

**Cartography and Geomatics
In the High School Curriculum**

DRAFT, August 8, 2002

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Introduction

This article addresses the changing place of cartography and geomatics in the elementary and secondary schools with particular reference to the new curriculum in Ontario. Although the school curriculum and its reform are of concern to professional geographers and cartographers these topics have not received much attention. It is important for several reasons.

- Most students do not elect to major in geography or cartography at the postsecondary level, so that geographic and cartographic literacy are largely a function of what is taught in the elementary and secondary schools.
- Continuing student interest in postsecondary programs in geography and cartography, and thus the long-term viability of those programs, will be affected by the exposure of students to these subjects in the elementary and secondary schools.
- Expectations of postsecondary instructors concerning the geographic and cartographic knowledge and skills of incoming students will be informed by an understanding of the curriculum in the elementary and secondary schools.

Curriculum reform in the elementary and secondary schools was the subject of a lively and well-attended round table discussion at the annual meetings of the Canadian Cartographic Association (CCA) held at Wilfrid Laurier University in May 2002. A panel of six university and secondary school instructors discussed a range of topics surrounding the status of cartography and geomatics in the high schools.¹ Questions included:

- What is the current status of geomatics and cartographic education in terms of changes in curriculum and trends of student interest?

¹Members of the round table:

Garth Chalmers, Geography Teacher, University of Toronto Schools, Ontario Institute for Studies in Education
Dan Koegler, Geography Teacher, Waterloo Collegiate Institute, Waterloo

Mark Lowry, Geotechnology Consultant for the Toronto District School Board, Regional Councillor for
Metropolitan Toronto, Ontario Association Of Geographic and Environmental Education

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- What geomatics and cartographic knowledge and skills are expected by provincial curriculum standards?
- What can university instructors assume about the cartographic knowledge and skill set of high school graduates? What background do university programs recommend?
- What are the benefits to stronger vertical integration among universities and high schools? How can these ties be strengthened?

The questions were addressed largely from the perspective of the Ontario curriculum, reflecting the context and experience of the panelists. Although members of the audience also highlighted developments from their own provincial jurisdictions, it was clear that further discussion and knowledge of reforms in each province would be useful.

This article summarizes some of the major concerns raised during the round table discussion. First, it highlights the place of cartography and geomatics in the new Ontario curriculum, and then outlines a number of issues in the implementation of that curriculum. The conclusion identifies ideas that would benefit from further discussion and research.

Cartography and Geomatics in the new Ontario curriculum

Curriculum reform in geography has been progressing steadily, albeit unevenly, through the United Kingdom, USA, and Canada. Within Canada, there already have been fundamental changes made to the curriculum in Alberta, Ontario, and Nova Scotia. Ontario's new curriculum is worth examining in more detail as it provides a model within which geography, cartography and geomatics have significant roles.

Elementary School Curriculum

In Ontario geography and cartography are presented under the more general rubric of social studies in Grades 1 through 6. At this level the focus on social studies is on Heritage and Citizenship, and Canada and World Connections. In Grades 7 and 8 students are required to take specific courses in both History and Geography. Geography in Grade 7 focuses on 'The Themes of Geographic Inquiry, Patterns in Physical Geography, Natural Resources'. In Grade 8 the focus shifts to 'Patterns in Human Geography, Economic Systems, Migration'.

Throughout the Grades 1 to 8 curriculum students are assessed in four strands of expected knowledge and skills:

- Understanding of concepts
- Inquiry/research skills and map and globe skills

- Communication of required knowledge
- Application of concepts and skills

It is encouraging to note that one strand of expectations is dedicated specifically to ‘Inquiry/research skills and map and globe skills’. Each of the expectations within the elementary curriculum relating to cartography are listed in Table 1. These expectations are cumulative, which is to say that they are first introduced at the specified grade level and then reinforced in subsequent grades. The concept of scale is introduced as early as Grade 1, and most mapping expectations are in Grades 2 and 4.

Secondary School Curriculum

In Grades 9 to 12 of the new Ontario curriculum, geography is included through an integrated program of study called Canadian and World Studies which encompasses five subjects: economics, geography, history, law, and politics. This program builds on two compulsory courses: Grade 9 Geography of Canada, and Grade 10 Canadian History the Twentieth Century, (as well as a half-credit course in Civics). Following this are nine geography electives available to students: 4 courses in Grade 11 and 5 courses in Grade 12.

Within the Canadian and World Studies program the content relating to cartography and geomatics is included in two different ways:

- There are five strands of learning expectations in the Canadian World Studies program that are common to geography courses in Grades 9 through 12. One of these strands is Methods of Geographic Inquiry in which students are expected to become familiar with a broad range of new and traditional techniques and approaches including mapping, air-photo interpretation, remote sensing, image analysis, GPS, and GIS.
- There are two courses that specifically focus on geomatics and cartography: Grade 11 Geographics: The Geographer’s Toolkit; and Grade 12 Geomatics: Geotechnologies in Action. The richness of the overall learning expectations of these courses is exemplified by the list for the Grade 12 course, as shown on Table 2². Both these courses have even more specific expectations which directly relate to map understanding, skill development, and application. Readers interested in this level of detail should consult the course profiles at <http://www.curriculum.org/occ/profiles/12/12canwldp.htm> (July, 2002)

Overall, the curriculum has two senior courses and a general learning expectation dedicated to mapping and geotechnology knowledge and skills. High school graduates taking these courses will have taken a grade twelve course whose expectations are similar to those of a 2nd or 3rd year

² Current offerings of the Geographics and Geomatics courses consist primarily of GIS with very few schools incorporating any remote sensing or spatial analysis.

university course. Clearly the new Ontario curriculum is rich in geographic expectations and both cartography and geomatics figure prominently among those expectations. The consensus of both the discussants and the panel was that geography, even though pinched for funding and resources, has a curriculum which is rich, vibrant, and engaging. As all members of the round table noted, however, there are critical issues concerning the capacity of the schools to offer and successfully deliver this curriculum.

Issues Relating to Cartography and Geomatics in the new Ontario curriculum

Panel members identified a variety of issues and concerns facing both high school and university-level educators. These issues can be grouped into those that deal primarily with high schools and those that pertain to the university level.

High School

Although it is premature to fully assess the implementation of the new curriculum, the limited enrollment data available so far suggests a declining student demand for secondary school geography courses. Aside from the Grade 9 course, which is compulsory, overall enrolment in grade 11 and 12 geography is down for 2002-2003. The total number of geography course sections is down, and only a few schools are able to offer both the Grade 11 Geographics and Grade 12 Geomatics courses.

Several reasons have been suggested for this decline. As of 2002-2003, the existing 5-year 'OAC' program of study is being replaced by a 4-year program. As a result of this change students have fewer options for taking electives such as geography. With less opportunity for electives, students focus their attention on English, maths, and sciences as the critical prerequisites for admission to university. Furthermore, teachers have suggested that students are potentially losing interest in geography between Grades 9 and 11, as only history is required in Grade 10. The concern is that fewer students will want geography courses. This concern is compounded if students have an unsatisfactory Grade 9 geography experience due to poor textbooks, limited resources, uninspiring teachers, excessive class sizes, and the lack of fieldtrips.

The decline in interest in geography may be a temporary problem associated with the transition to the new curriculum. Nevertheless there is a serious and longer term consideration that schools lack the resources necessary to offer the curriculum. At the senior high school levels (Grades 11 and 12) geography must compete for resources with math, science, and English, along with other elective programs. Few resources are available to support the professional development of teachers. Insufficient resources and the lack of teachers with necessary skills combine to restrict the number of schools offering the Grade 12 Geomatics course.

The panel members who represented the high schools presented a very divergent picture of the present situation of resources within the province. Many schools are properly equipped to

launch a strong geomatics based program or course but others are struggling to simply gain access to computers. This divide is likely to persist over time.

Panelists also noted concerns with the depth and quality of education that students receive in the geomatics courses. Although the introduction of geomatics into the high school curriculum is seen as a major force of change in reviving the subject, there is a risk that students will focus on the technology and the execution of the software but gain little in their ability to extract information from the data. This is a familiar issue - that training in the use of the technology can take precedence over a broader understanding of geographical thinking, cartographic literacy, and spatial analysis.

University

Teachers have made the point that more high school students would take senior geography courses if geography were among the entrance requirements to university. At present, the sole course requirement to enter a geography undergraduate program in Ontario is English. Interestingly, the only university program in Canada to have geography as an entrance requirement is the midwifery program at Ryerson Polytechnical University (a program which requires students to have fairly diverse backgrounds). Students are less inclined to take geography in high school because courses such as math, science and English are the key entrance requirements to many programs. Students applying to geography programs may be lacking a strong fundamental understanding of the discipline.

Curriculum reform in the elementary and secondary schools poses several challenges to university professors teaching geomatics courses. Will undergraduate courses in geomatics be sufficiently challenging to high school students who have taken a grade twelve course which has expectations similar to those of a 2nd or 3rd year university course? As some panel members have suggested, given the emphasis on software training in the schools, there is an opportunity at the university level to emphasize spatial analytical skills as well as the underlying theory behind GIS.

Given the disparity in resources currently facing high schools in Ontario, students will be entering university with widely varying skills and knowledge. The disparity of skill sets in the classroom creates another familiar teaching challenge of providing sufficient instruction to the novice while offering more advanced content to those with much stronger geomatics backgrounds.

Conclusion

The changing place of geography and cartography in the elementary and secondary school curriculum warrants the attention of professional geographers and cartographers. Through curriculum reform and especially through the emphasis on geomatics, there is a great opportunity

to enrich the discipline and attract new students. However, there is also concern that curriculum reform may marginalize geography and cartography relative to other subjects.

The CCA can help foster geographic and cartographic literacy at all levels of education. It might consider how to foster the vertical integration of the curriculum from K-12 to postsecondary education. One opportunity for universities is the provision of ongoing professional development for teachers through specialist programs, summer institutes, and occasional workshops. As well, fostering the expansion of the provincial and national competitions in GIS at the Skills Canada Competition is another opportunity (<http://www.skillscanada.com>, July, 2002).

The CCA can also promote appropriate forums for on-going discussion of this topic. These might include agenda items for future meetings of the CCA and/or further feature articles in *Cartouche* and elsewhere. It is appropriate for the CCA, as a national association, to develop a perspective that transcends the various provincial education jurisdictions across Canada. As a start it would be helpful for geographers and cartographers from each province to report on the current status of the curriculum and its reform from their various perspectives.

**Table 1: Expectations Relating to Cartography:
“Developing Map and Globe Skills” through Grade Levels 1 - 8**

Grade	Expectation
1	make and read simple models and maps of familiar areas in their local community
1	use non-standard units to measure distance
1	demonstrate an understanding of scale, that is, give reasons for using small objects to represent large ones on map
2	use symbols, colour, and cardinal directions on maps of Canada and other countries
2	identify the earth as a sphere and half the earth as a hemisphere
2	demonstrate an understanding that the globe is a model of the earth
2	identify the equator and polar regions on a map and/or globe
2	use legends and recognize pictorial symbols
2	use cardinal directions
2	locate their local community, Toronto, and various countries
3	make and use large maps of rural and urban communities, using familiar units of measure
3	locate and label provinces and capital cities
3	consult map legends
3	recognize that different colours indicate different things
4	locate and label provinces and capital cities, Ottawa, major water bodies, physical regions
4	identify symbols
4	use cardinal and intermediate directions, non-pictorial symbols, and colour to locate and describe physical regions
4	use number and letter grids to locate places on base maps and road maps, and in atlases
4	use pictorial symbols to represent natural resources
4	use latitude and longitude to describe location
4	use special purpose maps
4	create sketch maps of familiar places, using symbols for places and routes
6	create sketch maps to show relative positions of places
6	use shading/colouring to indicate variations in characteristics
6	use time zones to identify time differences
7	map locations
7	make and interpret climate graphs
7	draw cross-sectional diagrams
7	identify patterns in physical geography, and natural resources using thematic maps
8	use a variety of maps
8	identify patterns in economics, and migration using thematic maps

Source: The Ontario Ministry of Education and Training, 1998. The Ontario Curriculum Social Studies, Grades 1 to 6 and History and Geography, Grades 7 and 8. Queen’s Printer for Ontario, 1998.

<http://www.edu.gov.on.ca/eng/document/curricul/social/social.html> (July, 2002)

**Table 2: Overall Expectations Relating to Cartography and Geomatics
in the Grade 12 Geomatics: Geotechnologies in Action**

Geographic Foundations: Space and Systems

- explain how the earth is modelled for scientific and mapping purposes
- demonstrate an understanding of basic spatial concepts
- explain the process of map projection and the properties and uses of selected projections
- explain the use of geotechnologies in studying physical and human systems
- use geotechnologies effectively to display and analyse patterns and regions on the earth's surface

Human-Environment Interactions

- explain the use of geotechnologies in studying human-environment interactions
- evaluate the effectiveness of geotechnologies in identifying environmental problems and finding solutions

Global Connections

- explain the use of geotechnologies in addressing matters of global concern
- explain the role of geotechnologies in understanding people and places around the world
- analyze how perceptions of places, situations, and events are affected by maps
- explain the role of geotechnologies in facilitating interaction, cooperation, and communication between peoples

Understanding and Managing Change

- explain the use of geotechnologies in monitoring change in dynamic systems
- explain the use of geotechnologies in modelling and predicting future change
- identify key stages in the evolution of geomatics

Methods of Geographic Inquiry

- select and apply geographic skills, methods, and technologies to gather, analyse, and synthesize ideas and information
- use a variety of methods and technologies to communicate the results of geographic inquiry and analysis effectively
- evaluate sources of spatial and other data

Source: The Ontario Ministry of Education and Training, 2002. Canadian and World Studies, Course Profile, Geomatics: Geotechnologies in Action, Grade 12, University/College Preparation. Queen's Printer for Ontario, 2002.
<http://www.curriculum.org/occ/profiles/12/12canwldp.htm> (July, 2002)