

University of Guelph

Learning Commons

Numeracy and Quantitative Reasoning Support Initiative

Response to Numeracy Needs

With the endorsement of the Learning Commons Steering Committee and VPAC, a collaborative project involving the Learning Commons, the Dept. of Mathematics and Statistics, Data Resource Centre (DRC) and Teaching Support Services (TSS) has begun to explore how we can enhance numeracy support offered by each of our departments. A small committee comprised of the following individuals was formed in 2005 to plan and develop numeracy programs and services:

Aldo Caputo, Teaching Support Services
Joe Cunsolo, Mathematics and Statistics
Michelle Edwards, DRC/Computing and Communications Services
Steve Gismondi, Mathematics and Statistics
Janet Kaufman, Learning Commons/Library
Nancy Schmidt, Learning Commons/Student Affairs
Bo Wandschneider, Computing and Communications Services

To date the committee has:

- discussed what we understand numeracy and related concepts to be. The following articulate some of the concepts and the differences among them:

Numeracy is not the same as mathematics. It is an aggregation of skills, knowledge, beliefs, dispositions, habits of mind, communication capabilities, and problem solving skills that people need in order to engage effectively and autonomously in quantitative situations arising in life and work.

-- Iddo Gal, cognitive scientist

Quantitative reasoning as an interpretive activity that takes place within a deductively structured framework. It involves a tapestry of meaning provided by a warp of abstract patterns and a weft of context and story line. In quantitative reasoning, context provides meaning.

-- George Cobb, statistician

Quantitative literacy involves understanding the mathematical concepts and skills that are necessary for everyday life. It includes computation, interpretation, inquiry, and application of mathematical concepts that are critical for life in the contemporary world.

-- Glenda Price, college provost

<http://www-math.cudenver.edu/~wbriggs/qr/whatisit.html>)

- considered a model developed by Joe Cunsolo and agreed that it could use the model to guide the development of programs and services.

- discussed the need to consult faculty and students further about their needs, and possibly to draw others into the committee.
- reviewed University of Guelph statements regarding numeracy
- developed a project proposal for submission to the Learning Enhancement Fund

Numeracy Skills of Students

Broad, integrated support for students taking courses which require basic skills in mathematics and statistics are not generally available in the way that learning, writing, research and information technology support is. The Mathematics and Statistics Department operates a Learning Centre located on the third floor of the Library where tutors provide help, on a drop-in basis, with course-work problems for seventeen 1000 and 2000 level courses in mathematics and statistics. Senior undergraduate and graduate mathematics and statistics students are recruited, selected, trained and supervised by the Mathematics and Statistics Department. The need for numeracy skills extends beyond courses in mathematics and statistics, into the social sciences, business and sciences, but we are not aware of any formal support similar to what is offered by the Mathematics and Statistics Dept. in its Learning Centre. Students in social science and business programs may have taken a limited number of mathematics courses at the senior high school level, and some refer to themselves as “mathphobic”. Anecdotal evidence indicates that many students not registered in courses offered by Mathematics and Statistics Students seek support from the Mathematics and Statistics Learning Centre.

For several years the large calculus course for biologists (MATH 1080) has not allowed the use of calculators on any quiz, term test, or final exam. Recently, the MATH 1000 calculus course followed suit. Elimination of the use of calculators revealed the students’ underlying “rustiness” with basic algebraic and arithmetic skills that any numerate citizen should have at their fingertips. We are also aware that some standardized tests e.g. MCAT, do not permit the use of calculators therefore requiring test-takers to have some basic numeracy skills.

Numeracy Mandate

At present the Mathematics and Statistics Department and the Learning Commons are the only departments that have taken on the responsibility of supporting numeracy in the broader university community. The Department of Mathematics and Statistics has acknowledged its role in its mission statement:

“A principal Departmental mission is to maintain excellence in one of the largest and most central service teaching roles in the University... [The] Department assumes primary responsibility for achieving the University Learning Objective of “numeracy”.

The Learning Commons also refers to numeracy in its mission statement:

“The mission of the Learning Commons is to support and enhance student learning, writing, research, numeracy, and use of technology at the University of Guelph. Through collaborative partnerships, it provides expertise, services and resources to support the University’s strategic goal of being a learner-centred and research-intensive institution.”

In pursuit of its mission the Learning Commons:

- Responds to diverse learner needs by offering services in multiple formats including individual and group assistance, workshops, in-class presentations, facilitated study groups, and help desks.
- Enhances students' access to information and learning opportunities through the development of a range of print and web-based resources
- Collaborates with faculty, TAs, and staff to enhance student learning and improve academic performance

Consequently, the Mathematics and Statistics Department and the Learning Commons are partnering to take a more systemic approach to enhance numeracy support across campus.

Commitment to Numeracy

In 1987, the University of Guelph Senate approved the University of Guelph Learning Objectives which arose from the Aims and Objectives Report. They are a set of objectives described in terms of the desired characteristics of educated graduates, and are used in part to guide the development of courses and programs. The Learning Objectives describe numeracy as:

“...the ability to use mathematics at a level and in a manner appropriate to good citizenship and to vocational fitness. Mathematics deals with quantity and form, with measurement, structures, and relations, and encompasses a richer intellectual domain than just the utilitarian skills of numerical computation. It is as a mode of thinking, no less than as a collection of useful techniques, that it justifies its place in any well-rounded curriculum.

Numeracy, in the sense adopted here, is an essential attribute of the informed and responsible citizen. A correct understanding of the proper use of numbers is necessary in a culture in which information routinely comes in numeric form and significant decisions of social policy often have quantification at their base. Without the ability to comprehend the use of quantitative data, and to detect instances of misuse, we may have to forego opportunities for independent judgment.

Numeracy, more generally, enforces an accuracy and precision of procedure and thought that is valuable to all educated persons. As a mode of conceptualization of thought, it should be part of the mental apparatus of all graduating students. While a grasp of the nature and principles of mathematical forms of inquiry is essential to an understanding of scientific thought, it can be of benefit in other areas of intellectual activity. Opportunities for fostering numeracy exist in more disciplines than those traditionally requiring a substantial knowledge of mathematics. A recognition that numeracy, in association with literacy, forms the foundation of most if not all of the other learning objectives, should result in greater exploitation of those opportunities than in their avoidance.”

There are numerous courses in a variety of programs that require numeracy skills. Faculty teaching these courses expect students to have basic mathematical and statistical skills. The Student Affairs Integrated Plan 2006-2010 states that:

“The change from a five-year to a four-year high school curriculum has had an impact on students’ emotional maturity and academic experience level at entry, both of which influence self-awareness and learning effectiveness. Faculty have noted recent deficits in both skill and content knowledge, particularly in mathematics. These issues have resulted in an increased demand for learning, writing and numeracy support.” (p. 3)

OVC identifies advanced level numeracy as a general competency expected of its graduates in DVM 2000. They state that graduates will be able to:

- Understand the value and principles of describing situations in numeric terms.
- Assimilate and comprehend numeric data and use appropriate tools to manage such information.
- Use skills of numeracy to check validity of information.
- Use numeric interpretation of data to make connections and develop new principles and thoughts.
- Integrate literacy and numeracy.

<http://www.ovc.uoguelph.ca/services/college/dvm/dvm2000/General.html>

Several Integrated Planning documents developed in the past year, refer to numeracy:

- The Student Affairs Integrated Plan 2006-2010 advocates that the University “expand opportunities, resources, and services for students to improve their numeracy, learning and writing skills.” (p. 9)
- The Library’s Integrated Plan 2006-2010 calls for the development of “Learning Commons programs which support research-based and technology assisted learning, numeracy and writing intensive courses, and increased learning and writing support for graduate students and first year seminars.” (p. 4) It also expresses support for the “integration and development of Data Resource Centre services (geospatial, numerical and statistical data services in support of teaching, learning and research) and [integration of] numeracy and information literacy programs with the Learning Commons.” (p10)
- The CCS Integrated Plan 2006-2010 states that CCS will: “Design and participate in new programs designed to increase numeracy through workshops and partnering directly with faculty.” (p.14) and “[c]ontinue in the successful Learning Commons partnership, including the expansion of services in support of graduate students and enhancing numeracy and literacy in the area of IT. This is closely linked to our initiatives in managing customer relationships and will directly relate to initiatives outlined in the white paper on undergraduate education.” (p.13-14)

The Lighting of a Fire: Re-imagining the Undergraduate Learning Experience, the Provost's White Paper "states that numeracy and the ability to communicate are essential to intellectual development, and lack of those skills hampers efforts in all directions." (p. 20) It goes on to recommend that courses which meet "centrally developed and accepted ... criteria", be designated as writing-intensive, research-intensive, eventually including courses that emphasize numeracy. (p. 28)

In addition to designating courses the report includes the following recommendation:

"Expand the university's support systems for students working to improve their **numeracy** and writing skills in the Learning Commons." (p. 30)

Numeracy in Practice

We have identified a number of ways that the development of numeracy skills is being addressed across campus by departments and colleges. They include the following:

1. Mathematics and Statistics professors, Joe Cunsolo and Steve Gismondi have been comparing students in MATH 1080 and 1200 to gauge the change, if any, in basic numeracy skills with the removal of the calculators in 1080, while continuing to allow them in 1200.
2. *Dive into Numeracy*: OAC, implemented a redesigned curriculum in 1995 based on the University of Guelph's 10 Learning Objectives, in particular "Literacy" and "Numeracy". To further support their Numeracy Objective, they sponsored the production of a manual by Joe Cunsolo entitled the *The Numeracy Reference Companion*. This manual has been distributed to incoming OAC students to be used as a numeracy reference throughout their university career. As further support, a numeracy component was introduced in the AGR 1150 course.
3. *Go4it now*: Steve Gismondi developed a web-based self-test module (multiple choice test, examples and related reinforcement review materials), based upon prerequisite mathematics for the three entry level calculus courses. The intent is to present beginning students with multiple choice questions that will help them to self-evaluate and assess their level of preparedness. Reference materials then provide resources to improve their level of preparedness. This module is available to all students, accessed from the Mathematics and Statistics Learning Centre WebSite.
4. *Survivor Math*: In winter semester 2006, a group of students in REXT*3100 developed *Survivor Math* a game-like activity designed as a "quick and fun review" of basic mathematical operations. They were motivated to develop the program based on their own experiences and observations that "many students struggle with basic math concepts such as decimals, fractions, exponents and algebra." Over the summer, one of the students worked with Joe Cunsolo and Steve Gismondi making slight improvements to the program and revising some related materials for implementation of *Survivor Math* during Academic Orientation 2006. Mary Wilson of the Learning Commons and four MATH*1080 Supported Learning Groups Peer Helpers assisted with delivery of the program.

5. Staff from the Data Resource Centre/CCS offer workshops that examine the use of data in a newspaper article and a public policy report. The focus is on how to interpret the results and reviews the use of count data and conclusions that can be drawn from them.

Next Steps

During the current academic year we plan to develop a website where we will assemble and make available more information and resources on numeracy and quantitative literacy. This backgrounder will be used to widen the discussion about numeracy support and to solicit content from a variety of disciplines. We will also begin to implement the model developed by Joe Cunsolo and use outcomes from this to help set our direction. The pace of development will depend in part on the success of the LEF application.