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An Assessment of a Blended Learning Model for Information and Geospatial Literacy

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Executive Summary

Among the most prevalent emerging trends in postsecondary education is a migration from traditional face-to-face instruction to models that leverage online and digital learning resources. Whether instruction takes place completely online or involves a hybridization of online and traditional approaches (e.g., “blended learning”), technology-mediated learning modules have the potential to address student preferences for “24/7” access to resources.

For administrators, these modules may represent a means of increasing cost effectiveness through their potential simultaneously to reduce instruction costs and expand the audience that may be reached by such resources. Despite the vast opportunities offered by online and blended learning, there is a current need for studies that consider the effectiveness of these models across all aspects of development, implementation and assessment. In response, this study uses a comprehensive and in-depth approach incorporating both quantitative and qualitative data from students coupled with qualitative data from stakeholders to assess the benefits and barriers of implementing blended learning modules to replace traditional (face-to-face) first-year undergraduate geospatial and information literacy instruction. Recognizing that “blended learning” is conceptualized differently across institutions and applications, this study considers it in a pedagogical sense as a fundamental redesign of the instructional model, which thoughtfully combines the effective elements of face-to-face and computer-mediated experiences to enhance teaching and learning (Garrison & Vaughan, 2008).

Briefly defined, geospatial literacy is the ability to conceptualize, capture and communicate spatial phenomena, while information literacy is one's aptitude to recognize when information is needed and have the ability to locate, evaluate and use it effectively. Though geospatial and information literacy are identified as important skills for 21st century learners, they are commonly taught outside of normal curriculum instruction, which puts a burden on the supporting institutions (e.g., libraries) that are relied upon to provide this instruction to students.

In the summer of 2011, McMaster University Library coordinated the development of a blended learning model to replace existing, course-embedded face-to-face geospatial and information literacy instruction for a selection of first-year undergraduate social science courses. The creation, implementation and assessment of this model involved collaboration between many campus stakeholders, including faculty members, library staff, library and faculty administration, and pedagogical staff from what was then known as the McMaster Centre for Leadership in Learning. Traditional, face-to-face instruction was replaced by a blended approach: Two interactive, Flash-based modules, one for each of information literacy (approximately 25 minutes in length) and geospatial literacy (approximately 45 minutes in length), were made available to students online through McMaster’s learning management system and were complemented by face-to-face activities. Motivation for the migration to module-based instruction included not only pedagogical considerations but also issues associated with budget constraints for instructional staff, increased demand for instructional accountability, a shift to demand-based library resource allocation, and the need for greater collaboration within and beyond the library.

In this study, we used a combination of qualitative and quantitative approaches to assess these online modules across dimensions of user satisfaction, development and implementation cost-benefit and student accessibility requirements (using Universal Instructional Design [UID] principles). Focus groups and personal interviews were conducted to understand the perceptions of faculty, instructional staff, teaching assistants and administrators towards the modules, particularly as they related to module development, implementation and effectiveness. An online survey allowed students to self-report their module use, satisfaction with the content delivery mode, and perceptions of module contribution to their learning within the course. The survey

response rate was higher for the geospatial literacy module and among females; respondents represented a range of faculties and undergraduates at various years in their program.

Overall, both course instructors and students identified significant value in using the online modules in a blended learning setting. Instructors felt that giving students access to instructional resources beforehand increased flexibility in how in-class time was used, thus increasing the effectiveness of face-to-face instruction, summative assessments and laboratory sessions. They also perceived that the modules helped students by increasing consistency in course content, giving them access to additional resources and helping to temper their anxiety in busy lab settings. Though instructors displayed concern about the degree to which students would access and use these out-of-class resources, over 80% of students reported using the modules, with most stating that they used the majority of the content. Reaffirming assumptions of student desire for "just-in-time" and "24/7" learning, over 80% of users reported using the modules on a repeat basis, and predominantly accessed the resources at their leisure on their own personal computers. Students reported that they were more likely to use the modules to better understand course content than simply to increase their grade in the course.

Though direct impact on student grades is difficult to quantify, instructors perceived little to no change in grades as a result of the migration to blended learning instruction. Students, however, overwhelmingly perceived a positive impact on their learning, as 65% and 77% of students felt that the modules improved their academic skills in information and geospatial literacy, respectively, and 78% of all students believed the modules to have influenced positively their overall understanding of course material. Unexpectedly, students commonly acknowledged shortcomings in their knowledge and skills prior to using the modules; this was especially pronounced for the information literacy module, where a larger proportion of students reported feeling uncomfortable using library databases or advanced internet search engine features before using the modules. This finding implies that assumptions about student proficiency with all things digital may be poorly founded, as students may not be as inherently ready to succeed in navigating online information resources as expected – shortcomings of which many students seem aware.

A number of areas for improvement were identified by instructors/administrators and students regarding the online modules and their implementation in a blended-learning framework. Prior to the implementation of the modules, instructors showed concern that students would feel overwhelmed by the addition of the modules to the existing course content and were unsure if the modules were used in a manner that represented true blended learning. There was also an expressed desire to include more student feedback in the module development process and to make the module development process more adaptable and user-friendly by "shortening the production chain." Additionally, instructors assigning the information literacy modules felt that removing face-to-face instruction with library staff increased the burden on them to be the authority on this content without adequate support. Though the large majority of students approved of the module presentation and reported that the modules supported most aspects of UID, there was a general agreement that the modules did not enhance or promote communication between the instructor and the students (UID principle #9).

Completing a cost-benefit analysis of the migration to a blended-learning approach proved to be difficult due to challenges in estimating the true cost of both traditional instruction and module development (considering extensive collaboration efforts). In terms of directions for future research, focus group responses identified a dualistic expectation concerning module development and deployment. While the pursuit of generalized, comprehensive and copyright content-free modules may potentially increase cost effectiveness by widening applicability, course instructors also expressed interest in tailoring these modules to specific course content, thereby increasing relevance to instruction. Balancing this apparent dichotomy of needs – while addressing the outlined areas of improvement – represents an important next step in further module development and implementation.

Acknowledgements

As with all large projects, numerous people were involved with this research. We would like to thank: Jacob Tarkowski for his work in data collection; Dr. Walter Peace, Dr. Michael Mercier, Dr. Carolyn Eyles, Dr. Maureen Padden, Julia Evanovitch, Lisa Leoni and Jessica Slomka for their assistance, advice, participation, and for allowing their geography classes to participate in this research project; Dr. Lori Campbell for her assistance, advice and hard work in incorporating the information literacy modules into the social science inquiry courses; and the numerous McMaster library staff who assisted along the way, with special thanks to Gordon Beck and Margaret Rutten of the Lloyd Reeds Map Library. We would also like to thank HEQCO for funding this research project and for its assistance throughout. To all the students who participated in the survey and to the focus group attendees who took valuable time out of their days, the research team owes a collective thank you. This task could not have been accomplished without your efforts.

This study has received ethics approval from the McMaster University Research Ethics Committee.

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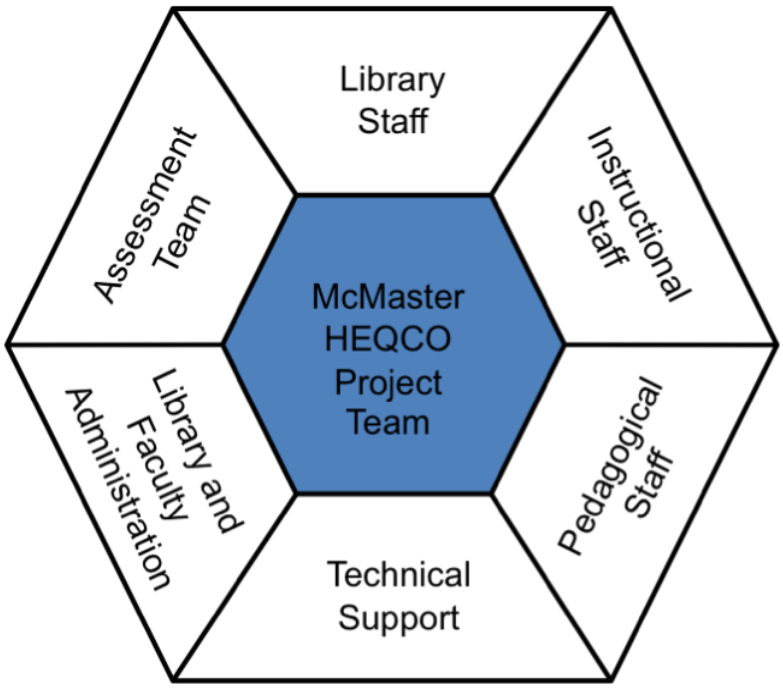
Introduction

> *"Blended learning is a coherent design approach that openly assesses and integrates the strengths of face-to-face and online learning to address worthwhile educational goals."* (Garrison & Vaughan, 2008, p. 5)

In response to pedagogical and financial challenges related to the traditional face-to-face model of instruction, and to students' preferences for "just-in-time" instruction and "24/7" access to instructional materials, a pilot study involving the creation, implementation and assessment of blended learning online modules for geospatial literacy and information literacy was conducted at McMaster University during the 2012-2013 academic year. The updated instructional model developed and assessed within this research project delivers newly created online learning modules, which students can access anywhere and at any time, to be blended with course lectures, discussion, assignments and evaluation. These modules replaced a traditional model, where geospatial and information literacy instruction was provided via a one-time, one- to two-hour, face-to-face session with library staff. This project stemmed from the collaboration of a wide range of campus stakeholders to address a learning challenge and develop a campus-wide solution, serving a large number of students. Given that this research project involved the discussion of curriculum and redefinition of learning culture, collaboration between faculty members, library staff, library and faculty administration, and pedagogical staff from the McMaster Centre for Leadership in Learning (CLL) was imperative to ensure seamless project implementation (Figure 1). The skills that are addressed have broader applicability to other university and college campuses.

Figure 1: The Varied Contributors Required to Ensure the Success of the McMaster University Blended Learning Initiative



Research indicates that information literacy and geospatial literacy are two important skills for undergraduate students. The Association for Research Libraries indicates that demand for library instruction is on the rise at institutions across North America (Stuart, 2009). Within the geography community there is heightened value placed on being spatially proficient. This research project focuses on information and geospatial skills which, until now, were taught using traditional learning models through the McMaster University Library. This research project introduces a blended learning approach and principles of Universal Instructional Design [UID] (Johnson and Pliner, 2004) through the development of online modules. The project was piloted in three McMaster University level 1 undergraduate courses, all of which incorporated instruction from library staff (both librarians and non-librarians) (Table 1).

Table 1: Undergraduate Courses Involved in the Pilot Introduction of Blended Learning Instruction

Course Code	Description	Total Number of Students in Fall 2012 (Male/Female)
Social Science 1SS3: Inquiry in the Social Sciences	An inquiry-based introduction to conducting research in the social sciences, with a focus on developing relevant, transferable skills through the application of the inquiry process vis-à-vis a selected social science theme. In the 2012 fall semester there were eight separate sections for Social Science 1SS3 taught by seven different instructors. Students in all sections had the option to participate in the survey.	235 (73/162)
Geography 1HA3: Human Geographies: Society and Culture	Introduction to human-environment relations and spatial analysis with special emphasis on urban, social, health and cultural environments.	546 (281/265)
Geography 1HB3: Human Geographies: City and Economies	Basic principles in spatial analysis and location theory applied to the changing urban, economic and environmental patterns of development and urbanization at the local, national and international scale.	319 (193/126)

This study addressed the following research questions:

1. What are the perceptions of users (faculty, administrators, library instructional staff, discipline-specific instructional staff) of the new blended learning model for geospatial and information literacy instruction?
2. Using a cost-benefit analysis, what is the resource cost effectiveness for delivery of geospatial and information literacy skills using the new blended learning model, and how does it compare to the traditional face-to-face model of instruction from the perspective of the course instructors?
3. How well do students learn and apply geospatial and information literacy skills using these online modules?
4. How well do the modules meet Universal Instruction Design criteria?

A research design incorporating both quantitative and qualitative data was adopted, including survey and focus group data, in order to address the research objectives and questions. Statistical analyses were

performed on online student survey data and thematic analyses were undertaken using interview and focus group data.

McMaster University

Founded in Toronto, Ontario, in 1887 by Senator William McMaster, McMaster University relocated to Hamilton in 1930. With a main campus in west Hamilton and regional campuses in Burlington, Waterloo, St. Catharines and downtown Hamilton, McMaster enrolled approximately 21,000 full-time undergraduate students and 3,400 full-time graduate students between 2012 and 2013.

McMaster is known for innovative teaching methods and the "McMaster Model" – a student-centred, problem-based, interdisciplinary approach to learning. McMaster University is committed to creativity, innovation and excellence in its teaching, research and scholarship, and its purpose is the "discovery, communication, and preservation of knowledge." The Blended Learning project encompasses the core components of the McMaster Model, specifically focusing on student-centred learning.

Courses for which Blended Learning Modules were Created

Courses used in this study all had previous ties to the McMaster University Library. These courses were chosen because the individual instructors or instructional team, in the case of Inquiry 1SS3, were interested in the idea of introducing blended learning into their course. In each case either a librarian or library staff had traditionally provided instruction.

Inquiry into the Social Sciences – Class Description

The Faculty of Social Sciences at McMaster University has been committed to inquiry-based learning in the form of a first-year, stand-alone, one-term credit course called "Inquiry 1SS3" since its implementation in 1998. Inquiry 1SS3 is an introductory course open to all first-year (level 1) undergraduate social science students. Classes meet once a week, with face-to-face instruction for three hours each week, and include a maximum of 30 students and one instructor per section. Instructors come from diverse social science disciplines, including geographers and educational consultants. Approximately two-thirds of all level 1 social science students take Inquiry 1SS3. Each of the eight sections is taught by a different instructor, each of whom brings a different theme to the course, with the exception of one instructor who teaches two sections (e.g., Inquiry into Public Health or Inquiry into New Media).

The goal of Inquiry 1SS3 is to introduce students to the research process and to support them in establishing effective learning strategies early in their academic careers (Justice et al., 2007). Inquiry 1SS3 offers students an opportunity to practice university-level skills essential for academic work, employability and life-long learning. The course is organized around a broadly defined topic of public concern (e.g., environment, social identities and globalization) and is designed to assist and support students in undertaking academic research and developing fundamental academic skills such as time-management and self-directed learning skills (Justice et al., 2007).

Inquiry into the Social Sciences – Intervention of Blended Learning

Traditionally, information literacy was taught by a librarian in a one- to two-hour session for each section of the course, followed by an online quiz at a later date. The new model involved each course instructor making the information literacy module available to assist students in preparing for both their capstone projects and a

course-wide test that assessed their ability to make informed decisions on questions of proper citation practices, information ethics and research strategies. Students applied the knowledge gained in various applications, as the course theme and assignments varied by instructor. As each course instructor has the academic freedom to run their course as they see fit, each varied in their method of solidifying the students' understanding of information literacy. The most popular model for the implementation of the information literacy module was to assign a portion of the module to be viewed prior to class, followed by an in-class assignment/discussion led by the course instructor based on the skills obtained. A commonality between all sections is the information literacy quiz developed by a team of course instructors.

First-Year Social Geography – Class Description

McMaster's School of Geography and Earth Sciences offers two first-year introductory human geography courses: "City and Economies" (GEO 1HB3) and "Society and Culture" (GEO 1HA3). Each of these courses is offered twice a year and is broken into two fifty-minute lectures per week in a large lecture hall setting, accompanied by a weekly two-hour lab period during which students are placed into smaller groups of forty or less to work on various assignments and labs. The number of lab slots per course varies on a yearly basis based on enrolment numbers and lab space availability, with an average of approximately 15 lab slots per course per semester. Traditionally, each course had one lab period in the semester take place in the McMaster University Map Library, where map library staff would give a lecture on the basics of geospatial literacy, including map elements and coordinate systems. The fifty-minute lecture occurred during the lab session and was the preamble to a geospatial literacy assignment both assigned and due within the two-hour lab period, requiring the application of material within the map library.

First-Year Social Geography – Intervention of Blended Learning

The model adopted by this research project facilitates the redistribution of time allotted to specific tasks within the two-hour lab period of GEO 1HA3 and GEO 1HB3. By using an online geospatial module to complete a "prelab" prior to the lab session, students are allotted more time to work on their assignment during the lab session. Since the "prelab" material is always available to students, they can also use this module for reference during and after the lab session, as needed. Instead of the fifty-minute presentation, the students are given a five-minute lab instruction from one of the course teaching assistants and then have the rest of the period to work on their lab, which is due at the end of the period. During the lab period two teaching assistants are available to assist students, with library staff also available to assist with more advanced geospatial questions.

Definitions and Trends

The aim of this research study is to evaluate an alternate instructional model for geospatial and information literacy. Prior to assessing the effectiveness of this alternative model, it is important to define "blended learning" and "24/7 delivery" in the context of this study, while also outlining recent trends in academic libraries and the importance of both geospatial and information literacy.

Blended Learning

"Web-based learning environments invite – and may even require – reconceptualization of the learning paradigm" (Dziuban et al., 2004, p. 2). A number of labels – web-based learning, e-learning, asynchronous learning networks – fall under the umbrella of "technology enhanced instruction." Traditionally these labels

have been focused on reaching out to off-campus student populations; however, a recent on-campus trend has been facilitated through another set of labels, which includes hybrid learning, blended learning, the "flipped" classroom and mixed-mode instruction. Blended learning is of particular interest to this project. The definition of blended learning is relatively fluid and is often applied to an entire course rather than to a single course objective, as is the case here with information and geospatial literacies. Attempts have been made to define blended learning quantitatively based on the proportion of traditional face-to-face instruction that is replaced by the use of technology-mediated instruction. For example, Allen et al. (2007) and Glazer (2011) consider instruction to be blended when 30 to 79% of instruction is delivered online. The Ontario Ministry of Training, Colleges and Universities (MTCU) suggests a slightly modified set of criteria for defining blended (hybrid) learning, stating that a hybrid learning course is one:

> *...where face-to-face teaching time is reduced, but not eliminated, to allow students more time for online study. This model comes in a number of formats; however the online component is typically 50-80% of the total course delivery.* (MTCU, 2011)

The MTCU's recognition of such a course structure is consistent with predictions of a "dramatic increase in the number of hybrid (that is, blended) courses in higher education" (Graham, 2006, p. 3).

While the use of a percentage-based criterion for defining blended learning is an effective general identification tool, there are a number of further considerations that arise depending on subject material, learning objectives and the inclusion of active learning elements. For the purposes of this study, we use the more philosophical definition of blended learning proposed by Garrison and Vaughan (2008):

> *the thoughtful fusion of face-to-face and online learning experiences... such that the strengths of each are blended into a unique learning experience.... Blended learning is a fundamental redesign that transforms the structure of, and approach to, teaching and learning.* (p. 5)

Simply stated, blended learning is defined as a combination of face-to-face and computer-mediated instruction. It is important to emphasize that blended learning is not meant to be seen as a temporary solution, but rather as a fundamental redesign of the instructional model with the following characteristics: (1) a shift from lecture- to student-centred instruction in which students become active and interactive learners; (2) increases in interaction between student-instructor, student-student, student-content and student-outside resources; and (3) integrated formative and summative assessment mechanisms for students and instructor (Graham, 2006). As summarized by Dziuban (2004):

> *Blended learning should be viewed as a pedagogical approach that combines the effectiveness and socialization opportunities of the classroom with the technology-enhanced active learning possibilities of the online environment.* (p. 3)

At the core, blended learning is part of the ongoing convergence of two archetypal learning environments: traditional face-to-face learning and distributed learning environments. Maintaining an appropriate balance between these two learning environments is critical, as evidence shows that many faculty and students lament the loss of face-to-face contact that occurs in a fully online learning environment. As such, blended learning is often referred to as the "best of both worlds" (Dziuban et al., 2004).

24/7 Delivery

The idea behind 24/7 learning is to expand the time available for instruction without infringing upon class time (Butler, 2010). As a delivery style, it falls within blended learning and may be accomplished using a variety of

approaches, such as the use of remote resources and remote classrooms, independent online learning and team learning environments (Butler, 2010). A 24/7 system must not restrict user access due to technological limitations upon learning, and as a result there needs to be a level of continuous "customer service"-type support (Butler, 2010). Online learning, and more specifically 24/7 learning, offers several advantages: course continuity for absent students, automatic access to course materials, scheduling compatibility and unlimited student access to review content prior to testing (Butler, 2010).

Universal Instructional Design

Universal design is "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Burgstahler, 2005, p. 1). Its origin is rooted in the universal design of architecture, where architects learned to embed accessibility features into their original designs and thus noticed that a broad range of people appreciating the new accessibility features (Ianiro, 2007). The implication of universality encouraged application to the discipline, which directly addressed the gap in recognizing the significant barriers that students with disabilities face in terms of access to curriculum and instruction (Johnson & Pliner, 2004). As a result, universal design for learning (or instruction) emerged. It is defined as "a new paradigm for teaching, learning, and assessment, drawing on new brain research and new media technologies to respond to individual learner differences" (Johnson & Pliner, 2004, p. 107).

An implicit assumption in universal design for learning (or instruction) is that in addressing the needs of students with disabilities, there is an element of equity and inclusiveness that is passed on to others as well. Johnson and Pliner (2004) recognize this in their claim that students do not need to have a disability to benefit from greater access to teaching materials. Edyburn (2005) distinguishes universal design in learning, which aims to reduce barriers for everyone, from assistive technologies, which aim to reduce barriers for those with specific disabilities.

Johnson and Pliner (2004) identified nine primary UID principles:

1. *Equitable use* – making classroom material accessible to diverse learning needs and styles;
2. *Flexibility in use* – the practice of using a variety of instructional methods;
3. *Simple and intuitive* – teaching in a straightforward and predictable manner;
4. *Perceptible information* – ensuring that course material is accessible to students regardless of their "sensory abilities";
5. *Tolerance for error* – building diversity of learning "pace and prerequisite skills" into course process;
6. *Low physical effort* – designing instruction "to minimize… physical effort" so that students can attend to essential learning;
7. *Size and space for approach and use* – engaging the classroom space in ways that address diverse student needs based on body size, posture, mobility, and communication;
8. *A community of learners* – teaching and learning environment supports and encourages interaction and communication among students/faculty and between students and faculty; and

9. *Instructional climate* – all students are encouraged to meet "high expectations" as they are "welcomed" to participate in the course.

Information Literacy

Information literacy is the ability to "recognize when information is needed and…to locate, evaluate, and use effectively the needed information" (ACRL, 2000, p. 2). Simply put, it is "about understanding information and how it works" (Badke, 2010, p. 130). An implicit assumption is that information literacy addresses a complex set of understandings and skills, which require a great deal of instruction and practice. However, the response of academia thus far has been to make it a remedial issue (Badke, 2010). A survey of over 100 colleges and universities in Canada and the United States revealed that fewer than 6% of institutions required a one- or two-credit full course in information literacy in order to meet graduation requirements, and only about 25% had an information literacy component built into basic writing and composition classes (Badke, 2010).

Information literacy is commonly misunderstood and underestimated, and often mistaken for information technology fluency. Information literacy focuses on content, communication, analysis, information searching and evaluation; whereas, information technology fluency focuses on obtaining a deep understanding of technology and the increasingly skilled use of it (ACRL, 2000). Information literacy is also taught predominantly to students in single, abbreviated (one- or two-hour) sessions, implying that a simple pedagogical introduction is sufficient. However, it takes time for students to develop capacity for information literacy (Badke, 2010) and they learn the skill more fully when combined with hands-on activities (Duncan and Varcoe, 2013). Research indicates that faculty have limited appreciation for librarians as instructors and do not consider them full academic colleagues (Badke, 2010).

To make information literacy a core element of academic curriculum, emphasis should be placed on the general usefulness of the skill as it "forms the basis for lifelong learning; it is common to all disciplines, to all learning environments, and to all levels of education" (ACRL, 2000, p. 2). Furthermore, varied modes of delivery assist student skill development. Fitzpatrick and Meulemans (2011) recommend a combination of librarian-led instruction with computer access during the instruction as the most beneficial method for students and their different learning styles. This lends itself well to blended learning and its potential to produce information literate individuals. The Association of College and Research Libraries (ACRL) has devised a comprehensive list of competency standards for information literacy in higher education (Table 2). "The competencies presented outline the process by which faculty, librarians and others pinpoint specific indicators that identify a student as information literate" (ACRL, 2000, p. 5). It is important to note that varying emphasis will be placed on the competencies, which are discipline-specific.

Several regional and discipline-based accreditation associations are now beginning to consider information literacy as a key outcome for college students (ACRL, 2000). Incorporation of information literacy across curricula, programs and services is being identified through a collaborative effort between faculty, library staff and administrators. In order to ensure proper implementation of this instruction, faculty need to establish context for learning through lectures and offer guidance on how to best fulfil information literacy needs (ACRL, 2000). Library staff will need to coordinate the evaluation and selection of intellectual resources, and organize and maintain collections, as well as access points. Finally, administrators need to create opportunities for collaboration and staff development among the various stakeholders involved in information literacy instruction (ACRL, 2000).

Table 2: Standards & Performance Indicators for Information Literacy (ACRL, 2000)

Standard 1	**The information literate student determines the nature and extent of the information needed.**
Performance Indicators: 1. The information literate student defines and articulates the need for information. 2. The information literate student identifies a variety of types and formats of potential sources for information. 3. The information literate student considers the costs and benefits of acquiring the needed information. 4. The information literate student re-evaluates the nature and extent of the information needed.	
Standard 2	**The information literate student accesses needed information effectively and efficiently.**
Performance Indicators: 1. The information literate student selects the most appropriate investigative methods or information retrieval systems for accessing the needed information. 2. The information literate student constructs and implements effectively-designed search strategies. 3. The information literate student retrieves information online or in person using a variety of methods. 4. The information literate student refines the search strategy if necessary. 5. The information literate student extracts, records, and manages the information and its sources.	
Standard 3	**The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.**
Performance Indicators: 1. The information literate student summarizes the main ideas to be extracted from the information gathered. 2. The information literate student articulates and applies initial criteria for evaluating both the information and its sources. 3. The information literate student synthesizes main ideas to construct new concepts. 4. The information literate student compares new knowledge with prior knowledge to determine the value added, contradictions, or other unique characteristics of the information. 5. The information literate student determines whether the new knowledge has an impact on the individual's value system and takes steps to reconcile differences. 6. The information literate student validates understanding and interpretation of the information through discourse with other individuals, subject-area experts, and/or practitioners. 7. The information literate student determines whether the initial query should be revised.	
Standard 4	**The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.**
Performance Indicators: 1. The information literate student applies new and prior information to the planning and creation of a particular product or performance. 2. The information literate student revises the development process for the product or performance. 3. The information literate student communicates the product or performance effectively to others.	
Standard 5	**The information literate student understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.**
Performance Indicators: 1. The information literate student understands many of the ethical, legal and socioeconomic issues surrounding information and information technology. 2. The information literate student follows laws, regulations, institutional policies, and etiquette related to the access and use of information resources. 3. The information literate student acknowledges the use of information sources in communicating the product or performance.	

(Geo)Spatial Literacy

"The term spatial literacy is rarely explained explicitly; rather it is more often discussed with reference to spatial abilities and spatial thinking" (Jarvis, 2011). Much like information literacy, the process of becoming spatially literate is a cycle, in which strategies are learned and knowledge is acquired over time. Though there is evidence that the base level of an individual's spatial ability is innate, spatial skills still need to be actively encouraged and practiced to promote development (Jarvis, 2011). A comprehensive definition offered by Bednarz and Kemp (2011) describes spatial literacy as an individual's ability to:

> *…capture and communicate knowledge in the form of a map, understand and recognize the world as viewed from above, recognize and interpret patterns, know that geography is more than just a list of places on the Earth's surface, see the value of geography as a basis for organizing and discovering information, and comprehend such basic concepts as scale and spatial resolution.* (p. 19)

Spatial thinking is understood to be a culmination of concepts, skills and cognitive approaches that allow individuals to use space to model the world using concepts such as direction, distance and spatial association. This supports the development of graphic representations of data or information in the form of diagrams, maps and graphs. Finally, cognitive strategies that facilitate problem-solving and decision-making in spatial contexts are needed (Bednarz & Kemp, 2011). Together, these three elements help to conceptualize spatial literacy.

There is a growing recognition among geographers and other scholars that being able to think in, with and through space, (i.e., to be "spatially proficient") is not only a necessary trait for success in geography and the geosciences, but for many other disciplines as well. Recent research is reaffirming that spatial ability, measured by concrete two-dimensional and three-dimensional visualization and reasoning tasks, is invaluable to science, technology, engineering and mathematics (STEM) education (Bednarz & Kemp, 2011). This is being met with increasing calls for spatial literacy education efforts in the United Kingdom, United States and Australia.

Recent Trends in Academic Libraries

A document published by the ACRL in June of 2010 shed some light on emerging trends in academic librarianship and higher education, compiling a top ten list of trends affecting libraries in the present and immediate future. Four trends coincided with the work of this project: (1) budget challenges will persist and libraries will be forced to evolve as a result; (2) demands for accountability and assessment will increase; (3) library collection growth will be driven by patron demand for both traditional and new resource types; and (4) increased collaboration will expand the role of the library within the institution and beyond (ACRL, 2010).

The first trend illustrates how libraries across North America are facing stagnant or reduced budgets. In the United States, higher education has seen a limited increase in federal funding, further exacerbating the fact that state spending has failed to keep up with enrolment growth and inflation. A similar phenomenon is apparent within professional academic librarianship in Canada (Peters, 2011). Budget pressures raise concerns around libraries' ability to attract and retain quality staff, build collections, provide access to resources and services, and develop and implement innovative services (ACRL, 2010).

The second trend highlights the increasing pressure on academic libraries to demonstrate the value they provide to their clientele and to institutions, as the perceived onus has fallen upon higher education to prove its value. This represents a trend of broader accountability pressures from various stakeholders, such as federal and state/provincial governments, accrediting bodies and the student body (ACRL, 2010). These pressures exerted on public education institutions as a whole are influencing internal funding formulas. As competition for limited funds increases, it is becoming increasingly important for libraries to demonstrate their impact on students (e.g., learning outcomes, engagement, recruitment and retention) and faculty (e.g., successful grant application and faculty research productivity).

The third trend implies that patron demand drives academic library collection growth and will continue to include new resources such as e-books and geospatial data (ACRL, 2010). There has been a shift from a "just-in-case" to a "just-in-time" philosophy due to factors such as budget restrictions, user preferences for electronic access to materials, limited physical space and the inability to financially sustain comprehensive collections (ACRL, 2010). The change in philosophy has been facilitated by various phenomena, including patron desire for new types of resources and resource sharing systems that can offer shorter turnaround time on content. However, long-term effects influencing the ability of academic libraries to meet their clientele's informational needs, the stability of new access methods and implications for future scholarships are not yet known (ACRL, 2010).

The fourth trend is that an observed increase in collaboration will expand the role of the library (ACRL, 2010). Diversification of collaboration efforts will continue in various forms, including integration of library resources into curriculum (i.e., information literacy), working with information technology experts to develop online tutorials, and working with student support services to provide integrated services to students (ACRL, 2010). The overarching theme is that of pooling resources and broad integration in a primarily digital context, such as the use of online learning modules.

A recent article published in the October 2011 Canadian Association of University Teachers (CAUT) bulletin outlines another emerging trend within academic librarianship. According to Peters (2011), academic librarians are under attack, given that their jobs are being deskilled, unbundled and sometimes even eliminated by library administrators. The availability of new information technologies that can be used to transform how libraries operate and a need for budget cuts contribute to this trend. It appears that administrators are quick to employ new technologies, and their implementation is almost always seen as an opportunity to reduce budgets (Peters, 2011). This makes it possible to reassign work to lower paid, non-academic librarian staff, which leaves considerably less expert support for an institution's teaching, scholarship and research. "This technology-over-librarian mentality may have undesirable impacts on the quality of the academy" (Peters, 2011, A3).

Academic libraries are facing a multi-faceted dilemma. They must tailor to constantly changing patron demands and continuously demonstrate their value to clientele, in addition to confronting the pressure of realized or impending budget cuts. Although there is recognition that library resources need to be integrated into curriculum, the solution needs to be cognisant of recent trends facing professional academic librarianship. These will undoubtedly limit the solution to one that not only tailors to emerging library trends, but also to those of pedagogy and the broader institution.

Methods

This research project was conducted at McMaster University in Hamilton. We employed a research design using both quantitative survey data from students and focus group data from instructional staff and administrators. Data collection and analyses are described below. Findings are discussed in subsequent sections.

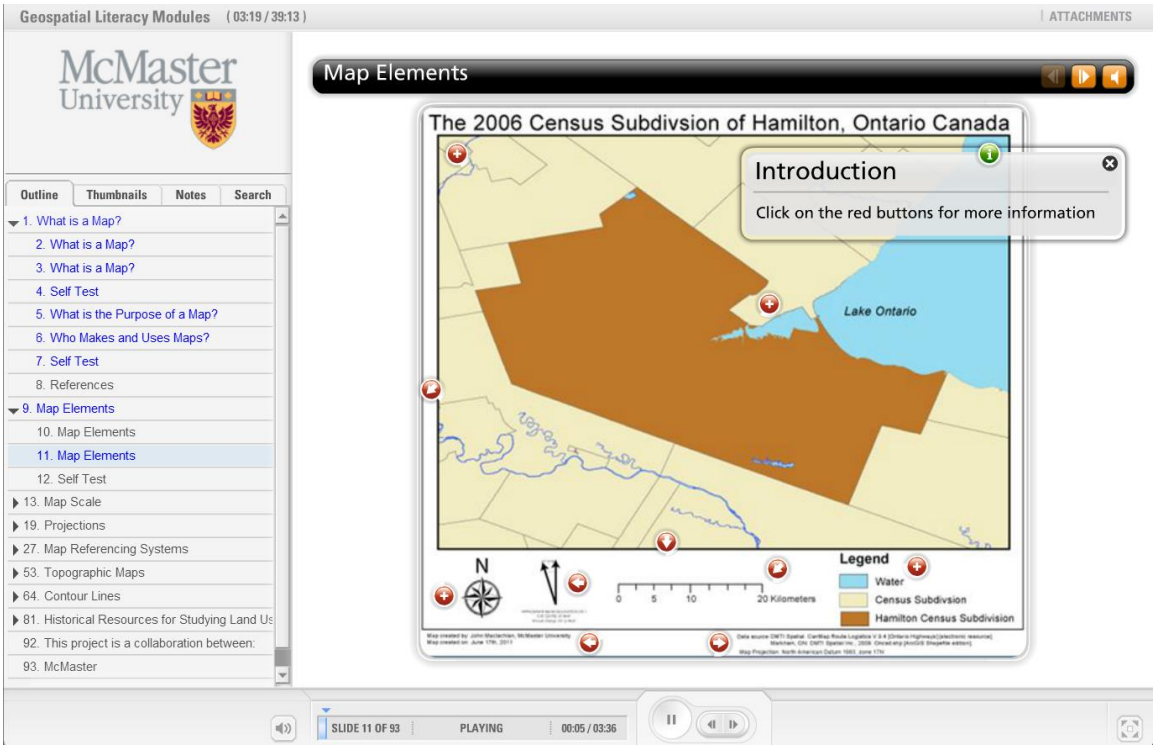
Online Module Development

The information and geospatial literacy modules were developed in the summer of 2011 and refined in 2012. Each of the two modules' development was coordinated within the McMaster University Library, though its development required the collaboration of faculty members, library staff, library and faculty administration, and pedagogical staff from the McMaster Centre for Leadership in Learning. While all module development was completed through a team concept, including course instructors, with the McMaster Centre for Leadership in Learning coordinating efforts and assessing the content, the writing of the content fell to a group of McMaster University librarians for the information literacy modules and to a Council of Library and Information Resources Postdoctoral Fellow and library staff members with expertise in geospatial literacy.

The rationale for developing modules for information and geospatial literacy was primarily grounded in these topics traditionally being taught within the library by library staff. Each course targeted for this study had a pre-existing positive relationship with the library and was seen as an important partner as the library reassesses how it intends to be involved with teaching moving forward due to budget challenges. It was agreed that students would benefit from the "24/7" availability of the online modules, but they should be blended with course material and practical concepts to be effective. Taking this approach allows for course instructors to utilize the resources for a blended learning approach if they choose to incorporate the modules within a course assignment or discussion, while also making the resource available for those who wish to use it in a more passive sense, such as assigned as course reading.

Articulate software (Articulate, 2013) was used to create Flash-based online modules that were interactive and self-contained (Figure 2); the modules were also narrated and utilized a number of different presentation and interactive elements to improve effectiveness and accessibility. Modules made use of information slides, multimedia elements, interactive quizzes and animations, as well as note-taking space. The modules could be navigated either linearly, by viewing content from the beginning of a section or page, or non-linearly, by using embedded play controls and/or the navigation menu to select a desired page or point within a page's presentation, all within the course learning management system. Modules can be played on both computers and tablet devices. The McMaster University Centre for Leadership in Learning created the final online product.

Figure 2: Screenshot of the Geospatial Literacy Online Learning Module



Online Student Survey

In November 2012, an online student survey was developed using LimeSurvey software, which was administered to all students in the following courses: Inquiry into the Social Sciences, Human Geographies: Society & Culture, and Human Geographies: Cities and Economies. Collectively, a total of 1,065 students were enrolled in these courses during the Fall 2012 semester. Some survey questions differed depending on whether students were evaluating the geospatial or information literacy modules. Survey logic was used to ensure that students were presented only with questions appropriate to the module they used. All questions concerning the benefits of blended learning and the logistics of the modules were kept consistent. A short, five-minute in-class presentation was given to introduce the survey. Each student received a letter of information/consent through the McMaster learning management system (Avenue to Learn), which contained a hyperlink to the online survey, with one reminder posted on the learning management system newsfeed function. Survey participation was optional and students were given one week to complete it. It should be noted that those enrolled in both geography classes only completed the survey once and in no instances did a student fill out surveys for both information and geospatial literacy. The student survey included questions related to demographics, learning approaches, use of the modules and experiences using the modules. After the survey closed, ten students were randomly selected to receive a $25 gift card redeemable in cafeterias on the McMaster University campus.

The student survey results were analyzed using both Excel and the Statistical Package for the Social Sciences (SPSS 21). Data were initially collected through LimeSurvey and converted into an Excel

spreadsheet. Data were then imported into SPSS, where frequencies were computed for each survey question. The complete survey is attached (see Appendix A).

Focus Groups

One objective of the research is to understand the level of user satisfaction associated with the online geospatial and information literacy modules (e.g., staff, faculty, administrators and students). In doing so, focus groups were undertaken with key stakeholders to ascertain facilitators, barriers and/or related issues associated with module development, and perceptions of how the modules are being used by teaching assistants (TAs), instructional assistants (IAs), instructors and students. Seven focus groups were undertaken (n=21), in addition to a one-to-one in-person interview (total n=22). Focus group participants were grouped according to their status as either discipline-specific instructional staff (i.e., instructor, TA, IA) or staff who supported the development of modules (i.e., library instructional staff, library management, administrators).

Participants were sent a recruitment email by a member of the research team (who was working outside of the instructional team and did not have any experience using or contributing to the development of modules). Upon agreeing to participate, each participant was forwarded an information letter and consent form for their review and signature (see Appendix B). Signed consent forms were collected by the research coordinator at the start of the session. Participants were given the opportunity to ask questions prior to the start of the focus group and interview. Focus groups took place in private on-campus meeting rooms; the in-person interview took place in the office of the participant. Focus groups and interviews were recorded digitally, with written permission for the purposes of verbatim transcription (conducted by an outside firm) and subsequent analysis. The interviews and focus groups lasted between 45 and 70 minutes. Each participant received a $25 hospitality gift card as a token of appreciation for his or her time.

An interview guide was informed by general themes resulting from the online survey, relevant literature and the current research objectives (see Appendix C). Key topics varied by type of participant. They included: 1) discipline-specific instructional staff: module development, effectiveness of the modules compared to the traditional face-to-face model, extent to which the modules were tailored to the course, improvements to the modules, whether the modules and face-to-face model represented a form of blended learning, and grades as an outcome measure; and 2) staff/administrators who supported module development: strengths and weaknesses of the modules, cost-benefit analysis of face-to-face vs. blended learning model, challenges and benefits associated with both models, differences in resource use between models, and perceptions of students' and faculty members' experience with the modules.

Analyses of a sub-sample (n=3) of randomly selected transcripts informed the development of a coding template (Miles & Huberman, 1994) (see Appendix D). An inter-rater reliability exercise was undertaken using one focus group transcript (14 pages in length), coded separately by the research coordinator and another research team member, to determine the level of coding agreement and to ensure confidence in the coding scheme template. Consistent with the coding dependability assessment procedure, as defined by Miles and Huberman (1994), agreements were represented when the same code was applied to a similar section of text (margin of error of between five and ten text lines allowed for differences in text selected for a given code). An inter-rater reliability score was calculated by the percentage of the number of agreements divided by the sum of all agreements, disagreements, code-no-codes (where text is coded on one transcript, but not on the other) and second-level disagreements (where the same text is coded, with the same topic and main categories applied, but with different sub-theme codes) (Miles & Huberman, 1994). The inter-rate reliability score was 70%, indicating an acceptable level of agreement.

Transcripts were uploaded into a qualitative analysis software package (NVivo 8.0) for thematic analysis. During data analysis, sections of text were chosen to support and shape individual codes listed in the coding template (Miles & Huberman, 1994). Through a constant comparison exercise, key themes emerged deductively from the research objectives, and inductively from the interview transcripts.

Data Presentation and Analysis

Reflecting the quantitative and qualitative methodologies of this study, data collected during this research project are organized by theme, rather than by the methodology undertaken to collect the data. Data such as "Profile of Online Survey Respondents" are used to describe the student body that responded to the online survey and are isolated from the focus group results. This distinction is made within each subsection of the "Data Presentation and Analysis" section.

Profile of Online Survey Respondents

Responses to the survey encompassed a larger cross-section of the student population than initially expected, with a larger number of non-level 1 students outside of the Faculty of Social Sciences participating. This is not a limitation strictly speaking, though it does have implications for the interpretation of results.

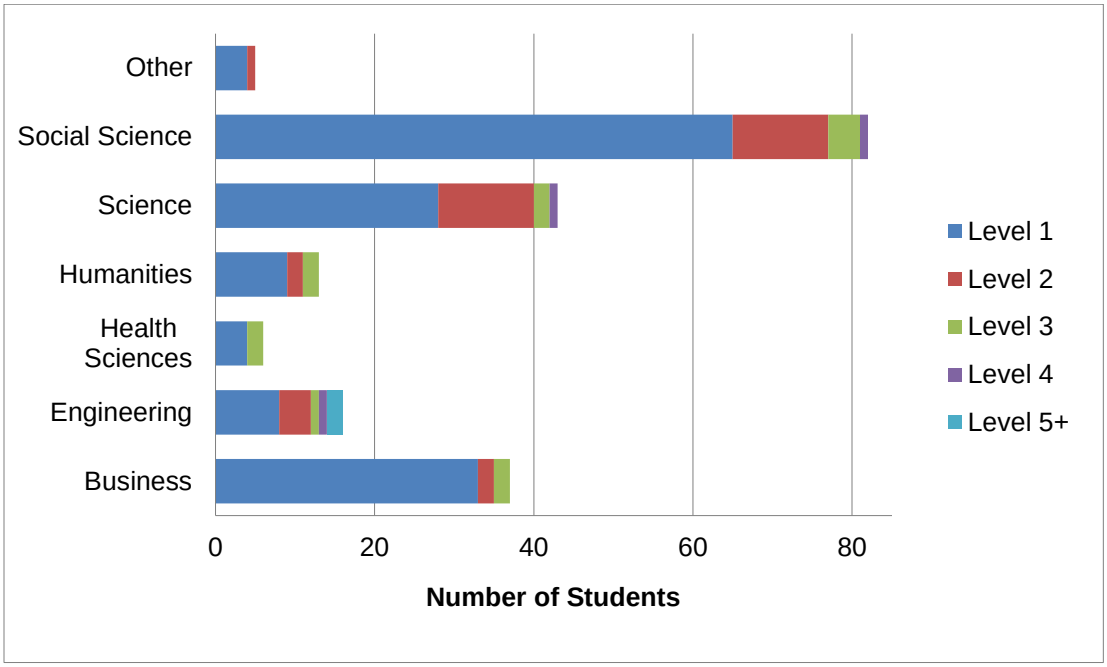
Both surveys were completed by a greater number of females than males, and the female-to-male respondent ratio was greater than the ratios within the general populations of the surveyed courses (Table 3). The results do not reflect potential causes of variability in responses by genders, but the difference in response rates should be noted.

Table 3: Gender Breakdown of Survey Responses in relation to the Gender Breakdown for the Population of the Courses Surveyed (n=203)

Module	Group	Male	Female
Information Literacy	**Population**	31.10%	68.90%
	Respondents	18.20%	81.80%
Geospatial Literacy	**Population**	55.40%	44.60%
	Respondents	35.90%	63.50%

Almost 75% of respondents to the online survey were level 1 students. Interestingly, only about 40% of respondents were social science students. This finding is surprising given that both geography courses are considered to be social science in nature and Inquiry 1SS3 is restricted to students in the Faculty of Social Sciences (Figure 3 represents faculty level and breakdown for all survey respondents). The faculty numbers may be partially skewed as a result of the School of Geography and Earth Sciences being situated in the Faculty of Science, as it offers graduation from both BSc and BA programs, and Inquiry 1SS3 is a popular elective course for upper-year students. There are potential implications related to the usefulness of the geospatial module for students, given that a number of BSc students in level 2 or higher will likely have had opportunities to acquire some of the base knowledge disseminated in the module at some point throughout their university career, prior to the use of the blended learning online module piloted through this research project.

Figure 3: Faculty and Level Breakdown of all Survey Respondents (n=202)



Themes Generated by Focus Groups

Focus group results are organized according to several key themes (see Appendix D), including:

- cost,
- course tailored modules,
- development,
- benefits and challenges of online modules,
- improvements,
- blended learning, and
- assessment.

Key themes are identified and organized in conjunction with the quantitative results. Table 4 provides a count and frequency analysis of the themes discussed during the focus groups. Both the number of times the theme was mentioned and the percentage of focus groups where the theme was mentioned are listed. Almost all focus groups (7 of 8) mentioned benefits of the modules including: “Students complete basic work before the class”; “Instructors available for higher-level questions in class”; and “Modules free up instructors' time to support students in class.” This finding illustrates a link to the objectives of both the geospatial literacy and information literacy modules.

Table 4: Themes Identified Through Analysis of Focus Group Results

Theme	# of Mentions	# of Focus Groups (%)
Course instructor expectations		
Positive expectations of modules	16	6 (75%)
Initial instructor trepidation about modules	9	4 (50%)
Cost of blended learning vs. face-to-face model		
Staffing cost	7	4 (50%)
Challenges of online modules		
Issues related to online quiz content	14	5 (63%)
Difficult to ensure student is viewing content	12	6 (75%)
Length of time to develop modules	10	4 (50%)
Benefits of online modules		
Students complete basic work before the class	23	7 (86%)
Instructors available for higher-level questions in class	15	7 (86%)
Students begin to take responsibility for their learning	15	5 (63%)
Modules free up instructors' time to supports students in class	14	7 (86%)
Module content as building blocks for subsequent years	9	5 (63%)
Instructors learn how to teach by drawing on modules	9	4 (50%)
Benefits of face-to-face instruction		
Personal connection between instructor and student	28	6 (75%)
Improvements to online modules		
Course-specific modules	11	6 (75%)
Make modules more interactive	7	3 (38%)

Student Use of Modules

Several instructors expressed concerns that students would not take the opportunity to use the modules, even when assigned as mandatory class work, without explicit connections to either a course assignment or assessment (test). Nearly 82% of student respondents within the information literacy stream indicated that they used the online modules, while 80% of geospatial literacy respondents indicated that they also used the modules. In a future study, additional questions intended to gauge students' general participation rates in course activities, such as textbook readings and attendance, would be useful.

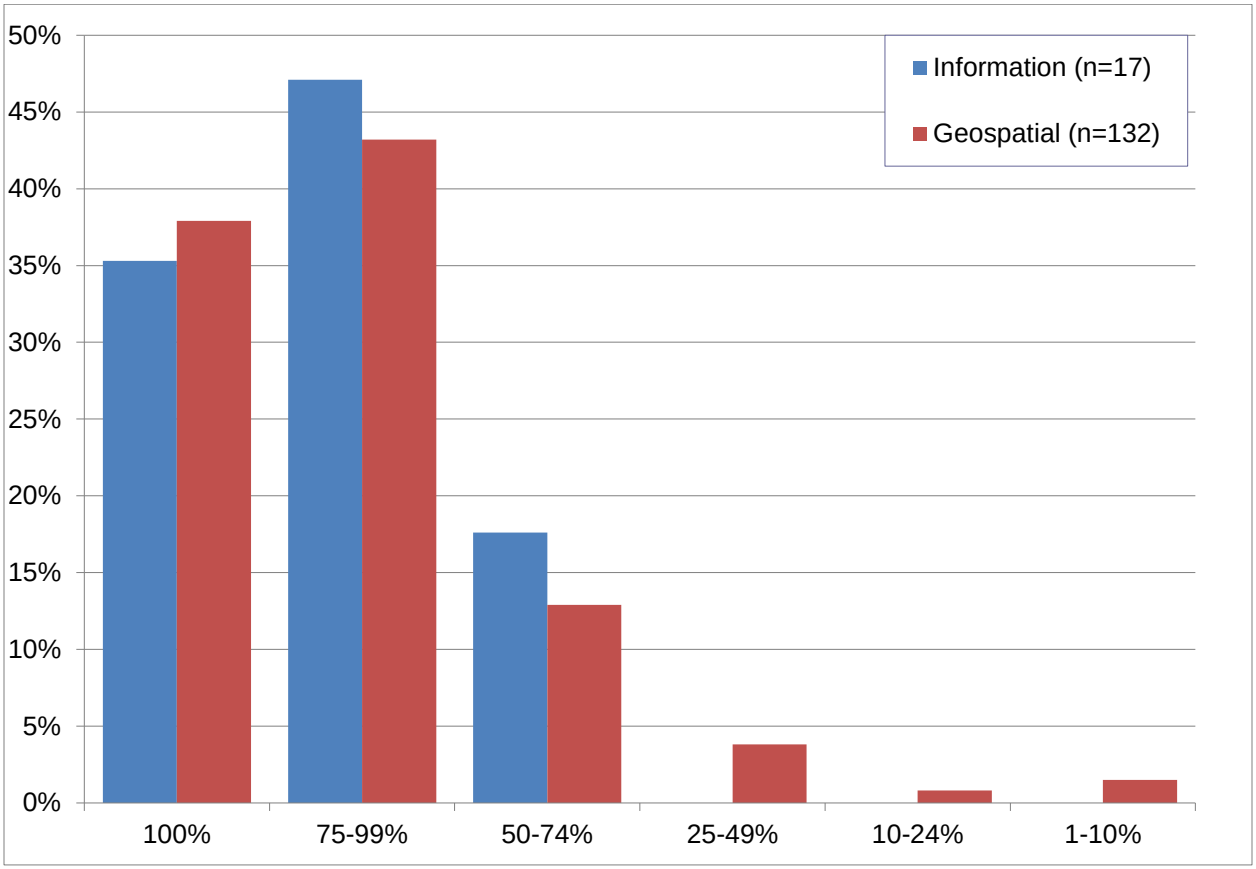
Secondary questions regarding module use explore why and where students access the modules. A large proportion of respondents agreed that they felt the modules helped them to better understand course material (see Table 5).

Table 5: The "Why" and "Where" of Student Module Use. Students could choose more than one applicable answer for each question

Question	Response	% of Responses (n=202)
Why did you use the online modules in your course?	Because they were there	21.1%
	Because they earned me marks	48.6%
	Because they helped me understand the course material	55.9%
	Because they helped me understand the material in other courses	21.8%
	Because they allowed me to work at my own pace	24.8%
Where did you access the online modules?	At home	58.9%
	At school in a computer lab	2.0%
	At school on a library computer	6.9%
	At school on my laptop	36.6%
	At an internet café	1.0%
	On my mobile device	2.5%
	While commuting	0.5%

Faculty were initially concerned that students were not devoting enough time to the modules and therefore were not taking in all of the information. However, over 80% of respondents reported using over 75% of the modules' content (Figure 4). This is a high percentage, especially considering that for many of the students, much of the information may have been review from either high school or past university courses. This is further supported by the fact that 25% of survey respondents were enrolled in level 2 or higher.

Figure 4: The Proportions of the Module Content Students Self-Report Using



Assessment of Modules

The assessment of both modules is based upon instructor satisfaction and impressions, as well as self-reporting by students. In the focus groups, respondents agreed that grades had either not changed in conjunction with the implementation of the geospatial and information literacy modules, or they had changed, but only to a small extent either positively or negatively. For example, when discussing the geospatial literacy module one participant stated:

> *It is hard to gauge. If marks are an indicator then certainly they are not doing any worse. They are possibly doing a little bit better. I do think the timing thing is important because if you remove any stress at all that is a positive thing, especially for first-year students at the very beginning of the term in first year.*

Another respondent illustrated the complicated nature of assessing student performance as it relates to the modules, particularly from one year to the next, specifically when trying to use test grades as a marker:

> *In terms of writing the test, it is hard to compare because we gave them a much more challenging test this year. They did really well. I think many of us were surprised at how well they did, but for me*

personally as I said the information literacy modules really play into these final capstone assignments as well. And I have had the lowest grades this term overall on the capstone assignments, but I don't know if it is that much related to information literacy, but a lot of it seems to be their writing.

Students overwhelmingly perceived that both the information and geospatial literacy modules improved their academic skills in the target areas. With respect to information literacy specifically, less than half of student respondents felt confident in their ability to find academic sources prior to completing the modules, and even fewer felt comfortable using either the McMaster Library database or a standard Internet search engine. While the academic community often assumes that students of the "digital age" are inherently comfortable using technology, the results show important areas for further analysis. With respect to each question related to self-reported learning, over 65% of students felt that the information literacy module improved their academic research abilities (Table 6).

Table 6: Reported Learning Before, and Improvement After, the Use of the Information Literacy Module

Before using the module I was:			After using the module I had:		
Confident in ability to find online academic sources for research (n=16)	Strongly agree	0.0%	**Improved ability to find online academic sources for research (n=16)**	Strongly agree	43.8%
	Agree	43.8%		Agree	25.0%
	Neutral	18.8%		Neutral	18.8%
	Disagree	18.8%		Disagree	12.5%
	Strongly disagree	18.8%		Strongly disagree	0.0%
Confident in ability to navigate the online McMaster library databases (n=16)	Strongly agree	0.0%	**Improved ability to navigate the online McMaster library databases (n=16)**	Strongly agree	33.3%
	Agree	25.0%		Agree	46.7%
	Neutral	12.5%		Neutral	13.3%
	Disagree	37.5%		Disagree	6.7%
	Strongly disagree	25.0%		Strongly disagree	0.0%
Confident in ability to efficiently use web search engines (n=15)	Strongly agree	6.7%	**Improved ability to efficiently use web search engines (n=16)**	Strongly agree	31.3%
	Agree	33.3%		Agree	37.5%
	Neutral	20.0%		Neutral	18.8%
	Disagree	20.0%		Disagree	12.5%
	Strongly disagree	20.0%		Strongly disagree	0.0%

Students entering university generally have a limited understanding of the basic skills of geospatial literacy, given that not all students have been exposed to them. The survey results support this assertion, as less than 41% of respondents agreed that they felt confident in their abilities to effectively read, understand and create maps, and to understand map scale. Even fewer were confident in their knowledge of basic map calculations and of map projections. Students felt strongly that the geospatial module improved their ability to understand maps in all categories. While students were most confident in their ability to read and understand maps prior to using the module (41%), the majority of students (83%) felt this skill had improved upon using the online modules. This means that at least half of those who were confident in their abilities prior to using the module

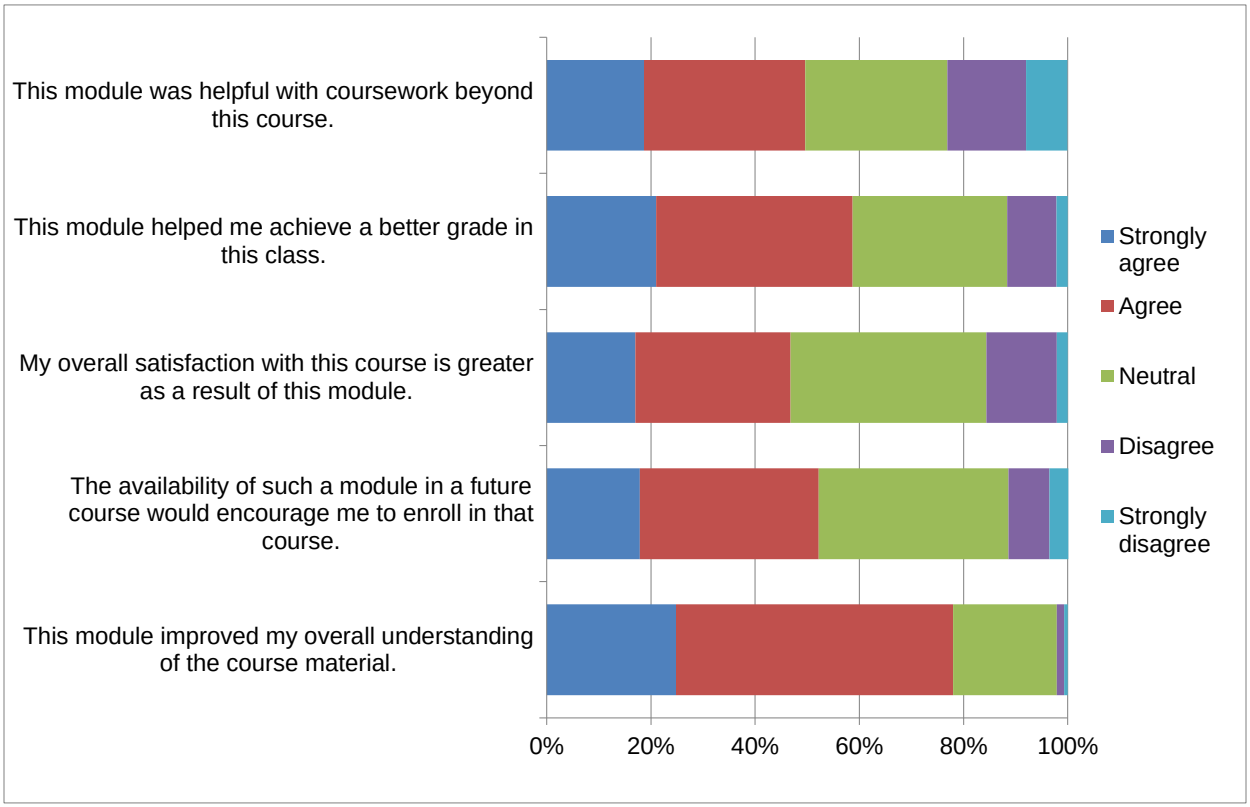
felt their skills had improved. Within each category, a minimum of 72% of students felt their ability to work with and understand geospatial information had improved (Table 7).

Table 7: Reported Learning Before, and Improvement After, the Use of the Geospatial Literacy Module

Before the module I was:			After using the module I had:		
Confident in ability to effectively read and understand maps (n=127)	Strongly agree	8.7%	**Improved ability to effectively read and understand maps (n=125)**	Strongly agree	32.0%
	Agree	32.3%		Agree	51.2%
	Neutral	28.3%		Neutral	16.0%
	Disagree	24.4%		Disagree	0.0%
	Strongly disagree	6.3%		Strongly disagree	0.8%
Confident in ability to create a map with all the necessary elements (n=126)	Strongly agree	3.2%	**Improved ability to create a map with all the necessary elements (n=126)**	Strongly agree	34.9%
	Agree	33.3%		Agree	46.8%
	Neutral	28.6%		Neutral	15.9%
	Disagree	27.8%		Disagree	0.8%
	Strongly disagree	7.1%		Strongly disagree	1.6%
Confident in knowledge of map scales (n=126)	Strongly agree	7.1%	**Improved knowledge of map scales (n=125)**	Strongly agree	30.4%
	Agree	29.4%		Agree	47.2%
	Neutral	31.7%		Neutral	16.8%
	Disagree	23.0%		Disagree	3.2%
	Strongly disagree	8.7%		Strongly disagree	2.4%
Confident in knowledge of distortions on flat surfaces (n=127)	Strongly agree	2.4%	**Improved knowledge of distortions on flat surfaces (n=126)**	Strongly agree	39.7%
	Agree	15.0%		Agree	42.1%
	Neutral	29.1%		Neutral	15.9%
	Disagree	34.6%		Disagree	2.4%
	Strongly disagree	18.9%		Strongly disagree	0.0%
Confident in ability to conduct general map calculations (n=126)	Strongly agree	2.4%	**Improved ability to conduct general map calculations (n=125)**	Strongly agree	30.4%
	Agree	15.9%		Agree	41.6%
	Neutral	23.0%		Neutral	20.0%
	Disagree	31.7%		Disagree	5.6%
	Strongly disagree	27.0%		Strongly disagree	2.4%

Student respondents for both sets of learning modules felt “Confident that the learning modules improved their overall understanding of course material”, with 78% agreeing with the statement (Figure 5). Given that improving student learning is the objective of any course, it is important that students feel that there has been improvement. Over 50% of respondents felt that “The availability of such a module in a future course would encourage me to enrol in that course.” Very few students reported being dissatisfied with the modules and the extent of their usage.

Figure 5: Student Perceptions of How the Online Learning Modules Improve Understanding of Material and Overall Satisfaction with a Course



Implementation Challenges

In the context of inquiry courses in the social sciences, discipline-specific course instructors acknowledged an inadequate amount of support for information literacy – or more generally, "library skills" – content delivery. While library staff were historically responsible for the delivery of these skills, many instructors are now delivering these course skills directly to their students. As one focus group respondent indicated:

> *There was some real unevenness in the comfort of the instructors as to how confident they felt they could teach these library skills... That was quite a challenge in feeling they were kind of downloaded with all this responsibility with not a lot of support. So the absence of face-to-face or real in-person librarian involvement was quite significantly felt I would say by the instructor.*

The burden associated with the heightened responsibility of instructors to provide library skills directly to students was acknowledged when one participant stated:

> *When we agreed to do the pilot the expectation was that a librarian would still be quite present. I expect for a number of reasons that wasn't the case, and so I think that was what made it particularly challenging as we began trying to figure out how to support our instructor so that they could really do a good job to help the students.*

Although some respondents were consistent in their perception of the benefits associated with students having full access to course resources, others were less so. Given that level 1 students made up the majority of those accessing the online modules, some instructors were concerned that they would be perceived as a non-course-related resource and thus overwhelm students. For example:

> *…the [advantages] tie into almost disadvantages in the fact that it is available as almost a separate resource for what is being done in class, and there is the possibility of it not being linked to the class material, and being perceived as something that is external and additional to the work that they are doing.*

Responses were mixed about the extent to which the module offered a form of blended learning. This could be related to the fact that most respondents were somewhat unclear about what constituted blended learning. However, despite being uncertain about the definition of blended learning, focus group respondents still believed in its usefulness:

> *I think we have given them [students] a good opportunity to learn. I still have as a preference the interaction between people rather than not having that at all, but given all the time constraints and so forth, this is perhaps a next best arrangement.*

Class size was perceived to be an important determinant of module success. Blended learning modules that were implemented in smaller inquiry-based courses with 25 to 30 students per class were seen as ideal settings:

> *I think the best way to do blended learning is to start with these smaller groups and see how we do that, and then there are some things that will lend itself to the larger class because there are two totally different entities [large vs. small class]. The real bonus of these inquiry courses in Social Sciences is that it is the only time these students are going to have a class with a small group where the instructor knows all their names.*

The challenges of implementation and acceptance of this type of learning into a traditional classroom setting are expected. The concerns raised by instructors and course administrators speak to the high level of teaching they have come to expect from their popular and well respected courses.

Cost

Throughout the focus group interviews, administrators agreed that the process of costing a blended learning model of instruction was near impossible due to the number of people involved, coupled with the uncertainty of the cost of the traditional face-to-face instruction of information and geospatial literacy. When asked, one participant indicated:

> *I think that would be hard. Nobody has successfully ever calculated the true cost of instruction in an accurate way.*

In addition to the staffing costs, the cost of training with and using classroom facilities and technology can be high. The cost of one session of instruction (staffing) was calculated at $361:

> *I thought that doesn't sound too bad, well in a sense it doesn't sound too high. It doesn't sound too low. But it is based on a multitude of assumptions, some or all of which could be faulty.*

A figure of $200 was calculated to cover the facilities cost; therefore, the cost of a face-to-face classroom session (staffing + facilities costs for one hour) totaled $561. However, in response to a question about the cost of the development of the blended learning online module, administrators were less certain:

> *I mean we could argue that what we paid them [CLL, Centre for Leadership in Learning], which was a fair amount of money, they probably covered their costs and I guess you could make an argument that the invoice equals CLL's commitment, that they more than covered their cost probably. But then there is a question of all our staff going back in time involving people that no longer work here to try and track down how much the cost of the project was, and it is a project that is still on-going.*

These findings suggest important implications. If, on one hand, administrators are unable to accurately cost a face-to-face model of instruction, then the possibility of doing a cost-benefit analysis of a face-to-face versus a blended learning model of instruction is low.

However, while participants were cognisant that the cost of the blended learning (online) model was high, it was suggested that the audience which could access the modules be expanded:

> *I know it cost a fair bit of money to do it, and it certainly cost staff time to get it all prepared but that is why in my point of view, the library should invest in other students too by posting it on the library website.*

In addition, participants recognized the value of making the modules available to students beyond level 1. If the modules were available on an on-going basis, as students move into higher levels, they could be beneficial as long-term reference materials. The notion of exchange possibilities within and between faculties, and with other institutions, was an important way to facilitate content sharing. However:

> *There has been a lot of effort in creating exchange possibilities, but there isn't a lot of clarity about how people are actually doing that, and of course there is not much clarity around technical platforms when you share something. To my knowledge there hasn't been any deep discussions around that, and the benefits in doing this are realized when you don't have to create every single second of media yourself, but those benefits are not being addressed yet.*

In order to create content-sharing opportunities, all modules would have to be non-course-specific in nature and free of copyright restrictions. In other words, their content would need to be generic, skills-based and clear of course specificity. An increased sharing opportunity has the potential to reduce costs in the long run as the number of people using created material increases. There is also the possibility of increased sharing between institutions to minimize the duplication of material creation.

Course-Tailored Modules

While participants agreed that making generic modules available through content sharing presented opportunities for collaboration with other faculties and universities, discipline-specific instructors valued the course-specific nature of the modules. In fact, many instructors supported further tailoring of modules to coincide exclusively with their course content. For instance:

> *Students' attention span is not very long and I feel like [the module] is quite lengthy with all the different sections. We don't all use the same material in terms of our assignments. We should be able to say, "I want section five, ten and eleven, and that is all I need," because otherwise we are asking*

> *the students to go through information that is not required of them. So to be able to specialize it to our course needs and the material that we are going to cover, I think would be really, really useful.*

Balancing this dichotomy of needs will play a role in the development of learning modules moving forward. As each of the modules can be viewed in a non-linear fashion, the onus may have to be on the students to view the portions of the module they need, with the rest being available for general interest. As students have access to the modules over the course of their academic careers, as long as the course shell remains in the learning management system, the non-specificity of the modules has potential value in the long term.

In addition, instructors valued the implementation of a quiz component to complement the modules, where students were required to view and understand the content in preparation for a summative test. In this way, the quiz became a checkpoint whereby instructors could track whether students were engaging with and absorbing the content of the modules. The modules require a higher level of student responsibility for their learning, as one respondent described:

> *That is the problem – if they don't [view the modules] and then they come into the lab and haven't viewed the material then you are going to really be spending a lot of time with so many students.*

Changing the context of the lab environment was an important objective of the geospatial literacy modules, and if students came to class having viewed the modules, then more time would be available for lab work and higher-level discussion with the instructor and other students. In addition, as described by one discipline-specific instructor:

> *We have homework assignments, but we also have homework tests that relate to the lab material. So one of the first homework tests they have is to watch the library modules and answer a few questions that we have developed based on it, and that kind of goes hand in hand with the student responsibility contracts we have as well.*

Module Development

Module development took place over a four-month period. As such, participants (administrators and discipline-specific instructors) agreed that these time constraints hindered their ability to elicit student feedback on modules. For example, as one respondent indicated:

> *I would have liked to see definitely a slightly longer timeframe just to get the feedback, we definitely want students reviewing things before they go out, and we need their input. The look and feel of things is important. It is very important to make sure they are involved.*

In addition, the sustainability of the modules would require that they become more adaptable and user-friendly, “shortening the production chain.” As one respondent indicated:

> *I think the modules that we introduce are so heavy in the sense that they are really long, really text heavy, they are taking a huge amount of manpower to edit so they are not agile, they are not flexible, they are not something that can be changed on the fly. So as we want to develop the blended learning program, we have got to adapt more tools that allow us to do things quicker.*

One respondent valued the collaborative nature of the module development process. Having contributions from a number of stakeholders helped to shape the online modules in a way that ensured that:

> *It was a pretty collaborative process with contributions coming from Earth Sciences people, and then adding the materials from the people in the map collection was really helpful. [Principal investigator] worked to sort of bring it all together, and then using the CLL staff. I think it all worked really well as a collaborative effort, which was good.*

In future module development it would be useful to use software that allows for little effort to update and edit created online modules. Also, the timeframe of four-months from concept to completion was much too concentrated and led to either rushed or missing feedback to the modules while they were being created.

Benefits of Online Modules

Despite the short development time, consistency in course content was a key advantage associated with online modules. Instructors conveyed the usefulness in having a pre-defined module in place:

> *This is a chance to get the instructional material right. I know even when I am teaching sometimes I make mistakes or omit things... But these modules have the opportunity to have the materials that is always available, in one place, and a chance to get it right.*

Online modules changed the context of the classroom and lab experiences of instructors, freeing them up to provide additional assistance to students. As one respondent indicated, by removing the course lecture component:

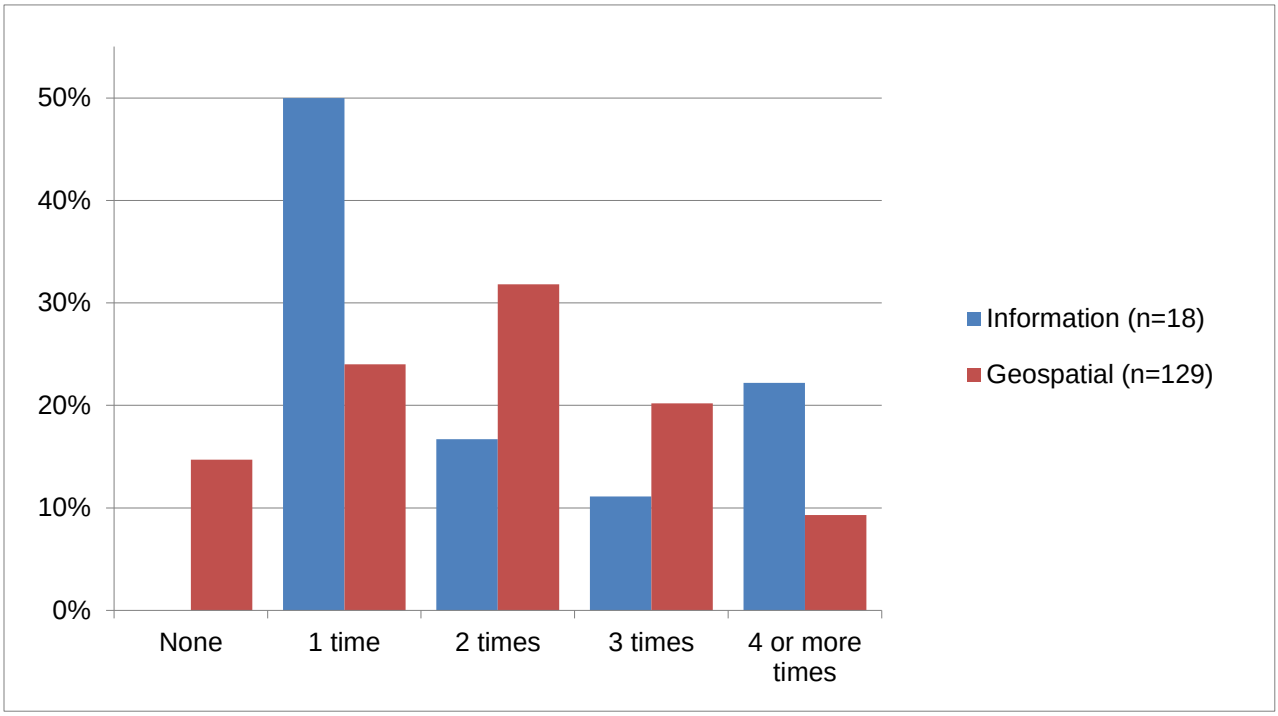
> *We didn't have to worry about the presentation part, and we could be floating around in the lab available for questions. If we weren't busy and if someone came in we could go off to the side and help them with whatever they needed, so that worked well.*

In addition to the changing classroom dynamics, providing students with additional resources for success was a key benefit of the online modules. For example:

> *I think from now being on both sides from the TA and now the instructional staff side, I do think it really does help. The library staff is still involved in the process with the delivery of the assignment. I think they are still key players in this, but the lecture material with these modules they do complement really well. So I think the more resources you can give to students to try and succeed even with the assignments, I think it does make a huge difference.*

The flexibility of being able to use the modules as a resource beyond that of a lecture is evident in responses to the student survey question “How many times after the first use did you refer to the module?” The results show that a large proportion of students revisited the module again after initial use, while only 15% of geospatial literacy module users did not refer back even one additional time (Figure 6). This finding indicates that students took responsibility for their own learning while taking advantage of the 24/7 availability of the material.

Figure 6: Response to Student Survey Question "How many times after the first use did you refer to the module?"



Focus group participants made a link between students having access to reference resources (i.e., modules) and reflection time, which helped to temper students' levels of anxiety in what had previously been a very busy lab setting:

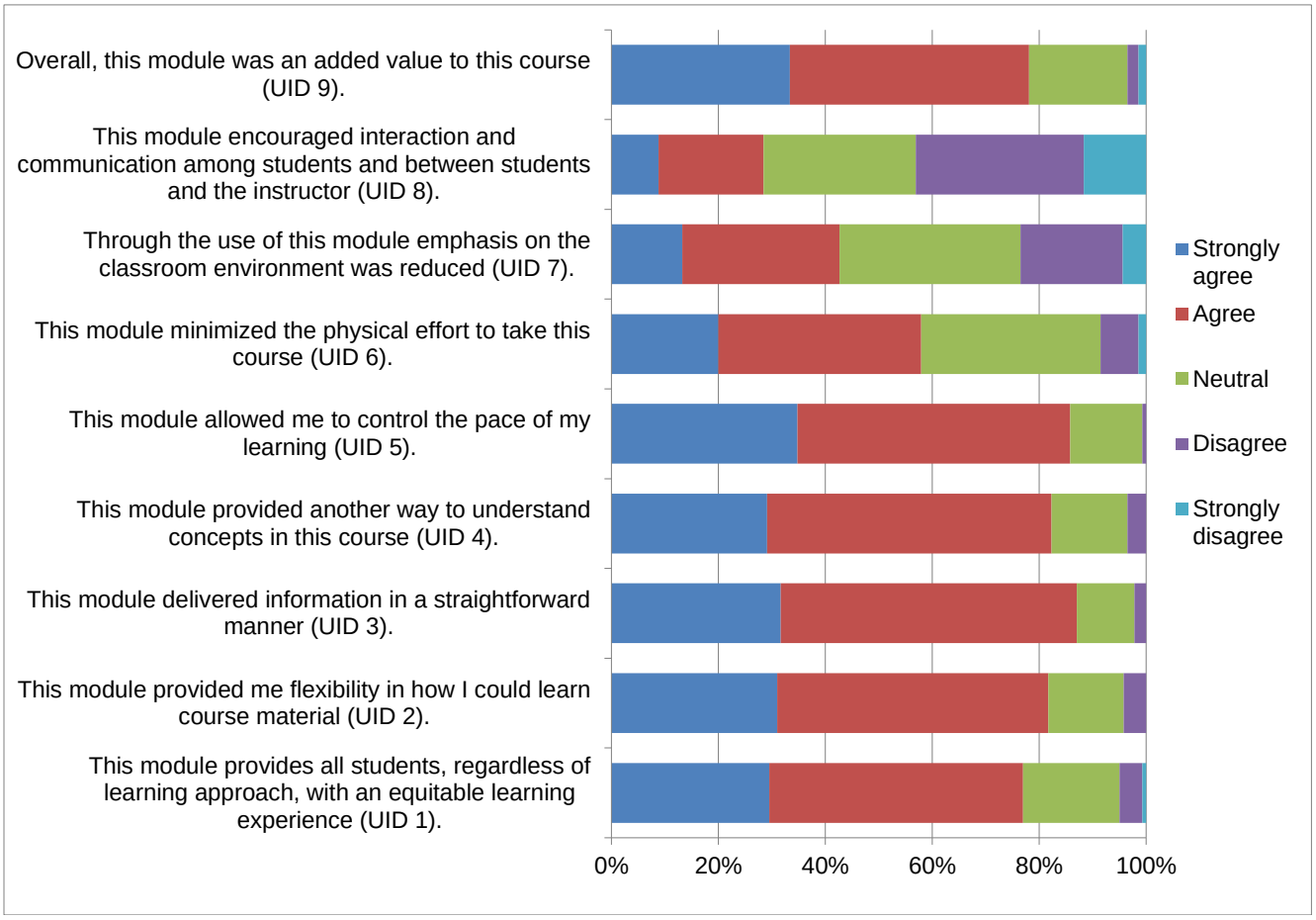
> *Students have time to actually take notes, reflect on it [the modules]. We do make sure to further develop it [the content of the modules] and we give them time in lecture to ask questions, and then when they show up they have time to complete the assignment. They have us there as a resource to ask questions as well, and it just seems a lot smoother. It is not as high anxiety. As well, we have noticed a big difference in seeing the way students interact with the assignment, and with each other. It is now a supportive environment as well.*

The perception of flexibility provided by the modules from the focus group data was further emphasised in the student survey response to the statement "This module provided me flexibility in how I could learn the course material" (Figure 7). While a small percentage of students who used a module felt that the module decreased their flexibility (4%), a large proportion felt that the modules allowed them to be more flexible in where and when they continued their studies (82%). This fits directly with the second principle of UID, as proposed by Johnston and Pliner (2004).

The student survey included questions regarding students' perceptions of the modules in relation to the nine principles of UID. A majority of students felt that the modules added value to the course (see Figure 7). The only UID principle which students did not feel the modules were successful in meeting was encouraging interaction and communication among students and instructors, with only 29% agreeing that this was the case

(Figure 7). This finding needs to be considered in future phases of this research. Figure 7 illustrates student responses to various questions related to UID. Each question is linked to one of the nine principles proposed by Johnston and Pliner (2004) and is identified within the graph. For example, the question “Overall, this module was an added value to this course” is linked to UID principle 9, as denoted by 'UID 9' in Figure 7 below.

Figure 7: Student Survey Results to Questions concerning the Success of the Modules in relation to Universal Instructional Design



Potential Areas for Improvement

Participants suggested several key improvements to the modules, including making them more interactive. For example:

> *If they were more interactive I would call it more blended learning where they are actually doing samples for geo spatial, like you can really see maps; there is more of an interaction with it. I don't find it replaces at all a lecture face-to-face, you are more learning how to blend it into your class to be able to use it than it being a standalone tool on its own.*

Another participant agreed, citing the value of interactivity of the modules:

> *I think most people were leery of it, but it turned out really, really well. The modules are semi-interactive and we have taken these modules to be sort of a first step that hopefully we will keep adding to and making them more interactive for students.*

Various focus group participants suggested adding different narrators to deliver course content within the modules to break any potential monotony.

Generic skills-based modules would help to further student development, particularly as they transition from level 1 into higher levels. The development of a module related to academic referencing style was perceived to be a useful addition to the existing online modules. As one respondent described:

> *I know they need help with referencing, but why does it have to be geography?... What those first-years should do – just like all the master's students have to do – an ethics module and a safety module... It would be good if they could have a referencing module that they could always access, because I find that is one of the big things."*

Further, it was suggested that these modules continue to be available to upper-level students. For example:

> *The theory behind inquiry is that you need to build on it, and reflect on what you are learning as you go, and that is how you become critical because nobody expects that in a one semester course that you are going to be great at all of these research skills. So the whole idea is if you don't keep using it and instructors don't keep building on it, students lose it.*

In response to the challenge of teaching library skills at the course level, a key improvement was to ensure that students had the opportunity to interact with the library itself vis-à-vis liaison training opportunities with someone in the library. As expressed by one respondent:

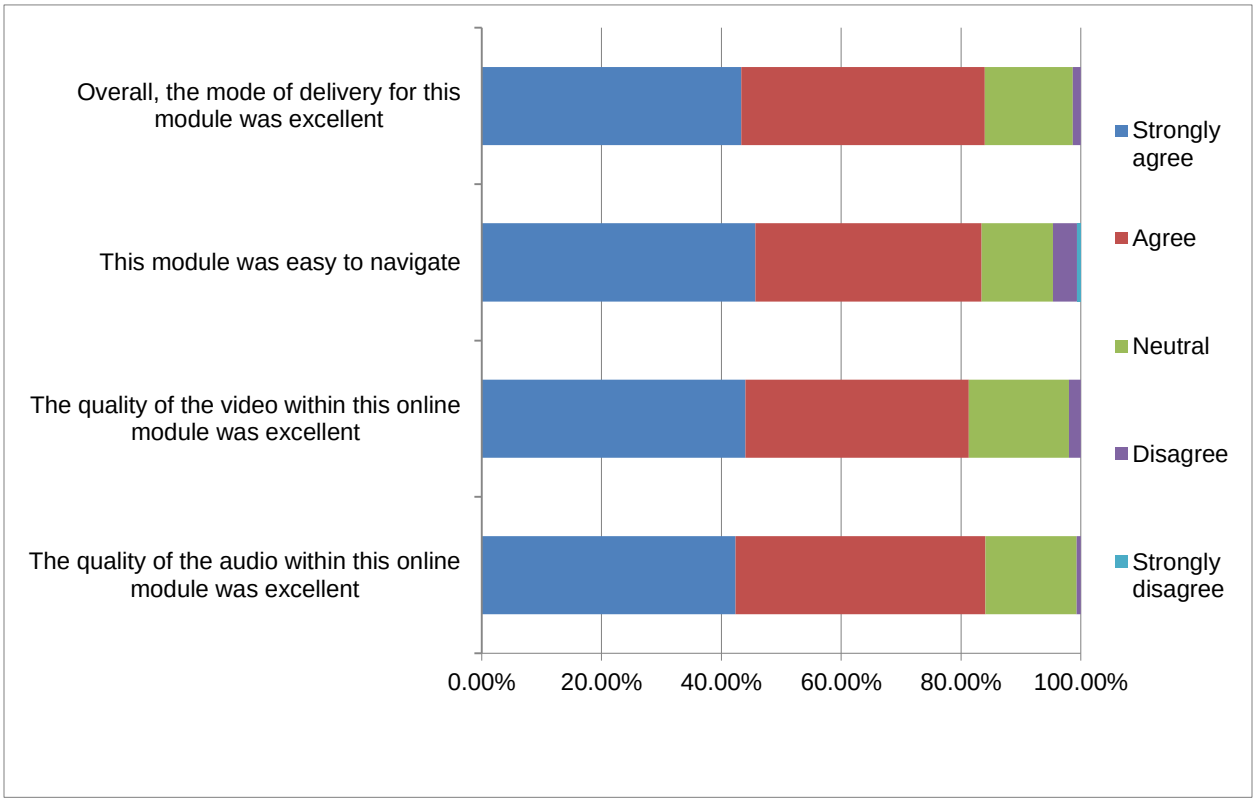
> *It is different when you are actually looking for journals online or in databases versus actually seeing stacks or pulling out a journal and looking at it. It is a totally different experience, and I think the hands-on part of it would be beneficial for them. So we need to have somebody in the library who can still do at some level some of that training, guiding students through some of this.*

In the same context, another instructor respondent had taken the initiative to invite a teaching librarian to the class for a short question and answer period related to the library skills module. Specifically:

> *It was helpful and the students liked it because they were comfortable enough. I did it towards maybe two-thirds of the way through the term, so the students were already comfortable enough with each other I think to ask questions. So overall I think it is great.*

Potential technological improvements were mentioned within the focus groups, such as sound and figure quality. Students viewed the quality of modules favourably with respect to audio, video and navigation (Figure 8).

Figure 8: Results on Questions of Student Satisfaction with Audio/Video Presentation and Organization of the Modules



Limitations of the Data

The two data sources used in the evaluation of both the geospatial and information literacy modules provide important information on their effectiveness and feasibility. However, there are a few limitations.

Online Student Survey

The student survey was more successful in the assessment of the geospatial literacy module than it was for the information literacy module. For example, student participation in level 1 human geography classes was 21.8%, much higher than the student participation rate of 9.4% in the Inquiry into Social Sciences course (Table 8). This discrepancy arose despite the fact that both surveys were administered to all three classes in the same manner: using a guest presenter to introduce the survey in the classroom, the learning management system to facilitate survey access, and one reminder to students. While a low participation rate does limit the extent of statistical significance of the survey results, it still allows for discussion of broader trends as they relate to the focus group findings. Where applicable, survey responses to general questions for both the geospatial and information literacy modules were amalgamated to increase sample size. Amalgamated survey questions included “Where did you access the modules?”, which represents a question that does not specifically ask about the content but rather how the modules were used. For all questions, the n value represents the number of students who answered that specific question. Students would skip certain

questions– and in some cases, multiple responses could be given for a single question. As a result, the n value is variable throughout the results.

Table 8: Response Rates for the Online Student Survey

Response Rate	Population	Number of Respondents (n)	% of Total Population
Information Literacy	235	22	9.4%
Geospatial Literacy	830	181	21.8%

Information Literacy Module Delivery

Focus group session participants indicated the various course instructors used the online modules in inconsistent instructional contexts. As with any course, instructors have the academic freedom to disseminate information to their students in the best way they see fit. With Inquiry 1SS3 being taught by numerous instructors, all with a different topic of study, there was an expected variation in the instructional methodology. In some cases, a short, librarian-led, face-to-face information literacy discussion was used to compliment the online modules, while in other cases the students relied solely on the online modules, without the added librarian-based discussion. Though this implementation discrepancy provides excellent background for further investigation, the anonymity of the survey means that the instructional context surrounding the student could not be determined. This inconsistency in how the modules were used could produce some bias in the student survey results. Such delivery inconsistency did not take place in the geography courses.

Conclusions

This study addressed the implementation and assessment of blended learning modules for geospatial and information literacy instruction in three level 1 courses at McMaster University. In doing so, qualitative focus group interviews and one in-depth interview were conducted in Winter 2013, together with a comprehensive online student survey. The results informed a series of implications and opportunities for pedagogical design and practice. Several main themes emerged from the data that related to the original research questions. These themes provided insight for future research directions.

The focus group results reveal the perception of a pedagogical burden on course instructors who have adopted a blended model of instruction as they need to reorganize their traditional teaching methods. It is not that the instructors are not willing users of blended learning – as they tend to speak positively of the experience – but that instructors would like more input and time to reflect on how changes in course delivery can be most effectively incorporated into their courses. This suggests that support services and long-term planning, which include instructors, are a critical component of blended learning, both for students (e.g., computer access, software, Internet connection) and instructors (e.g., course development needs, technical assistance) (Vaughan, 2007; Garrison & Kanuka, 2004). An opportunity exists to explore potential support services for this blended learning model, particularly as it relates to local, timely technical support in order to update the digital resources (Davis & Fill, 2007). In a recent study of institutional adoption and implementation of blended learning in higher education, the findings of Graham, Woodfield and Harrison (2013) indicate the need to create training opportunities to assist new and existing faculty members in implementing blended learning models of instruction. For example, the authors suggest providing technical training opportunities for teaching assistants to support their professors in implementing the online portion of the blended learning model. These types of support opportunities are valuable, particularly if there are plans to expand the current blended learning pilot model to large-scale courses.

Focus group respondents illustrated the importance of engaging students in the process of blended learning model development. This finding is supported by Moskal, Dziuban and Hartman (2013), who found that a number of factors are needed to implement a successful blended learning program. These factors include soliciting student input throughout the blended learning development and implementation process to inform effective practice, and ensuring the existence of a reliable and robust infrastructure to support students and faculty. Future iterations of blended learning modules should explicitly incorporate student feedback via focus groups during their creation.

Determining the cost effectiveness of developing a blended learning model of course delivery was complicated. Consistent with the findings of Garrison and Kanuka (2004), and given the collaborative nature of module development (i.e., administrative support, course developers, instructors, technical support), the fact that project hours were not tracked in a systematic way makes financial comparisons between online modules and a face-to-face instruction model difficult. While respondents were cognisant of the costly nature of developing and implementing online course modules, they also knew of strategies to balance the cost. Reusing existing and/or adapted learning resources would provide the opportunity for other institutions and organizations to purchase and utilize the modules (Malcolm, 2005). Repurposing and sharing existing online modules requires that they be “generic” and context-free (Olivier & Liber, 2003). The provision of generic geospatial and information literacy modules on a broader scale deserves further exploration, particularly on a cost-recovery basis. It is within this context that issues of intellectual property and ownership also need to be investigated (Wallace & Young, 2010). Evidence indicates that the sustainability of modules requires attention, given that they are costly and that technical project support tends to dissipate once the modules have been implemented (Davis & Fill, 2007).

Consistent with the literature on blended learning and student outcomes (Heterick & Twigg, 2003), focus group results suggest that student grades under the new model are consistent or somewhat higher than they were prior to the implementation of the blended learning modules. This result is consistent with student survey results, where they expressed their satisfaction with both the logistics and effectiveness of the learning modules. Further assessment and evaluation is warranted, particularly if this model moves beyond the pilot stage and into a more permanent feature in the undergraduate programs at McMaster University. In this way, an opportunity exists to re-assess the course curriculum and, in doing so, better understand how and where blended learning models might be incorporated.

The overall positive feedback on the learning modules can at least be attributed in part to the conscious decision of the University to make every attempt to comply with Universal Instructional Design. Students indicated that by meeting UID principles, the modules contributed to their learning. Future research involving further integration of these principles – in particular, the inclusion of student-to-student and student-to-instructor communications – is needed.

Future research opportunities exist in this area through an exploration of student satisfaction with the blended learning model, particularly as it relates to learning style (i.e., deep vs. surface) (Vajoczki et al., 2011). While this research explored administrators’ perceptions of blended learning models, further analysis is warranted to better understand the link between collaborative leadership in the context of blended learning at all institutional levels (Garrison & Vaughan, in press). Within the student survey, additional questions intended to gauge students’ general participation rates in course activities, such as textbook readings and attendance, would be helpful and could potentially lead to interesting results about which students this type of learning reaches most effectively. The Blended Learning project supports McMaster’s desire to improve student learning and its commitment to innovation in teaching and learning.

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