the assessment was empirically validated and its content was also validated. It should be noted that this test does not measure all knowledge gained in high school. It is more aimed at assessing a sample of knowledge that is gained in the Education Program. The test covers three areas in the math program: geometry (9 questions); probability and statistics (5 questions); arithmetic and algebra (11 questions).

The test was administered by 208 schools representative of Québec, with regards to the poverty index, the school system (public or private) and the administrative region. All of the schools administered the test twice: in the fall of 2008, to Secondary V students who were not exposed to ER (control group), and in the fall of 2010, to Secondary V students who were exposed to the ER (reform group). In total, the schools administered the test to 4,664 students (3,189 in the control group and 1,475 in the reform group). The difference in the number of students in each group is due to the following: schools with students in the control group were asked to add an extra class of students with heterogeneous math profiles. As for the reform group, we left adding an extra class up to the schools.² The difference in methodological guidelines explains the difference in the number of students who completed the test from one group to the next.

Findings

Before describing the results, let us reiterate that the goal of our approach was to compare raw test scores between students who were and were not exposed to ER. This raw score must not be interpreted as a reflection of the proficiency of Québec students on an international scale. The scores of the students in our sample were comparable to the scores of the Québec students who participated in the major PISA³ survey and which place them far ahead of most OECD countries.⁴

First, a noticeably higher proportion of ER students got into higher-level math courses, with 56.1% of students in the reform group registered in the TS and SN options in Secondary V, compared to 43.1% of students in the control group that ended up in Mathematics 536 (13% difference). According to population data from the Ministère de l'Éducation, du Loisir et du Sport (MELS), when they took the math test at the end of the school year, 40.3% of students were registered in Mathematics 536, whereas 62.1% of students in the reform group had chosen the TS and SN options (21.8% difference).

Next, we looked at how both groups scored on the test we administered. As there were significant differences in the proportion of students that got into the different math options before and during the ER between the general population and the ERES sample, all descriptive data from the math test were first weighted.⁵ As shown in Figure 1, students in the reform group scored slightly lower than students in the control group. While small, this difference of 1.5 percentage points is statistically significant. Furthermore, the results also differ statistically speaking for two of the three math areas (algebra and geometry), as students exposed to ER scored lower than students in the control group. The difference between the two groups was greater in geometry (2.2%) than in algebra (1.4%).

¹ The chosen questions were last administered during 2003 or 2006 PISA assessments; none of these questions were used in 2009. The released questions from which our items were chosen can be found in this PDF document: www.oecd.org/dataoecd/14/10/38709418.pdf

² As the test was administered to a third group of students exposed to ER in the fall of 2011, it will be possible to conduct analyses of both groups exposed to ER to obtain a number of students that is comparable to that of the control group.

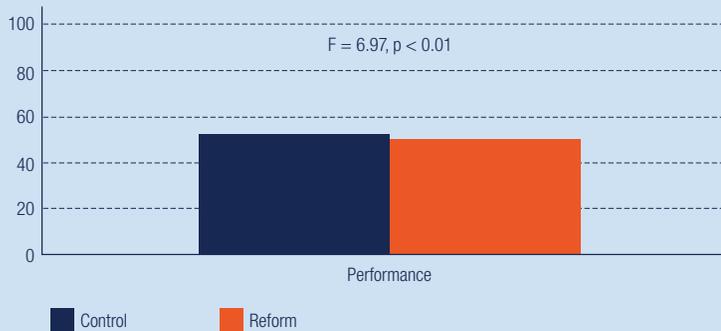
³ The success rate for 7 of the 25 questions in our test were compared to those observed in Québec by PISA in 2003 or 2006. The success rates for our sample were in the same range as those reported by PISA.

⁴ Ministère de l'Éducation, du Loisir et du Sport (2010). *La performance des jeunes en lecture, en mathématique et en sciences*. Programme international pour le suivi des acquis (PISA) 2009. Québec: Gouvernement du Québec.

⁵ The proportions observed among the general population for a given group and option were divided by the proportions observed in the ERES sample. The weighting criteria was based on the group and option.

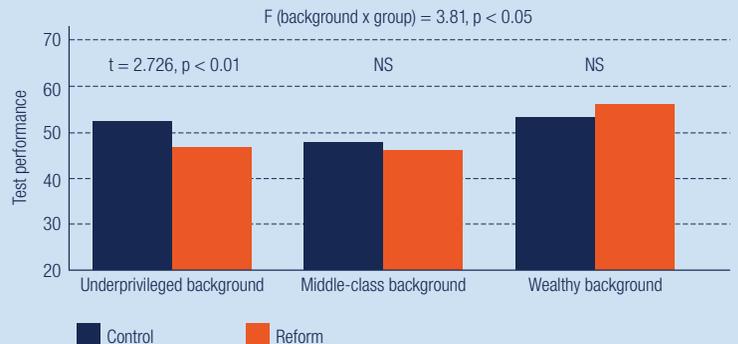


Figure 1:
MATH TEST SCORES FOR BOTH GROUPS



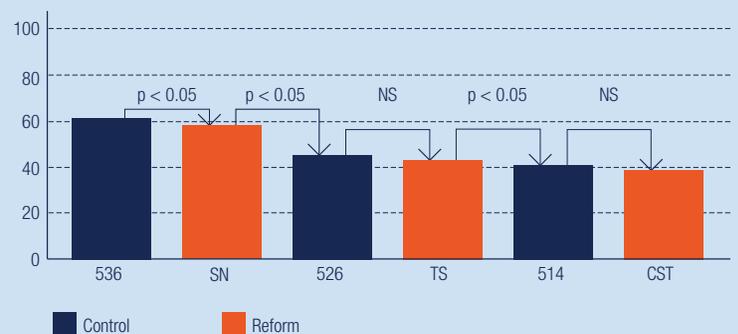
We then checked if the differences between the groups were caused by variations in five school and system characteristics: the poverty index (SEEI ranking⁶), the administrative region, the school system (public or private), the language of instruction (English or French) and the math course taken in Secondary V. The differences are neither associated with the school system nor with the language of instruction. However, they are statistically associated with the poverty index, the school's administrative region and the math course taken by the student. As shown in Figure 2, the difference between the two groups can mainly be seen in schools from underprivileged areas (SEEI ranking greater than 7). The difference in test performances ranges from 1.5 points (for all students) to 3.45 points (for students from poor backgrounds) at those schools. However, there are no significant differences compared to groups of students from middle-class (rankings from 4 to 7) or wealthy backgrounds (ranking lower than 4). The groups' scores also differed from one administrative region to the next⁷ ($F = 3.81$, $p < 0.0001$). The biggest significant differences were found in the following regions: the Outaouais (10.8 points difference), the Bas-Saint-Laurent (7.47 points difference) and the Laurentides (5.86 points difference). All of these differences were in favour of students in the control group.

Figure 2:
OVERALL TEST PERFORMANCE ACCORDING TO GROUPS AND SEEI RANKING



Lastly, differences in math test scores were seen depending on the math course taken in Secondary V. Students registered in pre-ER Mathematics 536 scored higher than ER students registered in SN (3.6 points difference), TS (14.2 points difference) or CST (20.7 points difference) courses. These results are shown in Figure 3, from which it is also seen that Secondary V students in the TS option scored lower than those in the SN option. The difference between the TS and SN groups was 10.6 points.

Figure 3:
TEST RESULTS ACCORDING TO GROUPS AND THE MATH COURSE TAKEN



Conclusion

Data from the ERES Project suggest that changes made to the high school math program have enabled students with a wider variety of profiles to access higher-level math options (TS and SN). Greater accessibility means greater heterogeneity in the math profiles of students pursuing their post-secondary studies in science and technology. However, in general, ER students were less successful than pre-ER students at the test administered as part of the ERES Project. The difference between these groups was larger in underprivileged-area schools and in certain Québec regions such as the Outaouais, the Bas-Saint-Laurent and the Laurentides. Test scores also varied according to the math course taken. Students registered in 536 had better scores than students registered in SN, who in turn had better scores than students registered in TS. This probably reflects the increased heterogeneity of math profiles. The continued work of the ERES Project will show whether these differences will again be seen in another group of students—those who started their high school studies in September 2007 and to whom the same test was administered in the 2011–2012 school year. The project will also involve a comparative analysis of Secondary V French standardized test results, in order to assess whether ER has affected students' performance in French.

⁶ The SEEI (index of socioeconomic status) is made up of the proportion of families with children whose mothers do not have a degree, certificate or diploma (which represents two thirds of the index's weighting) and the proportion of households in which the parents were unemployed during the census reference week (which represents a third of the index's weighting). <http://www.mels.gouv.qc.ca/sections/publications/index.asp?page=fiche&id=956>

⁷ Of the seventeen administrative regions, the ones examined were those in which the number of participating students was more than 3% of the group's total number. The following regions are therefore absent from the comparative analyses presented: Abitibi-Témiscamingue, Estrie, Côte-Nord, Nord-du-Québec, Chaudière-Appalaches, Laval and Centre-du-Québec.