Has Ontario taught its high-school students not to think?

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Elementary and high schools spend so much time on the content-laden curriculum that students are unprepared for the analytic and conceptual thinking they'll need at university

Has Ontario's educational system taught a decade of students not to think? There is growing evidence that the combination of standardized testing with a content-intensive curriculum that's too advanced – both introduced by the Conservative government between 1997 and 1999 – has done exactly that.

A dramatic indication that there could be a serious problem was the performance of my introductory physics class on their November test last year. It was identical to one given in 1996, but the class average over this 10-year period had plummeted from 66 to 50 percent. There is about a five-percent fluctuation in this test grade from year to year due to variation in student ability and the difficulty of the questions but, when I looked at the class average over the many times I have taught the course since 1981, I found that four of the five lowest grades have occurred in the last four years, with the lowest this year. When I enquired elsewhere at Trent University, I found the same pattern in the mathematics department, where the first test in linear algebra was down some 15 percent from its historic mean, and the calculus average had dropped nine percent from the year before.

But this is not just a Trent phenomenon. Brock University has seen a significant increase in the failure rate for students in first-year physics with similar results in mathematics. Both Brock and Trent are considering remedial teaching this school year. The University of Guelph, where reliable data is also available, experienced a similar drop in performance in the first-year physics course. There is general dissatisfaction about student preparation from physics instructors at other Ontario universities although it is difficult to get reliable numerical data as course structure and instructors change relatively frequently, and final grades are often bell-curved to maintain an acceptable distribution.

In contrast, there is no evidence of the same rapid decline in other provinces, according to the four other physics departments I've contacted in the Atlantic provinces and British Columbia. This appears to be a made-in-Ontario phenomenon.

Professor James Côté and co-author, Anton Allahar, in their recent book *Ivory Tower Blues: A University System in Crisis* (see a review in this issue), blame a general student disengagement with learning as source of the problem. However, most of the students I see are not so much disengaged as poorly trained for university expectations. Students' ability to do analysis and synthesis seems to have been replaced by rote memorization and regurgitation in both the sciences and the humanities. This is a complaint that I hear from instructors in senior high-school classes through to professors in the humanities. Trent philosophy professor, Bernie Hodgson, tells me that his students want "philosophy paint-by-numbers" – a memorized, fill-in-the-blanks approach to passing tests and writing assignments — and this is exactly what I and many of my colleagues are seeing in science and mathematics disciplines. While we still get some students with excellent analytical ability, there has been a serious decline on average. In mathematics and physics, it means that students do not really understand what they are doing even when they have covered the material in high school. This problem is reflected in the learning approach of most students, which has changed along with their test performance. All term, students were asking me when I was going to teach them what they need to know for the exam, as though physics has only a fixed number of facts or kinds of problems that need to be memorized and fed back to the instructor.

However, memorization/regurgitation is not an approach that works in physics or in other analytical fields such as philosophy, English, mathematics or the visual arts, where the main emphasis is on constructing one's own knowledge and approaches. There is always a certain amount of material that must be memorized, but knowledge of facts makes up only a small component of one's learning. More important is the ability to relate these facts in new ways, to see them in a new light, and to bring quite disparate ideas together to solve new problems or create new forms of art. This ability to analyze and synthesize is what makes good scientists, writers, philosophers and artists. It is the ability needed to drive a knowledge-based economy.

The dependence on memorization also affects work habits, with a third of students in some university classes not handing in assignments or failing to pick up graded work to find out where they've gone wrong. Why should they, if they believe the way to better grades is to memorize more material rather than understand? The resulting high failure/drop-out rate in the first two years of university has enormous cost to society, although the students who do persevere and graduate clearly have or develop the requisite skills.

What could have caused this dramatic shift in the approach of our students? I do not believe the problem is with the teachers, who are generally well trained and dedicated. The main possible explanations seem to be the following:

1. In 1997, the Ontario government introduced a new, content-intensive curriculum for grades K to 8 in mathematics and language, followed in 1998 by the science and technology curriculum. The design of this curriculum was top-down, unlike earlier curricula that had been designed by local teachers and their school boards under general guidelines from the Ministry of Education. Much of the new curriculum in the junior grades is considered by many experienced teachers to be beyond the mental development of students at that level. This encourages blind memorization rather than understanding. Moreover, the new curriculum significantly reduces time spent on the visual arts, and was so content-heavy that it greatly limited the amount of time available for developing analytical and conceptual-understanding skills from kindergarten on, even though the development of these skills was a stated goal of the curriculum. Students first exposed to the science curriculum in Grade 5 are now starting second year of university. Two high-school English teachers recently told me that this curriculum is the main cause for the loss of analytical ability. This problem was aggravated by the retirement, shortly after 1997, of many established teachers who understood the importance of developing analytical skills but had become disenchanted with the state of education. Then in 1999, a new four-year curriculum was imposed on high schools, starting with Grade 9 and advancing one year at a time to the 4U (4th-year, University-preparation) courses in Grade 12. As a result, 2003 saw the graduation of the "double cohort" of the 4U students and the last of the OAC five-year students.

2. In 1997, the Ontario government also introduced standardized province-wide testing in math and reading/writing in Grades 3 and 6, with a math test in Grade 9. I am told that much of the teaching at the elementary level is now directed to passing those tests, as schools are rated publicly on the results. Students must also pass a standardized literacy test to graduate from high school. This emphasis on passing standardized tests which cover too much material at too advanced a level increases the dependence on rote memorization and takes time away from the development of conceptual understanding and analytical skills.

3. With the elimination of the Ontario Academic Credit (OAC) high-school year (Grade 13) in 2003, our students entering university are a year younger. The teenage brain is still developing its "executive functions" during this time, so students enter university with a year's less ability to analyze and plan ahead.

4. Are we just admitting poorer students to university? The average entrance grade of students from high school has not declined over the last few years, but grade inflation is clearly present: the percentage of academic-stream Ontario Scholars, those graduating students with averages over 80 percent, has risen from about five percent of the graduating class in the early 1960s to almost 50 percent now.

5. The trend among young people to move away from reading and towards video and video games, means they spend less time developing reading/writing/analytical skills.

6. Young people's general belief that the web is the source of all knowledge puts a greater emphasis on memorizing facts and much less on the ability to develop one's personal ability to think. They do not appreciate that, even as students, they will be expected to develop new knowledge, not just regurgitate existing facts.

Of these explanations, the last three should have caused a gradual decline over the last 10 years, rather than a fairly abrupt change over the last five years; so, while contributors, these are not likely the main culprits. That our students are a year younger is not likely the main cause of the problem, as there was no obvious difference between the OAC and the 4U students in 2003-04 when they arrived at university together. Moreover, the younger age would have caused an abrupt shift in student performance in years 2003-05 which should have been constant after this, whereas the decrease in performance has been most apparent in 2006-07.

This leaves the first two options as the main causes of the decline in student performance. My personal belief is that it is the content-heavy curriculum that is the main culprit. When I speak to primary and secondary teachers with experience from before 1997, this is the outstanding complaint that they have with the educational system. A retired Grade 1 teacher whom I respect greatly for her expertise in teaching at this level tells me that they used to spend part of two weeks developing the idea of “fiveness” in her students. How many different ways can you make up five, using different objects as well as cuisenaire rods (coloured rods that come in varying lengths, such as 1, 2, or 3 cm). Which of several groupings is less than or greater than five? And so on. When they were done, students understood the number five at a broad conceptual level, and they carried this understanding to other numbers. She says there is now little time for such activities if a student is to be ready to pass the standard tests which are tied to the new curriculum; all a student has to do is memorize that 2+2+1=5.

This view of the curriculum is not restricted to teachers at the K-12 level. A review panel of university physics professors has just recommended that some 30 percent of the Ontario high-school physics curriculum be removed to allow more time for the development of conceptual understanding and analytical skills. Moreover, the review teams for all of physics, chemistry, biology and earth sciences agreed that: “a) The existing curriculum is too ambitious and focuses on breadth instead of depth; b) Some topics are clearly too advanced for grade 11/12 students and should be dropped; c) There is a yawning gap between the ambition of the curriculum and the reality of students entering University. Students continue to demonstrate serious deficiencies in problem solving skills, basic math skills, and hands-on laboratory skills when they arrive at the university level.”

These potential problems with the curriculum were, of course, pointed out years ago. For example, in 2000 Margaret McNay, at Western’s Faculty of Education, wrote an article on the new curriculum in the Journal of Curriculum Studies in which she said, “Grade 1 students can learn to parrot ‘right’ answers, and grade 7 students to memorize incomprehensible definitions, but no educational advantage is gained when the conceptual demands of what is taught are beyond the comprehension of the students.”

The question arises as to why we are only now becoming aware of this problem at universities, 10 years after the new curriculum was introduced. One would not expect that the shift in a student’s mode of learning, from one based on understanding to one based on memorization, would occur instantly, and many teachers continued to teach the way they always had, regardless of the new curriculum. However, a student first exposed to the new science curriculum in Grade 5 in 1998 is now entering second year of university. I believe that the rapid decline in performance over the last five years has its roots in the teaching at the elementary level; a university student’s ability to think decreases with the length of time they were exposed to the new curriculum.

I recently reviewed the drop-out rate from my introductory physics class that I have taught quite regularly from the 1980s. Over this time, the drop-out rate has increased gradually from eight percent in the early 1980s to more than 20 percent now, with one glaring exception. In the Ontario double-cohort year of 2003-04 and the next year, (which included about 25 percent of the four-year students who stayed in high school for an optional fifth year), the drop-out rate plummeted to eight and 10 percent, even though the class performance was not exceptional. Similar results were seen at Brock and Guelph universities. The best explanation is that these students were told that they would have to work very hard to gain one of the limited places at university. The work and study habits they developed then carried into university, and helped them through their first year. The lesson is that at least some student problems can be reversed very rapidly if the incentive is large enough.

The indications are strong that we have taught students to memorize and not to think. If we do have such a problem, we must move quickly to determine its magnitude, and deal with its causes. A new Ontario curriculum was introduced for K-8 in Mathematics and English in 2005 and 2006, respectively, and a new high-school science curriculum is currently under review as mentioned above. Let’s hope that local teachers and school boards are bringing their expertise to the development of this new curriculum, and will be involved in its monitoring and evaluation. There may be 10 years of students who have been taught not to think, and reversing that effect will be not be easy without a determined effort.

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Read about how in 2010, there is a big drop in math skills of entering students.