A Case Study of the Perceptions of Student Participants in an
Undergraduate Research Initiative at City University

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ABSTRACT

Undergraduate research is an area of increasing interest and focus in postsecondary education. Hands-on undergraduate research initiatives are believed to lead to learning outcomes that serve the student in a number of ways, including career choice, employability and tools for lifelong learning. They also advantage employers by facilitating the development of skills that have been identified as desirable for the receptor-community into which they choose to enter, whether that is academia, government, industry, not-for-profits or entrepreneurial activity. There is growing demand from all stakeholders to know what benefits, if any, accrue from participation in undergraduate research programs.

The purpose of this mixed methods study was to describe and evaluate the experiences, perceptions and attitudes of participants (n=175) in a case study of the Undergraduate Research Initiative (URI), a full-time, non-curricular, twelve-week summer project, driven by the research interests of students who are mentored by a faculty member, at City University in Ontario. The study aimed to determine the scope of effects on skills and learning outcomes across a diverse range of disciplines (n=40) from the student perspective.
Inquiry was based on identifying learning outcomes as reported by participating students; the extent to which perceptions varied by faculty/discipline; the extent to which perceptions aligned with university undergraduate degree level expectations (UUDLEs) as set out in Ontario’s Quality Assessment Framework; and the extent to which students’ expectations were met by the URI program. An additional area of interest was to examine the synergies and gaps between reported student learning outcomes, university undergraduate degree level expectations, and workplace-identified skills.

Findings from this study showed that perceived learning outcomes as a result of participation in the URI program covered a broad spectrum of themes and comprised all three domains (cognitive, affective, and psychomotor) identified by Bloom (Bloom, 1956). The fact that the URI experience led to the development of skills recommended in the UUDLEs guidelines, speaks to the value of the program for accountability purposes. The universality of impact of the URI program across disciplines was somewhat unexpected, but is a strong argument for the importance of program design in meeting objectives.
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To my dearest friends, for your patience and support;

To my colleagues, for your understanding;

To my parents, for taking care of the family;

To my family, for enduring all the shouting;

To my husband, Mladen, for everything.
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CHAPTER ONE

Introduction

The purpose of this research study was to explore and describe the experiences of participants in a case study of an undergraduate research initiative (URI), conducted at a university in a large, multiculturally diverse city in Ontario, Canada, to determine the scope and diversity of learning outcomes resulting from this experience, as identified by participants, across a broad range of disciplines. Undergraduate research experience is an area of increasing and immediate importance in postsecondary education, not only in Canada, but globally. The knowledge economy is well served by a combination of real experience and traditional, theoretical learning; however, in my professional experience, undergraduate research programs can be both costly and resource-intensive. Thus, there is growing demand both from the stakeholders who must justify the costs, such as individual institutions and government agencies, to the beneficiaries, namely students and future employers, to know and understand what, if any, the benefits of participating in undergraduate research programs are, and the best way to achieve them. How can universities and colleges engage students within the mission and mandate of the institution, while helping them to develop the skills that they need to become productive members of the economy and help enhance Canada globally? The current debate is testimony to the conservative nature of our traditions that after more than two centuries since the idea of experiential learning first entered the literature on higher education, we are still struggling with the balance between the more traditional classroom learning and hands-on, experiential learning that is the subject of this study.
The scope of programs offered at City University included a range of disciplines: Engineering, Science, Architecture, Arts, Community Studies, Communication, Performing Arts, Design, Business and Management. Its focus on serving societal needs by offering professional and quasi-professional university programs provided a unique opportunity to explore and compare student perceptions of learning outcomes gained from participation in undergraduate research, across a broad range of disciplines. This evaluative case study focused on the Undergraduate Research initiative (URI) at City University, a model that was developed for that institution. The model combined practical, hands-on experience under the mentorship of a faculty supervisor, with the theoretical body of knowledge that is necessary to the conduct of research, provided by subject matter experts in Workshop format. It also encouraged poster and/or oral presentations, student participation in publications and exposure to symposia in the selected research area.

1.1 Background of the Problem

In 2011, the Ontario Ministry of Research and Innovation, a strong supporter of university research, was renamed the Ministry of Economic Development and Innovation. In part, this change reflected a shift that had been occurring in this province over several years, through which the government has been signaling the need for postsecondary education and research institutions to go beyond traditional instruction, and find ways to be more directly involved in contributing to the economic well-being of the nation. In 2012, there was another renaming, this time to the Ministry of Economic Development, Trade and Employment – a further signaling of the shift in direction that the government appears to be taking to engage
postsecondary institutions in being cognizant of, and proactive in, ensuring learning outcomes that will meet the future career needs of their graduates.

Indeed, this shift presages the current issue of skills shortages or mismatch, which has been linked to government and higher education policy, the question being whether institutions are graduating students with the right skills. Post-secondary institutions, while on the one hand celebrating experiential learning as beneficial, on the other hand are forced to act through their budgets, appointments and curricula. These constraints have made it challenging to reimagine and reconfigure the balance between traditional classroom teaching and experiential learning, which government is demanding of its public education institutions. The adjustments required across the post-secondary sector - philosophically, practically, and in terms of policy – are enormous and require a system-wide coordination of effort, resources and resolve.

Undergraduate research is not a new idea. In 1810, a German research university, the University of Berlin, was founded on the ideas of Wilhelm von Humboldt, whose central principle was the union of teaching and research in the work of the individual scholar or scientist, and who believed that students should participate in the function of the university, which was “to advance knowledge by original and critical investigation” (Anderson, 2010). This approach, however, was contrary to the traditional British model, which relied on the tutorial. Interestingly, specific reference to the term ‘undergraduate research’ was not made in early European institutions such as the University of Berlin, or in Scotland, where William Robertson's approach to education held sway, although while not widely used, it did show up as a term in the late 1800s and early 1900s in the United States (Kinkead, personal e-mail, 2013; Kinkead,
Klos, the founding director of the Office of Undergraduate Research at the University of South Florida and editor of a book on models of undergraduate research in the Arts and Humanities, indicated that it wasn’t until 2004 that she heard the term ‘undergraduate research’, although she had done it herself and was engaged in it with her students (Klos, 2011).

In 1894, John Dewey became Chairman of the Department of Philosophy at the University of Chicago and in a letter to his wife that year, he described his concept of what a school should be, “a school where some actual and literal constructive activity shall be the centre and source of the whole thing...” (Dewey, 1894). In 1896, this vision became a reality in the University Elementary School (the Dewey School) of the University of Chicago. It was where Dewey began to “work out in the concrete, instead of merely in the head or on paper, a theory of the unity of knowledge” by which he meant that knowledge is inseparably united with doing in the sense that people do things that result in learning, which if useful, is carried over to and incorporated into future activities (Menand, 2001 p. 320). This is quite different from the transfer of knowledge in a traditional classroom education, where teachers disseminate information in a vacuum.

A 1922 American Chemical Society report took this a step further by emphasizing the importance of the undergraduate researcher being trained in the use of the literature to learn how to find results of previous work for him/herself, and that he/she should develop personal initiative in identifying and approaching the problem to be addressed (Parsons, 1922). This is a further step in the recognition of experiential learning in the development of the undergraduate student. That same year, Union College began to require undergraduate
research for certain degrees, and tellingly, they were the first institution in America to replace Latin and Greek with French and German, a sign of the impact that the more pragmatic German higher education model was having worldwide (Kinkead, 2012). While not explicitly stated, one obvious result from this approach is that the student might actually contribute to the body of knowledge in their field.

The National Science Foundation (NSF), established in 1950, saw the advent of a coordinated focus on undergraduate research. One of its earliest meetings, in 1953, was to discuss how to improve undergraduate education in the sciences, which continued to strengthen interest in educational innovation and undergraduate research, with a focus on inquiry-based instructional practices in addition to research into the process and practice of education (Kinkead, 2012; National Science Foundation, 2014). This focus continues to the present time.

The Boyer Commission Report had a great impact on undergraduate research (Boyer Commission on Educating Undergraduates in the Research University, 1998). Following on the heels of a number of studies, including the American Council on Education (American Council on Education, 1988) and the National Science Foundation (National Science Foundation, 1993), the Boyer Report accuses research universities of failing their undergraduate populations, and challenges them to reinvent themselves as “intellectual ecosystems” with shared goals of exploration, creativity, investigation and discovery (Boyer Commission on Educating Undergraduates in the Research University, 1998 p. 9). In a 2003 follow-up study, Katkin reports that the Boyer Commission report recommendations “to make research-based learning the standard” (Boyer Commission on Educating Undergraduates in the Research University, 1998 p.
15) is both “labor-intensive and expensive” (Katkin, 2003 p. 37), an assessment confirmed by my own observations in the Office of the Vice President, Research and Innovation. As for the progress that was made in the five years since the Report, Katkin observed a trend in increased undergraduate participation in supervised research and scholarly activity (Katkin, 2003).

Institutions are beginning to look at the educational process more holistically, and one model that is emerging utilizes the knowledge gained through traditional instruction, to leverage comprehensive understanding of the research process through the combination of the students’ interests, ability and self-motivation and individual mentorship (OECD, 2012). Ontario and Canada, it is argued, must depend on a workforce that knows how to be innovative and creative, is able to think critically, problem-solve and understand the meaning of teamwork, especially in a global economy.

There are a number of design principles found in the literature for undergraduate research programs. They can be curricular, co-curricular, or completely outside the curriculum. Some are paid in the form of awards or employment and some are unpaid in the form of volunteer experiences or credit courses. They can be faculty-, departmental- or institutionally-based. They can be offered in the summer or throughout the academic year. Some are based on merit, some on need, and some on a combination of both. They can be at the students’ home institution or at a partner institution. Sources of funding can come from the institution, the faculty researcher, donors, government, industry partners or a combination of all of these.

I had the privilege of designing and implementing a new model for undergraduate research at City University. Undergraduate research generally takes place within the fairly narrow confines of the research project itself. In this model, the student-initiated research
proposal, once accepted, became part of a much larger program that sought to break down disciplinary barriers and expose students to a much broader research landscape through a series of mandatory workshops, poster and oral presentations, publication opportunities and potential travel to symposia. The required workshops, learning strategies and outcomes that comprised the 12-week intensive summer program, continued to evolve between the program’s inception in the summer of 2010 and the end of the third cohort year in 2012. The students who participated were as diverse as the faculties from which they were drawn, bringing a wide range of experience, interests, knowledge and skills. Students applied for the program at any time following the completion of their first year. Requirements included the same minimum GPA as would be expected if they were applying to graduate school, since encouraging pursuit of a graduate level education was one of the goals of the program. Around this time, there was emphasis on graduate expansion both from the government and from City University.

The Undergraduate Research Initiative (URI) program at City University is the focus of this case study. It was a non-credit research experience conducted outside the regular curriculum, during a 12-week, intensive time period under the direct supervision of a City University faculty researcher. The program was conceived in the early spring of 2010 following discussions with members of City University’s Executive Administration. These discussions identified the resolve of the Administration to provide meaningful research experiences to undergraduate students in keeping with the institution’s mandate and the emphasis on increasing graduate enrolment. As a diverse, multi-disciplinary university, it was important that students from all faculties and departments were eligible to apply. The first phase was
launched for implementation in the summer of 2010. There was overwhelming support from across the University – academia, students, and administration. In brief, eligible undergraduate students were to submit an application together with a faculty member, to engage in a research project (either discrete or as part of the supervisor’s ongoing research program) that was of interest to the student. Successful applicants are awarded a scholarship to support them during the 12-week summer term. This is described in more detail in Chapter 3.

The URI model at City University strove not only to provide a research experience to undergraduate students, but to bring together young minds from a wide variety of disciplines, encouraging a cross-pollination of ideas and experiences to bring innovative solutions to research issues. It was hoped that in this way, undergraduate research might become a mechanism for innovation and interdisciplinarity, where traditional training and mentorship meet the immediacy of the real world. If the benefits of the programs can be demonstrated, then institutions that offer them will become very attractive to potential students. However, there is considerable cost associated with the successful implementation of these programs – they are extraordinarily resource-intensive. That being the case, potential funding bodies - governmental, institutional or industrial – will need to be convinced of the relevance, efficacy, efficiency and value of undergraduate research programs before they are willing to make the investment. It is important, therefore, to establish as direct a link as possible between cause (educational experience) and effect (learning outcomes). In his article, *Assessing What Really Matters in Student Learning*, Kuh observes that,

> Without knowing how students spend their time, it’s almost impossible to link student learning outcomes to the educational activities and processes associated
with them. In the absence of this information it’s hard to know where to target institutional effort and resources in order to enhance student learning. (Kuh, 2001)

This case study examined the relationship between a specific model of undergraduate research (URI) and the learning outcomes that were attributed to that particular educational activity, as perceived by participants in the URI program. It also examined the extent to which students’ reporting of what they learned through this experience is both aligned with and fulfills Ontario’s University Undergraduate Degree Level Expectations (UUDLEs) across a broad range of disciplines.

In a 2007 paper published in the journal Science, Russell et al reported that undergraduates involved in ‘hands-on’ research are more likely to pursue advanced degrees and careers in science, technology, engineering and mathematics (Russell et al., 2007). These authors also determined that no particular method of program delivery was favoured, but that enthusiasm and early exposure were important (Russell et al., 2007). In their study, all of the survey participants were engaged in science, technology, engineering and mathematics (STEM) disciplines. On the other hand, there is a perceived cultural divide separating research in the Humanities from that in the sciences (Rogers, 2003). While bringing the student ‘into the laboratory’ is a solution within the science domain, scholarship in the humanities has historically been regarded as somewhat non-collaborative (Rogers, 2003). It involves a lot of solitary research with little place for undergraduate students. Because of the differentiation between ‘teaching’ and ‘learning’ in the classical sense, some humanities’ researchers actually
see a risk associated with student involvement, in that it could lessen the prestige with which
the scholarly publication is received (Wilshire, 1990).

The Social Sciences and Humanities Research Council (SSHRC) in Canada has done much
to change the parameters of humanities’ scholarship away from being a solitary endeavour. In
Future of the Humanities recommended providing “grants to groups of humanities researchers
to develop collaborative and/or interdisciplinary proposals” (Working Group on the Future of
the Humanities, 2001 p. 10). A survey of meeting minutes from the Annual SSHRC Leaders
Meetings revealed that there appeared to be a “disconnection between the universities’
research and pedagogical mandates, particularly in regard to undergraduate students” (Social
Sciences and Humanities Research Council, 2011 p. 2). It was also suggested that universities
need to respond to the new economy by building entrepreneurial and innovation skills at the
undergraduate level (Social Sciences and Humanities Research Council, 2011 p. 4). Thus, if we
accept Astin’s conclusion that institutions need to offer new experiences, new ideas, resources
and people (Astin & Astin, 2000), then it follows that we need to find ways to incorporate the
concept of undergraduate research experiences into all disciplines of study.

**The skills gap debate.**

Addressing a Canada-US business group in November 2012, Prime Minister Stephen
Harper called for postsecondary institutions to focus on specific skills, particularly in trades,
science and engineering, noting that individuals’ choices for education are tending to create a
chronic shortage of certain skills (Whittington, 2013). One of the challenges of this approach is
that every time technologies or industry requirements change, Canada would need to modify
programmes within the post-secondary sector to train/retrain the workforce. To view the skills gap in such narrow terms is short-sighted, since it ties education and employment to ever-changing workforce needs. Chegg defined the issue very succinctly, stating that, “Something at the intersection of higher education and workforce preparedness is misaligned” (Chegg Inc., 2013 p. 1).

I would argue that the misalignment results in part from confusion over what the missing skills are, whose responsibility it is to ensure that graduates entering the job market possess them, and how students can most effectively acquire them. The recently released Hays Global Skills Index Report suggests that skills shortages are not directly linked to the state of the economy in any one country, but are associated with government and higher education policy, whether institutions are graduating students with the right skills, and how effectively employers train their workers (Oxford Economics & Hays Recruiting Experts, 2013).

The first question to ask, therefore, is “Have the missing skills been identified?” Interestingly, the modern word ‘skill’ derives from the Old Norse ‘skil’, which translates into “knowledge or understanding of something” (Onions, 1944 1906). In the Chegg study, 1,000 hiring managers were consulted about what mattered to them when hiring. Skills they identified as being necessary to succeed in the workplace include, a demonstrated initiative to lead (93%), participation in extracurricular activities related to their field of study (91%), and others such as prioritization skills, completing a project as part of a team, problem solving, organization, working independently, communication, writing, and making a persuasive argument (Chegg Inc., 2013). In May 2013, Microsoft Partners in Learning and the Pearson Foundation conducted a Gallup poll to measure 21st century skills, which they define as
“advanced skills that prepare and equip youth for the challenges and demands of work in the 21\textsuperscript{st} century” (Microsoft Partners in Learning et al., 2013 p. 4). These skills were identified and defined by the Innovative Teaching and Learning Research project as: collaboration, knowledge construction, problem solving and innovation, self-regulation, the use of technology for learning and skilled communication (Microsoft Partners in Learning, 2013). In a speech to the Empire Club of Canada in March, 2013, David Naylor, as outgoing President of the University of Toronto, argued that thinking quantitatively, communicating effectively, analyzing critically and applying sound reasoning to challenging issues are skills needed by all individuals to confront challenges “that are more intertwined, complex and social than ever before” (Erin Millar, 2013 p. 2). To succeed in the modern economy, graduating students will need a set of meta-skills that go beyond short-term technical expertise. These skills serve to facilitate student success over a lifetime of learning, and encompass the ability and knowledge to apply what one has learned elsewhere to new challenges.

This brings us to the second question, “Whose responsibility is it to ensure that graduates possess the skills identified as critical for success in the workplace?” In other words, what is the nature of the relationship between what the workplace is looking for and what universities believe they should be providing? Table 1 lists skills that have been identified as needed by the workplace (Chegg Inc., 2013; Microsoft Partners in Learning et al., 2013), together with skills that universities have identified (Ontario Universities Council on Quality Assurance, 2012) as their responsibility to provide.

1.2 Statement of the Problem Situation

Surveying the websites of a cross-section of 31 Canadian universities (Alberta, Algoma,
British Columbia, Brock, Calgary, Carleton, Dalhousie, Guelph, Lakehead, Laurentian, Manitoba, McGill, McMaster, Memorial, Nipissing, Ontario College of Art and Design, Ontario Institute of Technology, Prince Edward Island, Queen’s, Royal Military College, Ryerson, Simon Fraser, Thompson Rivers, Toronto, Trent, Western, Wilfrid Laurier, York) I found that the most common

Table 1: Workplace Skills Demand Compared to UUDLEs

<table>
<thead>
<tr>
<th>Workplace Skills (Chegg Inc., 2013; Microsoft Partners in Learning et al., 2013)</th>
<th>University Undergraduate Degree Level Expectations (UUDLEs) (Ontario Universities Council on Quality Assurance, 2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A demonstrated initiative to lead</td>
<td>The exercise of initiative, personal responsibility and accountability in both personal and group contexts; Decision-making in complex contexts</td>
</tr>
<tr>
<td>Collaboration/ Teamwork</td>
<td>Working effectively with others</td>
</tr>
<tr>
<td>Prioritization and self-regulation</td>
<td>The ability to manage own learning in changing circumstances</td>
</tr>
<tr>
<td>Ability to make a persuasive argument</td>
<td>Ability to review, present and critically evaluate qualitative and quantitative information to develop lines of argument</td>
</tr>
<tr>
<td>Reasoning skills Knowledge construction</td>
<td>Ability to use a range of established techniques to initiate and undertake critical evaluation of arguments, assumptions, abstract concepts and information; Developed critical thinking and analytical skills inside and outside the discipline</td>
</tr>
<tr>
<td>Problem solving</td>
<td>An understanding of methods of enquiry or creative activity, or both, in primary area of study that enables student to devise and sustain arguments or solve problems using these methods.</td>
</tr>
<tr>
<td>Communication skills</td>
<td>The ability to communicate information, arguments, and analyses accurately and reliably, orally and in writing to a range of audiences.</td>
</tr>
<tr>
<td>Participation in extracurricular activities related to field of study</td>
<td>Developed, detailed knowledge of and experience in research in an area of the discipline</td>
</tr>
</tbody>
</table>

*Innovation
*Organization
*Working independently
*Technology use

*Highlighted columns indicate those skills that are not explicitly identified as UUDLEs.

undergraduate research opportunities conducted outside the curriculum were those offered by the Granting Councils (e.g., NSERC’s Undergraduate Student Research Awards (USRA) and
CIHR’s Health Professional Student Research Awards). There were also some programs offered at the departmental and faculty levels. I found that the majority of programs are based in and coordinated at the faculty level, regardless of the source of funding. Interestingly, while two of the three federal granting councils (CIHR and NSERC) currently fund undergraduate research awards, SSHRC had no program in place at the time of this case study. Some of the universities had implemented USRAs for Social Science and Humanities students as well as for Science students whose mentor did not hold an NSERC grant. Other than anecdotal evidence, none of the institutions that I contacted were aware of any formal assessment of learning outcomes as a result of the undergraduate research opportunity.

This is in contrast to literature on undergraduate research in the United States, where I found many studies, although mostly in STEM disciplines, describing the experiences of undergraduate students who have participated in a research program. I found much less about the specific benefits of the program in other disciplines, including Humanities, Communication, Design, Management and Community Studies. I believe that assessment of the City University model is valuable in that it presents a first-time opportunity, using a single model, to study and compare the effects and impact of an undergraduate research program on students’ learning outcomes across a broad spectrum of disciplines. Due to the resources required for the URI program, it would be beneficial to examine whether this is an efficient model that could have a significant impact on all participants, regardless of the discipline in which they are engaged. This case study sought to determine the impact of the URI program at City University through an analysis of what learning outcomes were achieved as perceived by student participants; to
what extent those perceptions varied by discipline, gender and academic term; and whether student expectations were met by the program.

1.3 Purpose of the Study

Based on my own experience and personal observations made over my 30-year career in the postsecondary sector, factors such as career indecision, apathy and the lack of meaningful engagement are among the primary impediments to a positive and successful undergraduate student career (Pascarella & Terenzini, 2005; Upcraft et al., 2005). The opportunity to participate in a mentored research experience has been shown to increase the sense of engagement (Chickering & Gamson, 1987), but it can also motivate students to explore and take advantage of opportunities that might not previously have been considered, such as graduate school and the facilitation of career choices.

This study explored the experiences of three cohorts of students who have participated in the City University URI to determine the effects and impact of a model for undergraduate research experience on students from a diverse range of disciplines. Using quantitative and qualitative data from all student applications (both successful and unsuccessful), final reports from successful student participants, an online questionnaire sent to all successful students and personal interviews involving successful URI Scholars over a 3-year period (2010-2013), I focused on the nature of the perceived learning outcomes, the extent to which disciplinary comparisons or contrasts could be made, and finally, the relationship between learning outcomes resulting from participation in the URI program and learning expectations as prescribed by the province of Ontario through the UUDLE’s rubric.

1.4 Rationale
I believe that experiential learning has the greatest potential for meaningful change in education. I’ve been involved in research administration my entire professional life, and have seen the sense of accomplishment, pride and astonishment when students are able to connect with enthusiastic mentors, design a research project, learn how to test their hypotheses and present their findings. I believe that it can be an extraordinarily empowering experience for a student, and one that has implications well beyond the classroom. I also feel that experiential learning can help institutions achieve the broad set of learning outcomes that are increasingly being identified as program goals.

Students are graduating from undergraduate programs at universities and colleges often lacking in any hands-on experience that could have helped them in making and succeeding in career choices, as well as impacting their decisions about whether or not to proceed to graduate studies. The evidence for the positive impact of an undergraduate student experience in research in science is overwhelming (Lopatto, 2007; Lopatto, 2004; Astin, 1993; McGee & Keller, 2007). The right undergraduate experience can change the learner by revealing career options not previously known, by instilling confidence and potentiating abilities, and by making them part of a team.

The findings of this study will provide data that will enable the assessment of the efficacy of one model of undergraduate research programs in achieving desired learning outcomes. Although the findings are not generalizable beyond the case study initiative, it may also provide other institutions with helpful data for making informed decisions about creating or modifying such programs at their own institution. For example, the findings may encourage
them to assess the extent to which the outcomes anticipated by the student align with institutionally-identified outcomes.

As a senior administrator at City University, responsible for the design, implementation, development and management of the URI program, I was in a unique position to observe the intersecting priorities of government, educational institutions, students and industry partners. The government wanted a postsecondary sector that was responsive in providing a relevant and appropriate education that would contribute to a prosperous economy. Post-secondary institutions sought appropriate resources to optimize the educational experience. Students wanted an education that also gave them career opportunities upon graduation. Industry demands included access to a highly-trained workforce in the midst of a skills shortage. I strongly believe that undergraduate research training can have a positive impact on all of the above, and that this study provides new insight into its broad impact. As a first-generation undergraduate student, I believe I would be a different person if I had received the support and mentorship that the URI program offers, and I feel compelled to explore the learning experiences of these first three cohorts to examine the impact on future generations of undergraduate students. Based on anecdotal feedback from students who have participated in the URI program, as well as senior faculty and departmental administrators, this program is seen as desirable at all levels within the institution. This case study sought to test that perception.

1.5 Worldview

For the most part, I am approaching the subject of undergraduate research and its impact, from the worldview position of pragmatism, whose proponents include Peirce, James,
Mead and Dewey, and more recently Rorty, Murphy, Patton and Cherryholmes (Creswell, 2009
10), insofar as I am trying to solve or add to the value of a real problem with a real world
approach.

As a worldview, pragmatism emerges from “actions, situations, and consequences
rather than antecedent conditions” (Creswell, 2009 p. 10), or as Peirce states, “the method
prescribed in the maxim is to trace out in the imagination the conceivable practical
consequences – that is, the consequences for deliberate, self-controlled conduct - of the
affirmation or denial of the concept” (Peirce, 1905 p. 494). In other words, the focus is on
identifying the issues and looking for solutions to the problem (Patton, 2002).

Pragmatism originated as a philosophical movement whose proponents supported the
view that a proposition is true if it works adequately, and that its meaning comes from the
consequence of accepting it. In his early Chicago School, Dewey was himself a practitioner of
pragmatism. He was trying out a theory by introducing applicability into the curriculum, which
consisted of goal-directed activities that mimicked real life. In other words, the process of
inquiry commences when the inquirer structures uncertainty into a problem (Ezorsky, 1967). It
was through these relevant activities that he incorporated instruction in math and science. As
Menand points out, “the pedagogical challenge, crucial to the theory, was to make the learning
indivisible from the doing” (2001 p. 323). Pragmatism in this sense was closely tied to the idea
of functionalism, the practitioner of which is concerned with what people do, and not with the
workings of the brain while they’re doing it (Menand, 2001).

This is an appropriate worldview for this particular research study for several reasons.
The foremost is the freedom of choice that it offers. Pragmatist researchers are interested in
the ‘what’ and the ‘how’ depending on the consequences (Creswell, 2009), and mixed methods research provides the opportunity to draw from multiple sources of information, and ways to analyze it in order to arrive at the most comprehensive understanding of the issues. This is a mixed methods’ case study to determine the impact or consequences of a new learning initiative on students, so that rather than preceding practice, theories and explanations follow from observations and findings. It is a means by which to identify and analyze the impact or consequences of the program on variables within different contexts. Those observations then inform future application of what has been learned.

1.6 Theoretical Framework

The foundation learning theory for the study’s conceptual framework is Kolb’s Learning Cycle (Figure 1) (Kolb, 1984). Kolb does not posit experiential learning theory as an alternative to behavioural and cognitive learning theories, but suggests rather that it is “a holistic integrative perspective on learning that combines experience, perception, cognition, and behaviour” with implications for the “conduct of education, the proper relationships among learning, work, and other life activities, and the creation of knowledge itself” (Kolb, 1984 p. 21). Integrating and expanding upon the experiential learning theories of Dewey, Lewin and Piaget, Kolb asserts that “new knowledge, skills, or attitudes are achieved through confrontation among four modes of experiential learning” and that ability in each of these categories is requisite to successful learning (Kolb, 1984 p. 30).

The theories of Kolb and others, including Piaget, Freire, Dewey and Lewin, have an inherent element of conflict in their models of experiential learning (Kolb, 1984; Piaget, 1970; Freire, 1974; Dewey, 1938; Lewin, 1951). Examples include the tension between abstract
concepts (observation) and concrete experience (action) (Lewin, 1951), between impulse, which propels ideas, and reason, which gives them direction (Dewey, 1938). Kolb suggests that learners need to possess different kinds of abilities that they bring to the learning process, and that it is in the resolution of the conflict created by the different approaches that learning occurs (Kolb, 1984). Unlike the historical epistemological debates between rationalism and empiricism, however, the experiential learning process described by Kolb provides a framework within which seemingly dialectical approaches can result in continuity, integration and harmony through a discovery and learning methodology that is part trial and error and part scientific method (Kolb, 1984).

**Figure 1: Structural Dimensions Underlying the Process of Experiential Learning**

Concrete experience focuses on feeling as opposed to doing and is concerned with the “uniqueness and complexity of present reality”, and is described by Kolb as the ‘feeling’ stage (Kolb, 1984 p. 68) where practical applications or usefulness predominate. Recognition that we
exist in our environment is the starting point for the learning process.

The next stage, reflective observation, seeks to understand why things are the way they are and is described by Kolb as the ‘watching’ stage (Kolb, 1984). In my experience with undergraduate research, this stage is accompanied by curiosity; it is the driver in choosing the area that is of interest to the student. The investigation or search for knowledge begins with identifying the aspect of reality for which you want to find the reason or explanation.

Abstract conceptualization is described by Kolb as the ‘thinking’ stage (Kolb, 1984). It involves synthesizing observations to create holistic approaches to knowledge through more sophisticated use of “logic, ideas and concepts” (Kolb, 1984 p. 69). In my view, it has been a feed-forward process to this point, with a focus on solutions rather than identifying mistakes. It is in the next stage that knowledge moves forward by integrating feedback.

The final stage of active experimentation or ‘doing’ brings to mind the scientific challenge of advancing from in situ to in vivo (Kolb, 1984). This is where you find out whether your ideas can hold up under testing. Before knowing, there may be numerous feedback cycles between the ‘thinking’ and ‘doing’ stages.

Within the structure outlined above, Kolb identifies four different elementary forms of knowledge – divergent, assimilative, convergent; and, accommodative – the “building blocks for developmentally higher levels of knowing” (Kolb, 1984 p. 42) where “learning is the process whereby knowledge is created through the transformation of experience” (Kolb, 1984 p. 41). While Kolb characterizes a vast array of learning experiences in the context of the structure described above, this study focused on research experiences within an institutional setting combining both mentored individual research projects and formal structured courses of
learning. For example, the students who applied for the URI program had already identified a unique reality that was to be investigated (concrete experience). Describing the research project to be undertaken is the necessary, first step in the application. Following acceptance into the program the students entered into an investigative environment where ongoing research and engaged mentors provided the ideal climate for understanding through reflection, observation, questioning and discovery (reflective observation). At this point in the URI program, students from diverse research areas were asked to ‘step out of their box’ and were brought together for instruction in some essential tools applicable to all research, including research ethics, thinking about graduate school, how to prepare a poster presentation, grant writing, and the importance of publishing. In addition, and also an element of reflective observation was the opportunity to interact with students from other disciplines, look at things from different perspectives and appreciate different points of view (Kolb, 1984). Through journal clubs, lab meetings, ongoing mentorship from supervisors and other members of the research team, the URI scholars began to go through the thinking process of integrating information, existing bodies of knowledge, logic and ideas to begin to conceptualize the place of the individual project in a wider body of work, and to formulate theories (abstract conceptualization) to explain observed phenomena. As the students gained knowledge and experience in the research setting, they became more actively involved in ‘doing’ the research (active action). During the program, it was hoped that at least one full cycle would be accomplished, and optimally, observations made during the active experimentation stage became the concrete experiences that drove the process to repeat itself and drove the discovery of new knowledge. The Kolb model describes experiential learning as a cyclical
process, although in a later publication, he reconsidered in light of Dewey’s spiral model (Kolb, 1984; Beard & Wilson, 2013). Both refer to what Piaget calls the “transformation from one state to another” within the holistic adaptive process (Piaget, 1970 p. 14). The obvious question that arises is, ‘At what point does the learner enter into the process?’ Based on my professional knowledge, I believe that there are different points of entry into the circle or spiral, a view implicitly reflected by Kolb (Kolb, 1984).

A brief discussion of adult learning theories will help clarify the process. Knowles observes that until well into the twentieth century, theories focused on the ends of adult learning more than the means of achieving the desired ends (Knowles, 1978). Similarly, we have a set of learning outcomes for undergraduate students, and are actively seeking the best methods for ensuring those outcomes are met. Early theories identified a key difference in how adults learned and also pointed to what we are now seeing as deficiencies in our postsecondary education system that are being addressed by programs of undergraduate research. For example, Lindeman observed that adult education should be situational rather than subject-oriented and that the curriculum should be constructed around the students’ needs and interests, which is what happens in the URI program (Lindeman, 1926). I would add that adults’ desire to learn is often coupled with the desire to inform and bring their experiences to investigation in order to make a meaningful contribution to the research. While this is more about motivation than process, it does add another dimension to Kolb’s theories in the sense of varying degrees of richness of the students’ experience that are brought to the process. Undergraduate research is the crux of the theoretical/practical continuum in that experience, as represented by the four stages of Kolb’s learning cycle, is part of the constant
feedback loop that creates new knowledge.

1.7 Research Questions

This study focused on three key areas expressed in the following research questions:

1. What learning outcomes were acquired through participation in the URI Program as reported by participating students?

2. To what extent do students’ perceptions about the learning outcomes they acquired through participation in the URI Program vary by Faculty/Discipline?

3. To what extent do perceived learning outcomes as a result of participation in the URI program satisfy objectives set out in the University Undergraduate Degree Level Expectations (UUDLEs)?

4. Were student expectations met by the URI program?

1.8 Scope and Limitations of the Research

This case study focused on a group of students with a high GPA, who attended City University, an urban institution with a very diverse student and faculty population. There are limitations to the study. The expectations, experiences and outcomes of the program are subjective and individualized to each student because the data are self-reported based on recall and reflect the perceptions of the students. Students from the earliest cohort were recalling an experience that had taken place three years’ earlier. Also, students’ self-reporting on their level of knowledge and intellectual development is subjective in their self-assessment, and their interpretation of what they are being asked (Rauckhorst, 2001; Pascarella & Terenzini, 2005).

Since the students have nothing to gain or lose, I assume they are as accurate as participants perceived things to be. Variables that affect these perceptions, some of which are
not explored in this study include the quality of the mentorship, field of research, context of project, environment and interaction with other participants; all of which influence the experience, but could not be controlled in a post *de facto* study.

Findings from this case study may provide meaningful information to other institutions who are considering programs of this type because of the sample size of approximately 175 students, the purposive selection process (total population of the first three cohorts of the URI program were invited) and the fact that the URI model is intended to examine participant experiences within an environment of interdisciplinarity.

One of the limiting factors of this case study is the lack of data regarding the experience of the faculty supervisors, who were not asked to report on the individual students who were mentored as part of their research. This is an area for further research. Another limitation concerns secondary application data. For Cohorts #1 and #2, only the successful applicants’ application forms were provided to me. For Cohort #3, all of the application forms (n=\~150), from which approximately 50 successful scholars were selected are part of the secondary data base. I was able to identify the successful applicants by comparison and cross-checking Final Reports and Application Forms of Cohort 3 students, based on faculty, discipline, key word searches and academic term, however, I cannot guarantee 100% accuracy that only successful applicants’ responses are included. This limitation, however, could potentially affect only pre-participation data, which was not the main thrust of the case study.

1.9 **Significance of the Study**

These findings will address a gap in Canadian scholarly literature in empirical material relating undergraduate students’ involvement in research to learning outcomes. Findings from
this study may be informative and of value to university and college administrators, faculty and students. Data identified that in this particular case study, undergraduate student learning in research programs was an enhancement to the curriculum, and in what way. Students’ opinions regarding their own expectations and experiences with undergraduate research were clarified. I hope that the findings will promote discussion around the legitimacy and relevance of this type of program, especially in a multi-disciplinary context. Finally, although the findings are not generalizable, they may help colleges and universities deliberate the effectiveness of undergraduate research programs at their own institutions.

1.10 Outline Summary of the Remaining Chapters

The study report is divided into five Chapters. Chapter Two is a literature review. Chapter Three outlines the research design and methodology. Chapter Four presents and analyzes the findings as they relate to the research questions and the literature. Chapter Five suggests the implications and proposes recommendations based on the findings of this study.
1.11 Terms and Definitions

CAAL: Collaborative for Authentic Assessment and Learning

CUR: Council on Undergraduate Research, a not-for-profit organization based in Washington, DC

Experiential Learning: City University has adopted the definition of the American Association for Experiential Education, which regards experiential education as a “philosophy that informs many methodologies in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their communities” (Association for Experiential Education, 2013 p. 1).

FA: Faculty of Arts

FBM: Faculty of Business and Management

FDC: Faculty of Design and Communication

FCS: Faculty of Community Studies

FESA: Faculty of Engineering, Science and Architecture

LEAP: Liberal Education and America’s Promise

Learning Outcomes: Complex clusters of knowledge, skills and attitudes acquired by students as a result of their educational experiences

NSF: National Science Foundation

NSSE: National Survey of Student Engagement

OCAV: Ontario Council of Academic Vice-Presidents

OECD: The Organisation for Economic Co-operation and Development
PTR: Progress-through-the-ranks

QAF: Quality Assessment Framework

RETRO: Returning Research Opportunities

SOLO: Structure of the Observed Learning Outcome

STEM: Science, Technology, Engineering and Mathematics

UUDLeS: University Undergraduate Degree Level Expectations

URI: The acronym for Undergraduate Research Initiative; refers to the name of the City University program that is the model for this case study

URI Scholar: The title given to the successful applicants to the program; refers to the fact that the student has received both academic distinction as well as a financial award

Undergraduate Research: An inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline.

VALUE: Valid Assessment of Learning in Undergraduate Education
CHAPTER TWO

Review of the Literature

The purpose of this research study was to evaluate and describe the experiences of participants in the Undergraduate Research Initiative (URI) conducted at City University in Ontario, to determine the scope of effects across a diverse range of disciplines. Particularly, it was meant to examine what learning outcomes were achieved as reported by participating students; the extent, if any, to which students’ perceptions varied by faculty/discipline, to what extent the URI program delivered the university undergraduate degree level expectation (UUDLEs) as set out by the provincial QAF, and whether students’ expectations were met by the URI program.

Before answering these questions, it is important to understand the current landscape in Canada of undergraduate research program opportunities, institutional learning outcome goals, curriculum designs that achieve those goals, the theoretical foundations for the assessment of learning, and, of course, student motivation and impact. This chapter explores and describes the intersection of these ideas as found in the literature reviewed.

2.1 Scope of the Literature Review

The vast majority of publications concerning the benefits of undergraduate research emanate from the United States and are based on studies conducted in the United States at US institutions. The most influential body in this area is the Council on Undergraduate Research (CUR), a not-for-profit organization based in Washington, D.C. It is a strong advocacy group, whose vast publications and outreach activities are designed to share successful models and strategies for establishing and institutionalizing undergraduate research programs. Canadian
and US data will be compared insofar as the data are available and comparisons are appropriate and possible. No models outside North America were addressed in this study.

2.2 Learning Outcomes and Undergraduate Research

Recent approaches to postsecondary education reflect a tendency away from the traditional notion of content-driven curriculum towards learning outcomes-driven curriculum development, which is the approach taken by Morrison, Ross and Kemp in the development of their model for designing effective instruction (Morrison et al., 2011). In their model, learning outcomes or objectives, are one of four fundamental and interrelated elements comprising the instructional framework (the others being learners, methods, and evaluation) (Morrison et al., 2011).

According to the UCLA-based Higher Education Research Institute's 2012 Freshman Survey, nearly 88% of respondents cited "to be able to get a better job" as a very important reason for attending college - an all-time high (Pryor et al., 2012). Economic and political realities are demanding a shift in the roles that postsecondary education and research institutions need to play. Increased competition amongst each other, pressure from the government, and growing demands from potential students for learning outcomes that will give them the skills they need once they leave, are requiring colleges and universities to look beyond traditional instruction to find ways to be more directly involved in contributing to the economic well-being of the nation by ensuring that graduates achieve learning outcomes that will serve them in their career choices. Indeed, in the 2014 British Columbia Liberal government’s Throne Speech, the Premier warned the province’s post-secondary institutions that the education system would be overhauled to ensure that they do a better job of
graduating students who meet the needs of the private sector (Clark, 2014). The goal of most programs that support student participation in faculty-mentored research is to ensure that the learner has acquired the knowledge, skills and attitudes to successfully complete their independent research project and to apply the learning outcomes beyond the educational setting. Thus learning outcomes from student participation in faculty-mentored research should be both specific enough to benefit the future graduate student in his/her chosen field and general enough to be applicable as the foundation and skills for lifelong learning. The skills required for each of these purposes are sophisticated, especially with the seemingly endless explosion of new technologies, and require transfer of learning to new contexts, which is a difficult cognitive skill.

As Ontario moves forward, it will need a workforce that knows how to be innovative, creative, think critically, problem solve and understand the meaning of teamwork, especially in the existing global economy. Institutions are beginning to look at the educational process more holistically, and one model (OECD, 2012) that is emerging utilizes the knowledge gained through traditional instruction to leverage understanding of the research process through the combination of the students’ interest, ability and self-motivation and individual mentorship. Principles of best practice, among other things, must encourage active learning and contact between students and faculty, and requires the commitment of both parties (Chickering & Gamson, 1987). Based on the observation that “Instructional Design is a process for solving skills and knowledge deficiencies...” (Morrison et al., 2011 p. 7) research experiences can address this particular gap in the current system, resulting in value for both the learner and society. Undergraduate research is an area of increasing importance in postsecondary
education, as the knowledge economy demands real life experience as well as traditional learning. Undergraduate research can be a mechanism for innovation, where traditional training and mentorship meet the immediacy of the real world. That is, it brings relevant, hands-on experience to tangible problems.

Student participation in faculty research results in learning outcomes that are most easily described using the categorization suggested by Bloom’s three learning domains: cognitive, psychomotor and affective (Bloom, 1956). Bloom’s taxonomy breaks down the domains and identifies active verbs that suggest the level of complexity expected at the end of the course, which will be used to further identify certain of the learning outcomes (Bloom, 1956). Complexity within the cognitive domain places knowledge, described as recall of information, at the simplest stage, followed by the classification of levels of progressively higher mental abilities, including comprehension, application, analysis, synthesis and evaluation (Bloom, 1956).

Similar to Bloom’s cognitive domain continuum, Krathwohl, Bloom and Masia organized the levels of the affective domain to form a continuum for attitudinal behaviour, from simple awareness and acceptance to internalization, which has guided the attitudinal outcome selection (Krathwohl et al., 1964). One important point to keep in mind is that learning outcomes may differ depending on the design of the research program. Identified learning outcomes serve two important functions in curriculum design. They focus instruction to facilitate effective learning, and they afford a framework for evaluation (Morrison et al., 2011). For example, faculty members may employ a student solely in the task of completing a literature search, with no active involvement in other aspects of the research project. Learning
outcomes in this case would be quite different from a program where students are integrated into an ongoing faculty project, who are managing a discrete piece of the project, or who design their own project based on interest or curiosity. The learning outcomes that I have described in this study might be achieved from a research experience program that provides students the opportunity to participate in meaningful research, engages them through mentorship by faculty members or senior graduate students, trains them in the rigours of the research method, and involves them in the sense of contributing to the advancement of knowledge in their area of interest.

Intended learning outcomes from participation in research are two-fold. Students should gain a deeper understanding of, and appreciation for, the research method. Not only should they gain complex cognitive skills, they should also experience a heightening of their attitudes, or affective domain outcomes. Student participation in the research experience is also aimed at instilling a culture and awareness in the students, so the affective domain learning outcomes are as important as the cognitive, but for different reasons. For example, the Council of Ontario Universities embarked on a project to communicate the importance of research to the general public, partly in an effort to ensure that government funding to support education and research remained a priority among the electorate. By providing a research experience to undergraduates, postsecondary institutions are contributing to an educated population that understands the importance of research and education. Civic knowledge and engagement, both locally and globally, while perhaps unintended learning outcomes, could ultimately have the greatest impact.
The cognitive domain – knowledge.

Learning outcomes in the cognitive domain are particularly rich. Instruction in this domain is towards objectives related to “knowledge, naming, solving, predicting and other intellectual aspects of learning” (Morrison et al., 2011 p. 109). According to Astin, students learn by becoming involved (Astin, 1985), which is one of the principles behind achieving these learning outcomes. Knowledge solidification and expansion have been cited among the most significant gains from an undergraduate research experience (Kardash, 2000; Mabrouk & Peters, 2000; Hunter et al., 2007). The URI program facilitates this type of involvement by pairing students and faculty mentors in the intellectual activity of research.

Undergraduate student participation in faculty research is extremely resource-intensive. It requires a dedicated commitment of time from the student and the professor, as well as graduate students who may be involved in the mentoring and teaching process. In addition, there is a substantial financial commitment from the funding bodies. For example, if a university wishes to run a program using the funding formula from the Natural Sciences and Engineering Research Council’s (NSERC) Undergraduate Student Research Awards (USRA), this could cost up to $6,000/student (Natural Sciences and Engineering Research Council, 2013). It is essential, therefore, that learning outcomes from student research programs focus on the higher complexity intellectual functions, rather than the lowest cognitive functions, which could be achieved through more traditional, less resource-intensive teaching methods. It is no surprise that a considerable number of learning outcomes that can be realized by student participation in faculty research fall into the more complex levels of comprehension that include assessment, analysis, synthesis, and evaluation (Bloom, 1956).
The psychomotor domain – skills.

This domain embraces practical skills using skeletal muscles, described by Morrison as “the physical activities of performing, manipulating and constructing” (Morrison et al., 2011 p. 110). The uniqueness of individual research projects, of students’ abilities, and of the training required to accomplish particular tasks makes it difficult to identify universal practical skills that will be acquired as learning outcomes. Two taxonomies for this domain are germane to student participation in faculty research. The first, developed by Heinich et al (Heinich et al., 1993) is based on the degree and sequence of coordination, while the second grouping, proposed by Kibler (Kibler, 1981) separates gross-and fine-motor skills (Morrison et al., 2011; Kilpatrick, 1951). Learning outcomes in this domain reflect a practical competence to perform skills necessary to advance the research project. Participants in the URI program conduct a discrete project with their faculty supervisors. While cognitive outcomes from many projects could be similar, given the nature of the scientific method, the psychomotor skills would reflect the particular needs of the project.

The affective domain – attitudes.

The third domain involves learning outcomes that concern attitudes, appreciations, values and emotions (Morrison et al., 2011). Learning outcomes in this domain have the potential to greatly influence the personal development of the student, as well as his/her role as a socially responsible citizen.

The learning outcomes resulting from student participation in faculty research do not necessarily stop at those outlined above, which in many cases are specific to the research endeavour. There is the broader question of how a specific research experience can contribute
to essential learning outcomes that should be part of the overall summative progress of every college and university student’s development. Proceedings from a National Panel on a new learning vision call for a type of education that would lead to learning outcomes that empower and inform students, as well as create in them a sense of social responsibility and ethical judgment (Greater Expectations National Panel, 2002). In a later publication, AACU recommended a set of essential learning outcomes, to which the research experience contributes, including knowledge of human cultures, and the physical and natural world; intellectual and practical skills; personal and social responsibility; and, integrated learning (Association of American Colleges and Universities, 2007). In other words, many of the learning outcomes from a meaningful research experience go beyond the specific project and discipline within which they are acquired. Insofar as they are applicable to the long-term interests and career choices of student participants, their impact can be endless.

Participants in the URI program have the opportunity to interact with others on many levels. Under the direct supervision of their faculty mentor, they also take part in wider laboratory activities such as journal clubs. Many are involved in field work, interviews, presentations at meetings, and the URI workshops that are held throughout the summer.

The design of the URI program was purposefully intended to promote learning outcomes in all three domains, with overlapping as well as singular consequences for participants.

2.3 Theoretical Foundations for the Assessment of Learning

The assessment or evaluation of learning is intended to determine whether or not learning outcomes have been achieved. It measures student success and it is an essential
component in the instructional design process (Morrison et al., 2011). It is critical, therefore, that the assessment tools are valid, that the processes are reliable, and that both are consistent with the intended learning outcomes that they are being used to evaluate. Proponents of authentic assessment would go further by insisting that tests should be central experiences in learning so that the first consideration is the actual task at which one wants students to be good, followed by the design of an authentic test, or what Wiggins refers to as ‘teaching to the test’ (Wiggins, 1989b). In traditional assessment, it is the institution’s curriculum that drives the assessment, whereas in authentic assessment, it is the other way around. In other words, authentic assessment requires that tests are connected to performance, place the student within a context, and mimic the messiness of the real world. This is in contrast to traditional assessment, in which students typically rely on the ability to recall information, multiple-choice tests, true-false tests and other ‘paper and pencil’ assessments. These types of traditional tests cannot effectively assess the full spectrum of learners, and may, in fact, leave some of the more innovative and creative thinkers behind, since the tests offer only one possible answer to each question. Thus, the learner is rewarded for correct responses, irrespective of how they arrived at them, and there is no chance to posit new explanations, or even different answers. Authentic assessment provides for multiple correct answers, weighted for their efficacy, among other things.

According to Morrison et al, one must develop testing instruments and materials to evaluate the degree to which learners acquired the knowledge, skills and attitudes identified by the expected learning outcomes (Morrison et al., 2011). In experiential learning, the most effective means of evaluation is through authentic assessment (Wiggins, 1990), since the
mentor/supervisor is working one-on-one with the student on a daily basis. Authentic assessment was a significant component of the 1990s culture, and Wiggins was one of its most prolific and convincing proponents (Terwilliger, 1997). In an earlier article, Teaching to the (Authentic) Test, which appears to be the first mention of ‘authentic’ in this context in the literature, Wiggins summarizes that there are four common, basic features of authentic tests (Wiggins, 1989a):

1) They are designed to be truly representative of performance in the field; only then are the problems of scoring reliability and logistics of testing considered;

2) Far greater attention is paid to the teaching and learning of the criteria to be used in the assessment;

3) Self-assessment plays a much greater role than in conventional testing;

4) The students are often expected to present their work and defend themselves publicly and orally to ensure that their apparent mastery is genuine.

While the author does not question the need for some kind of testing, one of the motivating factors behind his ideas is the belief that “essential intellectual abilities are falling through the cracks of conventional testing, and only by assessment reform and the use of authentic methods will student performance improve” (Wiggins, 1990 p. 5).

I would also argue that the success of a research project is itself a form of authentic assessment in that it shows that the appropriate skills and training were acquired in order to carry out the task. In a well-designed program, the students are also expected to present their work and defend it. In his paper, The Case for Authentic Assessment, Wiggins examines the nature, meaning, and effectiveness of authentic assessment compared to traditional
standardized tests (Wiggins, 1990). One of the major differences that Wiggins notes is that authentic assessment occurs when we directly examine student performance on “worthy intellectual tasks” as opposed to traditional assessment, which “relies on indirect or proxy ‘items’ – efficient, simplistic substitutes from which we think valid inferences can be made about the student’s performance” (Wiggins, 1990 p. 2). The author states that traditionalists “are led to believe that right answers matter more than habits of mind...” and thus, if the aim of assessment, which is the starting point, is merely to monitor performance, then conventional testing is probably adequate (Wiggins, 1990 p. 4). In support of the view that “The best tests always teach students and teachers alike the kind of work that most matters; they are enabling and forward-looking, not just reflective of prior teaching” the author systematically compares and contrasts authentic and traditional assessment methods to show that “it is the form, not the content of the test that is harmful to learning”, and reaches the conclusion that “a move toward more authentic tasks and outcomes improves teaching and learning (Wiggins, 1990 p. 3). Criteria on which he bases his conclusions include 1) expected learning outcomes; 2) tools of assessment; 3) methodologies for arriving at correct answers; 4) scoring criteria; 5) knowledge simulation, for example, real-life vs. curriculum content; and 6) applicability to adult and professional life (Wiggins, 1990).

Does this mean that we should no longer rely on traditional methods to assess learning outcomes in postsecondary educational institutions? In an article by Toth, the introduction into the curriculum of an innovative, blended inquiry learning and teaching methodology incorporating two processes of inquiry was evaluated on the basis of student assessment at the end of the study (Toth et al., 2009). While curriculum design was the subject of the paper, the
validity of the results rested in large part on the assessment process. Thus, as one establishes
instructional objectives and develops instructional material, designing and using appropriate
methods to assess learning outcomes must also be considered. While assessment may be
desirable, especially when the student body is diverse, it is important to know whether it
actually improves upon traditional practice. It is well recognized that in any group of learners
there will be a variety of learning styles, and therefore to get results that reflect the real ability
of each learner, no one assessment method would suffice. Just as the traditional assessment
overlooks intellectual capacity for innovation, so an authentic assessment could inhibit some
students.

Many of the arguments in favour of authentic assessment use practical examples to
make comparisons. These frequently come from doing as opposed to theory alone. For
example, when Wiggins refers to traditional tests as revealing “only whether the student can
recognize... what was learned out of context”, the reference is made to “inferring driving or
teaching ability, from written tests alone” (Wiggins, 1990 p. 2). I’m reminded of the ‘hands-on’
vs. the virtual argument in Toth et al, and the broader issue facing education today, which is the
balance between theory and practice (Toth et al., 2009).

The discussion is grounded in the concept of experiential learning and the premise that
any move to reform assessment should primarily support the needs of learners. While
agreeing with some of the ideas put forward by advocates of authentic assessment, Terwilliger
stresses that “the rhetoric of the reformers is misleading and largely unsupported by data” and
there is a risk that “perfectly useful and appropriate assessment methods will be discarded in a
rush to adopt a variety of other techniques of unknown psychometric and educational quality”
So what would an authentic assessment look like in practice? There would be an exemplary task or tasks to be performed by the student, and criteria and standards by which to evaluate the performance (Wiggins, 1990). Interestingly, the United States government has recently endorsed competency-based assessment by encouraging PSE institutions to seek federal approval for degree programs, recognizing the value of experiential learning which already exists in academia through internships and co-ops (Fain, 2013).

2.4 Institutional-Level Rubrics for Evaluating Learning Outcomes: Ontario and the US

Quality assurance of university programs is internationally understood to be integral to any meaningful educational system, resulting in increased pressure for clearly articulated learning outcomes from a university education (Ontario Universities Council on Quality Assurance, 2012). Although the learning outcomes identified by UUDLEs were expected to accrue from an overall university academic education, I was interested in discovering the extent to which a single undergraduate research experience could meet the expected goals and standards outlined in the Quality Assessment Framework (QAF). The reason for this was that if the URI program, for example, could be shown to be of value in the public accountability of education as well as in the personal development of the student participants, then a case could be made for the wider availability of structured research experiences. Therefore, this case study sought to identify perceived learning outcomes resulting from participation in the URI program in order to examine, among other things, the extent to which they succeeded in meeting the expectations outlined in Ontario’s QAF. I was also interested in comparing our localized provincial rubrics to another standard, and since Ontario has expressed a desire to move in a similar direction I chose the US framework as a comparison (OCAV/OCUR, 2008).
In Canada, education falls under provincial jurisdiction. In 2008, in a summary from a joint meeting of the Ontario Council of Academic Vice Presidents (OCAV) and the Ontario Council on University Research (OCUR) representatives from Ontario Universities stated that, with respect to undergraduate research, “we seem to be doing a fair amount but not in any particularly organized fashion. Were we to organize, we might be able to offer a higher quality research experience to more of our students…” (OCAV/OCUR, 2008 p. 1). In order to determine the accuracy of this statement, I conducted an informal survey of a cross-section of Canadian universities (see p. 9), the findings of which confirmed the observations of the 2008 OCAV/OCUR meeting held 5 years earlier (OCAV/OCUR, 2008). What I found was that while the majority of qualified universities participate in undergraduate research awards programs, such as NSERC’s USRA, and similar CIHR programs, opportunities for undergraduate students to engage in research outside these programs were available, but widely diverse in terms of program design, funding model, award criteria, organizational level and value. To the best knowledge of the individuals with whom I spoke, no assessment of the learning outcomes of the programs in place had been carried out, and the evidence for their success is, for the most part, anecdotal.

The US context.

The Council on Undergraduate Research (CUR) in Washington DC has been a leader in the promotion of undergraduate research opportunities and in publications relating to experiential learning theory, which is one of the reasons for using the US model as a comparator. Through their collaborative efforts, CUR and the National Science Foundation
(NSF) have broken ground in developing policies and establishing funding opportunities for undergraduate research education (National Science Foundation, 2013).

The creation of an equivalent Council in Canada is the logical next step. Post-secondary institutions, in the absence of leadership and coordination, and recognizing the importance of the activity, are creating a hodge-podge of offerings with little in common between institutions, and lacking in formal impact assessment.

Benchmarks for evaluation of learning outcomes should be consistent with the institutions’ mission and academic plan, appropriate to the associated learning outcomes, and aligned with the level of complexity stated by the intended learning outcomes (Ontario Universities Council on Quality Assurance, 2012). One US classification model for performance-based assessment is the Structure of theObserved Learning Outcome (SOLO) taxonomy, in which a sequence of sample verbs are used to indicate levels of understanding (Biggs & Collis, 1982). Competence is determined by measuring the student’s progression from the simple task of identification of a single aspect to the more complex functions of creation and reflection as components of synthesis and generalization to a new domain (Biggs & Collis, 1982).

More recently, the Valid Assessment of Learning in Undergraduate Education (VALUE) project, as part of the Association of American Colleges and Universities’ (AAC&U) Liberal Education and America’s Promise (LEAP) initiative, has taken a leading role in promoting the philosophy of authentic assessment of student work and shared understanding of student learning outcomes over the traditional reliance on standardized tests (Association of American Colleges and Universities, 2012). They have developed 15 institutional-level rubrics that contain core characteristics considered to be critical for judging the quality of student work in a
particular outcome area (Association of American Colleges and Universities, 2012). These comprise:

1) Intellectual and Practical Skills
2) Inquiry and analysis
3) Critical thinking
4) Creative thinking
5) Written communication
6) Oral communication
7) Reading
8) Quantitative literacy
9) Information literacy
10) Teamwork
11) Problem solving
12) Personal and Social Responsibility
13) Civic knowledge and engagement—local and global
14) Intercultural knowledge and competence
15) Ethical reasoning
16) Foundations and skills for lifelong learning
17) Integrative and Applied Learning
The Ontario context.

In Ontario, the Undergraduate Degree Level Expectations (UUDLEs), established by the Ontario Council of Academic Vice-Presidents (OCAV), serve as Ontario universities’ academic standards and identify the knowledge and skills outcome competencies that reflect progressive levels of intellectual and creative development (Council on Quality Assurance, 2010). Expectations are divided into six general areas, which are shown below. I have indicated the domain according to Bloom’s theories in brackets.

1) Depth and breadth of knowledge (Cognitive);
2) Knowledge of methodologies (Cognitive);
3) Application of knowledge (Psychomotor and Cognitive);
4) Communication skills (Cognitive);
5) Awareness of limits of knowledge (Affective);
6) Autonomy and professional capacity (Affective).

Within each of these categories, there is a subset of clearly defined skills. As one would expect, when I compared the expected undergraduate degree learning outcomes of Ontario to those of the US, there was overlap in the majority of the categories. Interestingly, there were three areas in the AACU VALUE rubrics (US) that were not mentioned in the Ontario framework: civic knowledge and engagement—local and global; intercultural knowledge and competence; and ethical reasoning. The latter appears in Ontario’s framework only at the graduate degree level. One of the features of City University’s URI program is that it includes a workshop in
ethics very early in the project. There is a section in Ontario’s framework that is not addressed in the US model - awareness of limits of knowledge. Similarities between the Ontario and US learning outcome expectations are enough to allow a comparison of the best way to evaluate effectiveness in achieving them. The majority of US studies, probably as a result of the leadership of the NSF in this area, were conducted in STEM disciplines, whereas the URI program examined learning outcomes from a cross-section of forty disciplines within five faculties.

Educational outcomes are closely tied to institutional mission statements, and clearly, the nature of these rubrics signals a movement towards a broader scope of learning outcomes that may be beyond the ability of traditional, standardized assessment methods to evaluate, and which is part of the more complex, overall summative progress for every college and university student. They also go far beyond subject mastery. This case study was meant to illustrate a valid alternative to traditional, standardized testing within a particular educational practice, in this case the URI program. The Collaborative for Authentic Assessment and Learning (CAAL), which is an extension of the original VALUE initiative, suggests that standardized testing does not measure some of the most valuable learning outcomes, such as critical thinking, problem solving or teamwork (Association of American Colleges and Universities, 2013), which are identified by both the US and Ontario as expected learning outcomes. While there is no element of formal assessment in the URI program, from the beginning of their research experience, participants undergo a continual feedback cycle whereby each stage of their research is dependent on the results of the previous stage. In a sense, it can be described as
authentic self-assessment, in which learner needs are met by positive feedback based on correct reasoning and accumulated success.

Authentic assessment is closely connected to real-life skills. As the needs of students evolve, and institutions strive for more sophisticated learning outcomes to prepare their graduates for a larger life course, it is obvious that authentic assessment has a place in teaching and learning, alongside traditional assessment methods, and its role in undergraduate research is without question. According to the UCLA-based Higher Education Research Institute's 2012 Freshman Survey, nearly 88% of respondents cited that being able to get a better job was a ‘very important’ reason for attending college (Pryor et al., 2012). Postsecondary educational institutions are expected by their students to ensure learning outcomes that will give them the skills they need when they graduate, and which will be transferable to different life and career situations. In the case of the URI program, students themselves identified those skills and the extent to which the URI experience provided them.

2.5 Experiential Learning Theories

How can one integrate undergraduate research into the postsecondary experience to help students learn about research in their chosen field of study and acquire the skills and learning outcomes that are both promised and expected?

Experiential learning is not a new concept. As early as 1801, Johann Heinrich Pestalozzi advocated a doctrine of education whereby direct concrete observation and action lead to learning (Kilpatrick, 1951). In the late 19th century, John Dewey proposed a new learning theory that was grounded in experience and that supported his philosophical commitment to social justice and democracy as espoused in *My Pedagogic Creed* (Article 1), where he asserts that
“all education proceeds by the participation of the individual in the social consciousness of the
race”, where education is defined as “a continual process of reconstruction of experience”
(Dewey, 1897 p. 13). His theory developed from his unhappiness with, and rejection of, the
either/or thinking associated with traditional views and the tension between the psychological
and social definitions of education, the former stressing the development of mental powers
without reference to their use; the latter making individual freedom subservient to political
status (Dewey, 1897). Dewey’s new education was based on experience that is both interactive
and continuous – the experiential continuum on which students build their knowledge (Dewey,
1938). Dewey clarified that experience and education can be directly equated to each other.
Education is a social process, and an educative experience is one in which an open and dynamic
mind interacts with the world of thought and ideas to solve both iterative and new problems.
The mere transfer of information, the value of which lies in the future, is not a component of
life experience and is therefore not educative (Dewey, 1938).

If knowledge is a work in progress then it should be taught as such. Because experiential
learning involves the application of concepts, ideas and theories in an interactive setting, active
participation in research is one of the most meaningful of educational experiences: if students
are free to express their individuality by identifying issues or problems of genuine interest; if
mentorship from faculty members and like-minded graduate students provides an environment
of stimulating discussion and debate through which students become active learners; if
knowledge and learning outcomes gained from the experience are foundational in the learning
process and applied to new situations, not only in the chosen field of research but more
broadly. It is expected that an educated person leaves the postsecondary system with skills that
have prepared them for the ‘messiness’ of the real world. Similarly, postsecondary education may help students to understand the interdisciplinarity of how the different fields of knowledge work together holistically. The act of discovering new knowledge is progressive and it is mirrored in the research method. The idea of unity of knowledge was one of the theories that Dewey was experimenting with in his own school, the University Elementary School of the University of Chicago (later known as the Laboratory School), although his ‘unity’ developed into the inseparability of knowledge and doing (Menand, 2001).

Acknowledging Dewey, Lewin and Piaget as forefathers of the concept of experiential learning, David Kolb developed his own model of learning styles that included experiential learning (Kolb, 1984). In that model he describes a cycle of concrete experience, reflective observation, abstract conceptualization or thinking, and active experimentation or doing, each of which leads to the other and in circling back, continually enriches the development of the individual over time (Kolb, 1984). Knowledge is created through the transformation of experience, which, while not sufficient, is certainly necessary to Kolb’s ‘cycle of learning’, which in turn is central to experiential learning theory (Kolb, 1984; Kolb et al., 2000). The cyclical nature of Kolb’s theory resembles a horizontal spiral that is continually circling and moving forward within the context of a longitudinal impact model, similar to a spliced DNA sequence. The path would be determined by the response to previous ‘tasks’ or ‘choices’ and would be an internal mechanism for development within the holistic experience that is postsecondary education. In the same way that this theory is applicable to the individual’s development, not only in college, but throughout their lives, so too can it be applicable to institutional goals and
missions, which increasingly include valued educational outcomes (Association of American Colleges and Universities, 2007).

2.6 Experiential Learning in Higher Education

For this study, I looked particularly at the ideas of Kolb and Dewey concerning experiential learning, which have implications for program development in postsecondary education that are discipline-specific, as well as applicable to the broader goals of the institution. Experiential learning is a powerful way to motivate and engage students, integrate theory and practice, develop skills for independent study and inspire interest in further learning (Upcraft et al., 2005). In Dewey’s ideal school, the individualist and the institutional ideals are reconciled. Postsecondary institutions, as well as bodies and organizations that represent them, are identifying learning outcomes that every student should achieve before graduation and there are many opportunities where the integration of experiential learning into the curriculum can facilitate these while at the same time helping students learn about research in their chosen field of study. Experience-based learning extends across the full spectrum of disciplines in the postsecondary sector including the humanities, science, health and medicine, social science, engineering, communication and design, and general arts. Opportunities include co-ops, field and education placements, internships, community service learning, work/study assignments, research courses, practica, thesis courses, structured exercises and role playing, games, and individual, mentored research experiences (Kolb, 1984). Although it is the latter that is the subject of this study, and general guiding principles apply to learning strategies for other types of opportunities, I think it is appropriate at this point to have some discussion about other examples in the range of approaches to experiential learning in higher education.
Insofar as experiential learning focuses on the process of development of the individual participant, the type of program delivery can affect individual learning outcomes. The tools and methods vary to a great extent, but share the common element of putting the learner “directly in touch with the realities being studied... rather than merely thinking about the encounter or only considering the possibility of doing something with it” (Keeton & Tate, 1978 p. 2). What is certain, is that all experiential learning turns us “away from credit hours and toward competence, working knowledge, and information pertinent to jobs, family relationships, community responsibilities and broad social concerns” (Chickering, 1977 p. 86). There are a number of cross-cutting strategies that can be used in different types of program delivery, all of which use experiential learning theory as the basis for facilitating learning outcomes.

**Community service learning.**

According to the Canadian Alliance for Community Service-Learning, this educational approach integrates community service with intentional learning activities in order to reach outcomes that are mutually beneficial to the student and the community organizations (Canadian Alliance for Community Service Learning, 2014). In the United States, the Community Service Act of 1990 defines the parameters of service learning as a method under which students or participants learn and develop through active participation in thoughtfully organized service that is conducted in and meets the needs of a community, is integrated into and enhances the academic curriculum, provides time for reflection on the experience, and helps foster civic responsibility (U.S.Congress, 1990).

Practitioners of service learning have embraced Dewey’s theories on the interplay between ideas and action, which when combined with Kolb’s learning cycle model, has
important implications for the practice of reflection, which is an important element of service learning (Kolb, 1984; Dewey, 1938; Eyler et al., 1999). Some of the expected benefits from this type of engagement include the opportunity to apply theoretical knowledge to real-life situations, engaging in dialogue and reflection that deepens the understanding and meaningfulness of social issues, network-building and sense of contribution (Canadian Alliance for Community Service Learning, 2014). It is collaborative – between the student and the community.

In a survey of over 1500 students, Eyler and Giles, drawing on pedagogical principles established by Dewey and other theorists, examined the learning outcomes of service (1999), to show their relevance to and importance for the academic mission of institutes of higher learning. Similar to undergraduate research, these opportunities can take a number of forms, each of which might place more emphasis on either of the service component or the learning component, including course-based, non-course based and volunteer programs. What they stress, however, is that reflection occupies a central role in the process of learning through community service (Eyler et al., 1999). Learning outcomes that the study identified included: interpersonal competence, personal development, tolerance for diversity, career benefits, better understanding of theories through hands-on experiences, improved ability to apply what has been learned, problem-solving skills, critical thinking and perspective transformation (Eyler et al., 1999)

There are a number of differences between experiential learning through community service learning and the undergraduate research opportunity inherent in the URI program at City University. For example, in service learning, a) the issues are not defined by the student,
even though the student is engaged with the community at some level in resolving issues; b) it is usually not evaluated according to learning outcomes; c) it may not be supervised or mentored by an academic; d) the focus is not specifically on student development. In undergraduate research programs, a) the students themselves identify the issue that is of interest to them; b) it is a scholarly activity leading aimed at producing new knowledge; c) academic mentorship is a requirement.

**Co-operative education.**

In this type of experiential learning, students alternate periods of full-time classroom study with periods of supervised and progressively more responsible workplace training that is related to their academic major, in appropriate fields of business, industry, government, social services and the professions (Canadian Association for Cooperative Education, 2014). It combines traditional classroom curriculum with work experience. As with community service and other types of experiential learning, cooperative learning is regarded as a valuable complement to students’ academic experience, personal growth and development, and career preparation (Ontario Ministry of Education, 2000).

As with other experiential learning programs, and in keeping with theories in the literature, cooperative learning integrates classroom theory with learning experiences at the workplace through the application of knowledge acquired in a traditional classroom course to real-world situations; the first of its kind in Canada started in 1957 at what is now known as the University of Waterloo (Haddara & Skanes, 2007). Like other experiential learning, cooperative learning is collaborative - between the student and the workplace. Reported benefits and learning outcomes for students include a positive effect on their careers (Riggio et al., 1997),
critical thinking, personal responsibility for own learning, problem-solving, and learning how to learn (Dressler & Keeling, 2004). According to the Canadian Association for Cooperative Education (CAFCE), student learning experience is extended beyond the limits of the classroom, they learn the expectations and requirements of their professional field, they learn job-seeking and job retention skills such as writing and interviewing, they develop interpersonal and communication skills, and they acquire confidence (2014). A study by Apostolides and Looye suggests that from among students who self-reported approval of their own cooperative experience, the most important factors were quality supervision, sense of contribution and challenging assignments (1997).

As with experiential learning through community service, there are a number of differences in the learning outcomes and benefits between cooperative programs and undergraduate research opportunities. For example, unlike programs such as the URI, in cooperative learning, a) the issues are generally practical, assigned as a project to the student, rather than being identified by the student as something they want to work on; b) evaluation is generally not according to learning outcomes; c) there is generally work supervision as opposed to academic mentoring.

Undergraduate research in which students, under the mentorship of a faculty advisor, design their research, decide what questions to ask and what topics to work on, results in a personal connection to the work and a feeling of ownership (Webb, 2007). From the initial interest in a topic, the depth of subject-matter knowledge increases cumulatively as the research project advances and the students bring their own experiences and that of others to bear on the research problem. This is the essence of experiential learning. Done properly, it can be both
creative and empowering, extending beyond the mere transfer of knowledge from teacher to student. The evidence for the positive impact of an undergraduate research experience is overwhelming, although studies have been primarily in STEM disciplines (Lopatto, 2004; Lopatto, 2007; McGee & Keller, 2007; Astin, 1993; Laursen et al., 2012). Russell et al (Russell et al., 2007) reported that undergraduates who are involved in ‘hands-on’ research are more likely to pursue advanced degrees and careers in STEM subjects. This is in part due to the depth of knowledge that they are able to acquire as they pursue their own interest in a subject.

Good practice in undergraduate education, among other things, encourages active learning and contact between students and faculty (Chickering & Gamson, 1987). An early research experience is one way to bring the student closer to his interests and goals and to see how the postsecondary experience will help him achieve success. In other words, it demonstrates the relevance of the education to the student, and because it is a hands-on experience, it moves learning out of the classroom and into the real world. One of the questions that this study sought to answer was what the optimum time is – early enough but not too early – to participate in undergraduate research. This is addressed in Chapters 4 and 5. The personal investment in acquiring the knowledge also makes it more relevant to the learner (Chickering & Gamson, 1987) and is, therefore, more likely to make the overall experience meaningful. Research helps us to understand how things came to be as they are, and more importantly for experiential learning, how we can understand, influence and adapt, not only in the reactive sense of fitting into the physical and social worlds, but in the proactive sense of creating and shaping those worlds (Kolb, 1984). The fact that in the URI program, students choose the area in which they are interested means that they are already motivated to acquire in-depth knowledge of the subject matter. The research method in which problems are
identified, potential solutions and consequences are considered, hypotheses are developed and experiments are designed and conducted to test the theory, aligns with Kolb’s experiential learning theory model and the research environment is conducive to the interactive component demanded by Dewey. The experience also is applicable across all disciplines. In terms of curriculum this implies that the individual experiences of the students should be the means by which the learning outcomes are achieved. Students need to experience something for it to be truly educative.

As with all curriculum design, experiential learning approaches do not begin in a vacuum, since learner needs and outcomes provide the initial definition of the breadth of the project and direct the focus of the curriculum design (Morrison et al., 2011). There are numerous ways in which the curriculum could be enriched and learning outcomes achieved through the effective use of experience-based learning. In this type of learning, teachers and faculty mentors have more responsibility in this type of learning to create the environment and circumstances within which the experience takes place. The close interaction with students creates a kind of experiential laboratory setting within which all participants engage. Upcraft et al (2005) have some specific recommendations for curriculum design, which include requiring students to keep a journal, creating assignments that encourage reflection on the learning experiences, providing regular opportunities for discussion, and developing appropriate ways to evaluate the learning from these experiences. The corollary that students should not be given correct answers, but should arrive at the answers themselves is not only a key component of theories of experiential learning, it is echoed in the concept of authentic assessment put forward by Wiggins (Smith, 2011; Wiggins, 1990).
Undergraduate research also finds its roots in many of the categories of intelligence described by Howard Gardner, including verbal-linguistic (presenting, researching and process writing); logical-mathematical (problem-solving, critical thinking, classifying, data collection); visual-spatial (graphing, patterning); bodily-kinesthetic (hands-on experiments); interpersonal (cooperative learning, teamwork); and, intrapersonal (individual study, personal goal setting) (1983). In addition to the individual laboratory experience, it is also important to be part of the broader research community so that interdisciplinary as well as intradisciplinary ideas can be shared. Thus, through a component of the URI program that is the subject of this case study; individual workshops integrate the theory of research through classroom instruction with the application of principles in the laboratory. Students from disparate disciplines are brought together to receive training and interact over topics such as knowledge and technology transfer, research ethics, graduate school, interdisciplinary approaches to the same question. Toth examines the development and effectiveness of the introduction of an innovative, blended inquiry learning and teaching methodology that supports the idea of the Workshop approach in undergraduate research (Toth et al., 2009; Gardner, 1983).

2.7 Principles of Experiential Learning in Program Design

While the URI program is not for credit, nor does it appear on a co-curricular transcript, if it is to have meaning and impact beyond the individual experience, then it is imperative that the design of the program follows best practise. There are five basic principles of curriculum content design: Scope, Sequence, Continuity, Integration and Balance (Morrison et al., 2011). Scope defines the breadth and depth of knowledge that needs to be included in the course. Where does the learning begin and end? Reflecting Dewey and Kolb’s theories, undergraduate
research ensures that the learning does not end, but that learning outcomes from each stage are cumulative. Kolb’s experiential learning theory provides a framework by which to examine the URI program and has also been used to structure other programs (Healey & Jenkins, 2000).

Morrison et al describe sequencing as “the efficient ordering of content in such a way as to help the learner achieve the objectives” (Morrison et al., 2011 136). Given the magnitude of the scope of the learning outcomes, sequencing is one of the most important considerations in undergraduate research experiences, and proceeds from a simple to complex methodology (Bloom, 1956). The independent research project model follows, to some extent, the Gagné model based on a learning hierarchy identifying prerequisite skills (Gagné, 1985). For example, in a science project, data analysis would require training in assay methods or pipetting techniques. I think it is also useful to look at elaboration theory sequencing, as described by English and Reigeluth, as a potentially useful model for proposed courses that introduce experiential learning (English & Reigeluth, 1996).

Elaboration theory applies increasing orders of complexity to achieve optimal learning and posits that students will do best if there is a meaningful context into which the training can be assimilated (English & Reigeluth, 1996). It also distinguishes between the types of expertise the learner will develop, which is ideal for undergraduate research programs. Content expertise helps the learner master a body of knowledge starting with the readily observable and advancing to the more detailed and complex aspects of the theory or discovery and task expertise sequencing follows a similar pattern in that one begins with the simplest task and proceeds to the more complex (English & Reigeluth, 1996; Morrison et al., 2011). This theory is
particularly applicable to the independent research project that is at the heart of the URI program, where progress in knowledge and skills drive the project forward.

The principle of continuity refers to the progression of content/units without gaps or overlap. This does not mean that the same material will not be repeated or analyzed under new conditions as a means of reinforcing or questioning concepts or theories that are integral to experiential learning. This is not duplication of content, but continuity through reinforcement of theoretical principles in an applied setting. There is support amongst educators for the introduction of innovative curricula, which would incorporate new opportunities for practice and application into the traditional teaching of theory and research (Albanese, 1990). The goal of experiential learning through undergraduate research projects is to ensure that the learner has acquired the knowledge, skills and attitudes to successfully complete an independent research project while at the same time has learning how to incorporate his or her own experience of the learning in future practice.

Integration applies to how things fit together. In order to achieve the desired learning outcomes, content and processes must be consistent with each other and neither confuses nor contradicts. Integration in the curriculum is ensured through the discrete subject matter of each project and the distinctive experiences of each participant. Integration of the theoretical with the practical can be better described as symbiotic. Integration also requires that concepts within and between subjects must clearly relate to each other. This is the premise of experiential learning, where the student moves from simple to complex issues and theories, spanning the full range of knowledge that is required to initiate a research project. It is in the initiation and process of the project that the content is applied to a real-life situation.
The final principle of design is balance. In content, this refers to the balance between theory and application; in process, it refers to variety, diverse learning styles and changes in pace and all of these elements must be clearly aligned, and relate to each other and to the intended learning outcomes. In undergraduate research courses, content balance is achieved through the distribution of theory and practice that drives the progress of the research. The sequencing will align the two elements so that theory will be immediately implementable; topics relate to each other through their common focus on research methodologies and taken as a whole, cover the gamut of expected learning outcomes in knowledge, skills and attitude. Learning styles within the laboratory will be addressed through interactions between the student and the other lab members.

2.8 Experiential Learning Strategies

Experiential learning in course curriculum will incorporate a number of strategies to achieve the desired learning outcomes. These could include lectures to ensure that theoretical concepts are incorporated into the knowledge base; collaborative and cooperative group work in the laboratory setting through engagement with other members of the research team, journal club meetings, and presentation of results to encourage teamwork and respect for other researchers and the research process; problem-based learning that relates back to the research question being asked, and the lab as the environment in which the theory is applied; These strategies constitute a holistic approach to the desired experiential learning outcomes, which together are meant to encourage independent and critical thinking.

Students can be transformed by their postsecondary experience. Innovative curricula that include the possibility for experiential learning can lead to positive growth and can provide
a “personalized education, exemplifying engaged pedagogy, and promoting students’ intellectual independence and maturation” (Elgren & Hensel, 2006 p. 4).

2.9 Summary

In this chapter, I have situated the URI model within the context of a theoretical framework of experiential learning. Aspects of curriculum design, assessment, learning outcomes have been discussed to help clarify concepts and explain the choice of strategies that will be used in later chapters. Since the majority of literature emanates from the United States, I included a comparison between expected learning outcomes from both US and Ontario rubrics, whose differences are insignificant for the purposes of this study. Remaining chapters will introduce and describe methodologies and design used for the study; present results of both primary and secondary data; and finally offer a summary of findings, conclusions and implications for the study.
CHAPTER THREE

Research Design and Methodology

This research study explored and evaluated the experiences of participants in a case study of City University’s Undergraduate Research Initiative (URI), a model that combines practical, hands-on experience under the mentorship of a faculty supervisor, with the theoretical body of knowledge that is necessary to the conduct of research, to determine the scope and diversity of learning outcomes across a broad range of disciplines. This study explored the experiences of the first three cohorts of successful URI Scholarship awardees (2010-2013), as perceived by the participants in the URI program to determine and analyze the effects and impact of a single model for undergraduate research experience on students from a diverse range of disciplines.

3.1 Research Questions

The case study focused on three key areas expressed through the following research questions:

1. What learning outcomes were acquired through participation in the URI Program as reported by participating students?

2. To what extent do students’ perceptions about the learning outcomes they acquired through participation in the URI Program vary by Faculty/Discipline?

3. To what extent do perceived learning outcomes as a result of participation in the URI program satisfy objectives set out in the University Undergraduate Degree Level Expectations (UUDLEs)?

4. To what extent were student expectations met by the URI program?
3.2 Research Design

Creswell identifies the choice of research design with the philosophical assumptions made by the researcher and the worldview in which the research is situated; by the strategy that is applied to the research; and by the methods used to carry out those strategies (Creswell, 2009). Pragmatism was the constitutive worldview framing this study insofar as it arises from “actions, situations and consequences rather than antecedent conditions” (Creswell, 2009 p. 176). Since this case study was intended to determine the impact of a new program model on students rather than simply confirming what we already know, pragmatism was an appropriate worldview for this study, given its intent.

Another consideration is the identification of research strategies. Given the position of the pragmatist worldview, research strategies that I employed included both quantitative (Survey Research) and qualitative (case study) data in tandem to create a synergistic study based on the strengths of both methods. This study employed Quantitative Survey Research as a strategy to identify attitudes and opinions of the sample population of URI scholars, and qualitative methodology to explore the specific URI program. Data collection was conducted within a three-year timeframe and involved the collection of detailed information through a variety of methods (Creswell, 2009).

Creswell identified three variations in mixed method strategies: 1) Sequential; 2) Concurrent; and 3) Transformative (Creswell, 2009). For this case study, I selected a concurrent mixed methods research design, which incorporated elements of both the qualitative and quantitative approaches. By concurrent mixed methods, I mean that quantitative data from a questionnaire were combined with qualitative data from open-ended questions and interviews.
The design strategy was guided by a specific theoretical perspective, in addition to the quantitative and qualitative data being collected at the same time, converged, and integrated in order to arrive at a more comprehensive understanding of the research problem (Creswell, 2009). Seen as two ends on a continuum with quantitative data on one end and qualitative data on the other (Newman & Benz, 1998), mixed methods research lies somewhere in between while incorporating elements of both (Creswell, 2009). This approach also provided the opportunity to draw from multiple sources of information (triangulation) to strengthen the study’s findings, and used a variety of research methods to analyze data in ways that arrived at the most comprehensive understanding of the issues.

The final stage in research design follows from the philosophical worldview and strategies of inquiry (Creswell, 2009). Choosing the research method that best serves the strategy is critical for data collection analysis and interpretation (Creswell, 2009). Although mixed methods are the approach that was used in this study, there was a heavier weighting towards qualitative methodology. Methods employed in this case study include both open- and closed-ended questions, statistical and document analysis, and multiple forms of data across a number of variables.

3.3 Site Selection/City University

City University is a pseudonym for the purpose of this study. Senior administration requested that the institution delivering the URI program and from which study participants were recruited remains anonymous. At the time it was decided to create an undergraduate research program, I was employed at City University, therefore, for this case study, City University was the most appropriate and obvious choice. The broad scope of programs offered
there covers a range of disciplines within faculties that included: Engineering, Science, Architecture, Arts, Nursing, Theatre, Community Studies, Communication, Design, Business and Management. The administration at City University was always strongly supportive of student engagement and success. The URI was seen as a program that aligned with City’s forward-thinking mandate to seek out new initiatives that would contribute to student success.

3.4 Case Selection/URI Program Description

The URI program was shaped in response to a request from senior administration to design a program that would provide an opportunity for qualified and interested undergraduate students across all disciplines to become engaged in research. One of the motivating factors was to introduce them to the idea of graduate school as a potential next step. The evidence for the positive impact of engagement through an undergraduate student research experience is overwhelming, and much of the literature points to a positive correlation with academic success (Lopatto, 2004; Lopatto, 2007; Astin, 1993; McGee & Keller, 2007; Kolb et al., 2000; Chickering & Gamson, 1987; Pascarella & Terenzini, 2005). Almost exclusively, however, these findings are, for the most part, based on undergraduate research experiences in STEM disciplines. The intended goal of City University was to provide the same positive experience across all disciplines within all faculties. As described by Klos et al., “the differences found in undergraduate research in the arts and humanities, compared with that in other disciplines, arise from what makes each of our disciplines distinct in the first place: the methods, epistemologies, results, and even sites of our inquiries” (Klos et al., 2011). Appendix H, lists project titles from all participants and reflects the vast diversity of research topics among the disciplines. It depicts not only a diversity in what is being researched, but also how the
research is taking place and how it parallels scientific method in the arts and humanities, which use individual critical, theoretical and creative approaches. For example, Crawford et al. have described a research study in the fine arts as one where theory and history are blended with practice through performance and exhibition, with “an emphasis upon discovering and understanding the relationship between artistry and scholarship” (Crawford et al., 2011). In the selection of projects for acceptance into URI, it was the faculty in each discipline area who assessed the project proposals and determined whether the projects were deemed “research” as defined in their particular discipline. The program also needed to be established within a 2-month timeframe in time for the implementation of an application process and commencing in the summer term.

As a Master of Education student at the Ontario Institute for Studies in Education (OISE) at the University of Toronto, I had the opportunity to take a course on student development in higher education taught by Professor Peter Dietsche. It was during that particular course that I became interested in the idea of engaging undergraduate students through individually designed research experiences, an auspicious segue into the opportunity to establish such a program at City University. The grounding learning theory for the study’s conceptual framework is Kolb’s Learning Cycle (Kolb, 1984). The URI program was designed to align with Bloom’s taxonomy, which breaks down learning into three domains: Cognitive; Psychomotor; and Affective (Bloom, 1956). Research suggests that elements of a successful program include three objectives: it should “promote student learning outcomes, advance the research agenda of the faculty mentor, and make a new contribution to the field” (Elgren & Hensel, 2006 p. 4). The URI program was designed primarily with the first of these objectives in mind, in the
belief that if done well, the other two would follow.

In Figure 2, I introduced Blooms’ domain theory and corresponding elements of the URI program into Kolb’s characterization of the experiential learning process. Because URI participants needed to identify their initial subject of interest in the application form, I used ‘concrete experience’ as the entry point into the ongoing cycle of learning represented by the diagram. The corresponding domain is indicated as ‘affective’. Subsequent aspects of the URI program are superimposed for each stage on the diagram, along with corresponding domains according to Bloom’s theory. This virtuous cycle reinforces learning outcomes in a constant feedback loop so that learning does not end when the cycle is completed. Skills acquired through the URI program are the basis for further inquiry.

**Figure 2: Structural Dimensions Underlying the Process of Experiential Learning, Relationship in the URI Model to Bloom’s Domains**

Source: (Kolb, 1984 42)
One consideration for the initial URI design was to focus learning outcomes on the higher complexity intellectual functions, rather than the lowest cognitive functions, which could be achieved through more traditional, less resource-intensive teaching methods. Since learning outcomes in the cognitive domain are particularly rich, it should come as no surprise that the majority of learning outcomes that can be realized by student participation in faculty research fall into the more complex levels of comprehension, including assessment, analysis, synthesis, and evaluation (Bloom, 1956). According to Astin, students learn by becoming involved (1985), which is one of the guiding principles of the URI program design. As a program organizer, I anticipated that upon successful completion of the URI program, student participants would have acquired skills in all three domains. The expected and stated outcomes for the URI program, as well as the means of achieving them, are described below for each domain.

The cognitive domain – knowledge.

Upon completion of the URI program, the student will be able to:

1) Assess the state of knowledge in the chosen field of research and select an outstanding problem or gap that needs to be addressed (Analyze, Assess and Select). This should be accomplished through one-on-one discussions with the potential mentor prior to beginning the research program. It is important that the student has some idea of the research questions they wish to address, since interest in the topic is critical to the quality of student effort and will maximize the development of the student and success in achieving learning outcomes (Astin, 1985).

2) Propose a realistic/sound hypothesis, the intention of which is to solve the problem or fill the gap (Synthesis). The proposed hypothesis does not necessarily have to be proven
to be true. What is important in this learning outcome is the independence of the thought process, innovation in proposing a possible solution and engagement with mentors to discuss the viability of the hypothesis. Kolb argues that it isn’t enough to merely learn, but that the student must be engaged in what he is learning in order for it to have personal meaning for him/her and contribute in a real way to personal development (Kolb, 1984). In other words, the students should care about what they are doing and be confident in their ability to succeed (Kolb, 1984). Student participation in faculty research is not intended to create interest, but assumes that it is already there, and provides what Dewey calls an ‘experiential continuum’ on which the student builds their knowledge (Dewey, 1938).

3) Conduct an effective literature review, organizing information around relevant topics and accurately critique extant and relevant literature in the field (Synthesis and Evaluation). The ability to Interpret and evaluate information from a variety of sources goes beyond the classroom or laboratory, and can be applied to any situation in the real world. Today’s students make use of online resources, search global databases, and are expected to be proficient in the fundamentals of literature review. This is a precursor to the successful completion of the research project. They will also understand the meaning and importance of international journal impact factors.

4) Analyze ethical questions relevant to the research project and evaluate institutional Ethics Guidelines (human and/or animal, as applicable) to determine what considerations are appropriate to the individual research project (Synthesis and Evaluation). In the URI program, this particular learning outcome is specific to a project;
however, its application is much broader. In achieving this learning outcome, students will reflect on risk/benefit assessments, the notion of informed consent, fairness and equity, as well as privacy and confidentiality and the government legislation that protects it.

5) Plan, design and test a research protocol that effectively proves or disproves the hypothesis being tested, correctly using the scientific method (Synthesis and Evaluation). Each research project is discrete, and this is where peer discussions and regular meetings with the mentor/supervisor will help to achieve this learning outcome. Tools such as weekly journal club discussions and presentations will bring in expertise.

6) Demonstrate effective critical thinking skills to solve complex problems relevant to the field as evidenced by successful completion of individual research projects (Analysis and Synthesis);

7) Compile preliminary evidence to support a proposal for funding, organize the data and generate an effective grant application (Synthesis). Writing an effective grant means that the student has a clear understanding of all aspects of the research project, that the student is able to interpret funding agency goals, and that he/she can successfully translate the results into a strong application.

The psychomotor domain – skills

Upon completion of the URI program, the student will be able to:

1) Demonstrate effective and correct application of skills in conducting experiments within a complex research project and proficiency with appropriate computer programs to analyze results. The research project and field of study will dictate the particular skills
that will be learned. This will likely involve imitation of an observed action, manipulation, precision and articulation (Heinich et al., 1993) as well as fine or gross bodily movements (Kibler, 1981). The point is that most research, particularly in the sciences, requires the demonstration of practical, purposeful psychomotor skills, even if only to operate a computer.

2) **Accurately record and organize results of experiments for later analysis (Study and Recording).** While this can be seen as a mechanical procedure of recording information, the nature of research requires that others must be able to reproduce your results. It will quickly become obvious and problematic in a research setting if a student's notes are only legible and organized to him/herself.

3) **Present the results of an experiment or of a series of experiments to peers and/or a general audience in a way that uses bodily and facial gestures to stress important points.** Kibler’s taxonomy includes both nonverbal communication as well as speech behaviour as belonging to the psychomotor skills grouping (Kibler, 1981).

**The affective domain – attitudes.**

The student will consistently:

1) **Show respect for supervisors and fellow students as demonstrated by appropriate interactions and interpersonal relations (Receiving).**

2) **Be receptive to new and alternative ideas from team members and cooperate in a lab environment (Receiving).**

3) **Accept responsibility by demonstrating self-directed learning (Valuing).**
4) Defend the premises and learning outcomes of the research design through a public poster presentation and question period (Responding).

5) Value the research by generating a paper based on the research results for submission to an appropriate journal or academic symposium (Valuing).

Timing.

The URI program had a 12-week dedicated format, which meant that the only time available to run it was during the summer, when regular classes were not in session and students could devote appropriate time to the project. While it made it easier to find space and to schedule the workshops that were required as part of the URI program, it also meant that professors needed to be willing to make that commitment over the summer. The application process required a time commitment from both student and mentor. The course had two components. The first, the independent research project, required a minimum of 40 hours per week for 12 weeks. The second, which was the formal course instruction, consisted of 5 workshops, each of which lasted for 8 hours in a one-day format.

Each professor who agreed to mentor/supervise a student was responsible for the costs of the research project. Therefore, lab expenses were not a central administration cost. In addition to the research project, student participants were required to attend five Summer Workshops, where they received instruction by course experts in key areas related to research. This was done by subject matter experts within the university, and occasionally by outside professionals who were brought in where necessary. Textbooks were available from the library and kept to a minimum; journal articles were placed on Blackboard, the learning management system for posting online resources, and courses at City University.
Content.

There were two distinct, but interrelated components to the program. The URI program combines the theory of research through classroom instruction with the application of principles in the laboratory. The development and effectiveness of an innovative, blended inquiry learning and teaching methodology was examined by Toth (Toth et al., 2009). Topics taught in each of the URI workshops had direct implications and necessary information for the conduct of the independent laboratory research project. It would be difficult, for example, to get too far into a research project without the knowledge from the first two workshops. Therefore, these two workshops (The Literature Review and Research Ethics), were scheduled to be taught within the first week of the course. Below is a sequential outline of topics that were covered over the 12-week period.

Workshop format.

Workshop #1 – The literature review.

1) Fundamentals of Literature Review

2) Using Online Resources

3) Searching Global Databases

4) Accessing & Understanding International Journal Impact Factors

Workshop #2 – Research ethics.

1) Assessing Risk and Benefit

2) Informed Consent

3) Privacy and Confidentiality

4) Fairness and Equity
5) REB Review

6) FIPPA

*Workshop #3 – Funding your research.*

1) Effective Grant Writing

2) How to Interpret Funding Agency Mission Statements and Program Criteria

3) Identifying Funders

4) Proposing a Lean Budget

5) Putting your Best Foot Forward – What your CV says about you.

*Workshop #4 – The why and how of publishing your results.*

1) The Relationship between Funding and Publishing

2) Planning your journal article

3) Drafting the document

4) Revising Organization and Arguments

5) Telling the research story clearly

6) Connecting with the reader

*Workshop #5 – Knowledge translation and technology transfer.*

1) Intellectual Property Law

2) Patent Law

3) Disclosing inventions

4) How to Fund Your Patent

5) Angel Investors
Assessment.

In the URI program, assessments were made in their relevance and application to each individual research project in a continual feedback loop. In some cases, however, this was by trial and error. That is, if the implementation of a change did not work the way it was expected, then a different approach needed to be taken. According to Morrison et al, one must develop testing instruments and materials to evaluate the degree to which learners acquired the knowledge, skills and attitudes identified by the expected learning outcomes (Morrison et al., 2011). The assessment method for this course was primarily formative evaluation, where the effectiveness of the instructional program was assessed while it was in progress (Morrison et al., 2011 274), since the student received direct feedback in the laboratory setting. For example, assume that a student determined that an ethics protocol was needed for the research project, based on the workshop in Research Ethics. If he/she was wrong, the Research Ethics Office would provide that feedback. However, if the student was correct in assuming that an ethics protocol was needed, then he/she would proceed to the next step.

As discussed in Chapter 2, in the laboratory setting, the most effective means of evaluation is through authentic assessment (Wiggins, 1990), since the mentor/supervisor is working one-on-one with the student on a daily basis. Methods for assessment could include observing behaviour during group work, engaging in informal talks with respect to experimental results and holding group discussions. As each outcome was deemed to have been accomplished, the student would progress to the next stage. Mastery of the workshop content was reflected in the progress of the individual research project. The success or failure of the
experiments to prove the hypothesis should have no bearing on the learning outcomes, as long as the research process is sound.

There was no formal assessment process and the program was not graded, however, summative evaluation, which measures the degree to which the major outcomes are attained, will be evidenced by the final element of the course, which is the poster presentation.

**Funding.**

A student-researcher joint collaboration became the platform tool on which the outcomes were based – the requirement being that it must be based either on an idea put forward by the student, or a discrete project within the ongoing research program of the faculty supervisor. One of the URI program challenges for the administration was to support the largest number of students with the funding that was available. Initially, we had hoped to provide the same funding as the NSERC USRA awards ($6,500), but in order to reach more students, it was decided to begin with a lower amount ($5,000) and gradually increase the award value as allowed by available institutional funds.

**Background.**

Once the decision was made to move ahead with the URI program, notices were sent out to Faculty Deans, Departmental Chairs and Institute Directors for circulation to faculty members. Advertisements were placed in university student newspapers, and details of the program were published on the research website. The response was staggering. Applications for URI Scholarships exceeded the number of places by more than three-fold. Not surprisingly, the majority came from the Faculty of Engineering, Science and Architecture (155), followed by Arts (98), Community Studies (86), Design and Communication (39) and Business (20).
Review committees were organized within each faculty, and each committee member was able to access the applications online. Individual faculty committees adjudicated the applications for excellence and ranked the candidates. There were consistently more high quality applications than there was funding, and to ensure an equitable disciplinary cross-section of students was funded by the program, the funds were allocated to maintain a fairly consistent success rate across all faculties. In 2010, due to the high number of quality applications within the Faculty of Arts, the Office of the Dean of Arts decided to fund an additional nine students, while the English Department and the Department of Politics and Public Administration funded one additional student each. It is not possible to ascertain in which disciplines the Faculty of Arts awarded the additional URI scholarships. In 2011, for the same reason, the Office of the Dean of the Faculty of Community Studies decided to fund an additional two students. Faculties that made the decision to fund additional students did not have their allocation reduced, and there were a minimum number of awards for each faculty.

**Application process.**

The application (Appendix A) required a description of the research project to be undertaken, the signature of the student, the signature of the researcher/supervisor approving the project, and the signature of the Chair or Dean to guarantee that the identified resources were available. After each cut-off date, all applications were sent to members of the Faculty Review Committee.

**3.5 Participant Selection**

The applications were assessed by independent faculty committees. The selection process for the URI Scholars began with each Faculty creating a committee to review their own
applications and select those to be awarded the URI Scholarship. A Final Report was obligatory (Appendix B). While the student-researcher joint collaboration was the project tool, there was also a requirement of the student that they attend themed workshops hosted by the Office of the Vice President, Research and Innovation. These workshops provided a theoretical framework applicable to all of the research projects, in whatever discipline they were conducted, including research ethics, graduate school opportunities, the importance of publishing your work, how to prepare a poster presentation, and how to write a grant. The workshop topics were revised and updated every year based on student feedback.

URI Scholars were encouraged to attend a ‘Welcome’ event to meet one another as well as the supervising faculty, and it also provided assurance that there were others to talk to in the event of any problems. At the end of the summer there was a ‘Celebration’ event at which all of the scholars were expected to give a poster presentation of their research project. Attendees included the members of the Executive Administration of City University, Faculty Deans, Departmental Chairs, Faculty members, students and family members.

The number of successful URI applications varied from year to year depending on the availability of funds from the Office of the Provost and the Office of the VP Research and Innovation, as well as any funds that the Faculty and/or Department were willing to contribute. In general, the number of scholars funded was approximately fifty per annum. Since its initiation in the summer of 2010, data has been collected and analyzed from three cohorts of URI Scholars who have passed through the program.

**Academic Preparedness.**

The following criteria were required:
• Completion of a minimum of 1 year undergraduate study;

• GPA of 3.5 or greater

The figure of 3.5 as the minimum GPA was chosen because it corresponds to the entrance requirement for graduate study at the institution. In spite of this, there were exceptions to the rule. For example, many students have difficulty adjusting in their first year to a changing lifestyle (moving away from home), new social environment or unexpected academic pressure, and this is often reflected in first-year grades. Based on transcripts and mentor assessment, a student who performed exceptionally well in subsequent years was still considered for the program, even if their GPA overall fell below the cut-off criterion.

Preference in choosing participants was given to students who would be entering either their 3\textsuperscript{rd} or 4\textsuperscript{th} year in the following September, since one of the aims of the program was to prepare them for entry into graduate school. However, in the first year of the program, 11\% (n=15) of the applications came from students who had only completed one year of undergraduate studies. Of these students, 8\% (n=5) were successful in being chosen for the URI scholarship. Since these students had identified an area of interest, found a mentor who would guide them in their endeavours and submitted an application, it was decided not to exclude them from the program. Over all three cohort years, 12\% (n=49) of the applications were from students who had completed their first year of study, with a 9\% (n=15) success rate.

Data that can be gleaned from the application forms (Appendix A) are somewhat limited by the questions themselves, which were deliberately kept to a minimum, ensuring that sufficient information was collected on which to base award decisions, while the process was not too onerous for the student applicants and their proposed faculty supervisors. The total
number of applications received for the URI program in years 2010, 2011 and 2012 was 139, 113 and 146, respectively (n=398). There were considerably fewer applications in the second Cohort year, and one possible reason for this is the funding uncertainty for 2012, which delayed the announcement of the program until late in the academic year, when many students may already have accepted jobs for the summer.

**Learner maturity.**

Learner maturity was judged on a detailed description of the proposed research project and approval of a mentor/supervisor willing to participate in the project. Even before applying, students must have assessed the relevant field, and selected a project that was of interest to them. Further, they needed to have identified an appropriate researcher in the area and convinced that researcher to be part of the project. The curriculum for the URI program assumed a high level of self-directedness and independence, with a fairly low level of scaffolding support required.

**Learning styles.**

Gardner describes nine categories of intelligence (Gardner, 1983) and the ways in which you can increase the likelihood that all of the students’ intelligences are addressed. The proposed workshop curriculum for the URI program reflected the following (Table 2):-

**Table 2: Gardner’s Categories of Intelligence**

<table>
<thead>
<tr>
<th>Category of Intelligence</th>
<th>URI Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal-Linguistic</td>
<td>Presenting, researching and process writing</td>
</tr>
<tr>
<td>Logical-Mathematical</td>
<td>Problem-solving, critical thinking classifying, learning the scientific model, collecting data</td>
</tr>
<tr>
<td>Visual-Spatial</td>
<td>Graphing, patterning, using charts</td>
</tr>
<tr>
<td>Bodily-Kinesthetic</td>
<td>Hands-on experiments</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>Collaborative learning, sharing, group work</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>Individual study, personal goal setting, individual projects, personal choice in projects</td>
</tr>
</tbody>
</table>

Source: (Gardner, 1983)
Motivation and attitude.

This is perhaps the most important characteristic of the prospective URI Scholars (Morrison et al., 2011). The students had to care about what they were doing and be confident in their ability to succeed. This course was not concerned with strategies to create interest, but assumed that it was already there because of the application process itself. Applicants were required to identify a research project that interested them, describe and to some extent plan the project to present to a prospective faculty member, convince the faculty member that the plan was feasible and the commitment real, and compete with others for one of the positions.

3.6 Data Collection

Phase 1 – Analysis of anonymized secondary data.

The secondary data for all three cohorts (2010-2012) were provided by City University. These data were for institutional evaluative purposes and no consent was therefore needed. However, City University made all of the anonymized data available to me. This includes qualitative and quantitative data from two sources: 1) Application forms (Appendix A) from each of the successful URI Scholars; and 2) Final reports (Appendix B) from each of the successful URI Scholars.

1) Application Forms remained essentially the same during the first 3 cohort years.

Information gathered from the questions on the Application Form (Appendix A) consists of the following:

Student Information. Name; student number; address and contact information.
**Academic Background.** Discipline; faculty/department; cumulative GPA; number of terms completed towards degree program when the award would be held; signature agreeing to abide by City University policies and regulations governing awards. Note that for 2011 and 2012 cohorts there was an additional question – If graduating, will you be returning for further studies?

**Supervisor Information.** Name and title; faculty and department; contact information; title of proposed research project; proposed start/end dates; signatures of professor and head of department (the latter to ensure that the project had departmental approval).

2) Final Reports remained the same during the first three cohort years. Information gathered from the questions on the Final Report form consists of the following:

**Personal Information.** Name; contact information; student number; faculty/department; name of supervisor; start/end dates; title of research project.

**Description of Research Activities.** Description of the project and the role of the student within it; whether the student was involved in submitting or preparing any publications or proposals for presentation at any conference or symposium.

**Account of Personal Experience in the URI Scholars Program.** What have you learned from this experience? How has this experience focused or changed your ideas about research? Were you considering graduate studies before taking part in this program? If not, are you considering graduate studies after taking part in the program? If applicable, explain how this experience has affected your decision regarding graduate school?
Future Opportunities: Would you be interested in attending an event that would bring together all of the URI Scholars? Would you be interested in an opportunity to display or present elements of your research results at such an event?

Feedback: Please provide any feedback, comments or recommendations you may have that would be beneficial to improving future rounds and further experiences.

Phase 2 – Collection and analysis of primary data.

For Phase 2 a follow-up online questionnaire (Appendix C) was sent to the URI scholars in the first three cohorts (n=175) following approval of Ethics Review Boards at the U of T and at City University. In response to a very low response rate to the online questionnaire (7%; n=12) after the initial e-mail plus one reminder e-mail), a second reminder email was sent out that included a draw for an iPad. Following this incentive, the response rate rose to 28.4% (n=48).

Creswell states that qualitative research data tends to be collected in the field; that the researchers collect the data themselves through examining, observing or interviewing; that data analysis is more inductive and moves from individual pieces of information towards more abstract themes, and that care must be taken to understand the participants’ meaning (Creswell, 2009). Perhaps most importantly for this study, he describes a feature called Emergent Design, by which he means that the initial plan or design of the research cannot be too tightly prescribed, and all phases of the process may change or shift after the researcher enters the field and begins to collect data – questions may change .... But the key idea is to learn about the issue from participants and to address the research to obtain that information. (Creswell, 2009 p. 175)
Table 3 indicates the source of the data that was collected to answer the research questions that drive this study.

**Table 3: Data Sources to Answer the Research Questions**

<table>
<thead>
<tr>
<th>RESEARCH QUESTIONS</th>
<th>DATA SOURCE</th>
</tr>
</thead>
</table>
| **RQ #1**: What learning outcomes were acquired through participation in the URI Program as reported by participating students? | Final Reports  
Survey Questionnaire (Questions #9 and #11)  
Participant Interviews (Questions #2 and #5) |
| **RQ #2**: To what extent do students’ perceptions about the learning outcomes they acquired through participation in the URI Program vary by Faculty/Discipline? | Final Reports |
| **RQ #3**: To what extent do perceived learning outcomes as a result of participation in the URI program satisfy objectives set out in the University Undergraduate Degree Level Expectations (UUDLEs)? | Survey Questionnaire (Question #10) |
| **RQ #4**: To what extent were student expectations met by the URI program?       | Survey Questionnaire (Questions #6, #7 and #8)  
Participant Interviews (Question #1) |

*Establishing Credibility.*

For the secondary data analysis, comprising the Application Form and Final Report, the data requested were in response to institutional requirements and therefore the information previously included on these reports provided the only data available from those sources.

Content validity of the survey questionnaire for collecting the primary data analysis was established by two colleagues who are experts in the field of postsecondary education and research, and who reviewed the survey questionnaire to ensure that all relevant constructs
were included and those that were not relevant were not included (Appendix C). The survey questionnaire was pilot-tested with six undergraduate students from City University to determine face validity; they were asked for feedback to ensure that there were no ambiguous or leading questions, and that the instructions were clear.

Since I was employed at City University at the time the URI program was implemented, there could be a perception of Conflict of Interest. I have dealt with this in the following manner. I have consciously focused on this issue and conducted self-checking throughout the study to ensure that I did not personally bias the findings. I am no longer involved in the program in any way, nor do I have any vested interest in the results. I believe that this time-gap gives me distance from the data and objectivity in assessment. Finally, I requested independent validation of the themes identified in the qualitative data from two qualified individuals whom I trust to give me impartial feedback.

3.7 Data Analysis

I examined the input and responses from the Application Forms, Final Reports and Survey Questionnaire of participants to identify themes among the different types of experiences that were reported, consciously looking for similarities and differences by discipline, gender, academic term, expectations and other parameters related to my research questions. Quantitative data were calculated as appropriate. All qualitative data were analyzed to identify themes or perspectives. Where appropriate, data transformation from qualitative to quantitative was considered, in order to determine the strength of issues/themes identified. Content analysis was cross-checked through both colour-coding as well as a key-word search.
3.8 Methodological Limitations and Assumptions

To the extent that this study is based on qualitative research, there is a certain amount of description involving strategic, ethical and personal issues in the research process (Locke et al., 2007). Both content validity and face validity tests were conducted. In the qualitative methodology learning the meaning intended by the participants was the focus, and not the meaning brought by the researchers (Creswell, 2009).

The follow-up online survey and interviews relied on the recall of the participants. The assumption was made that the responses were as accurate as possible, since the participants had nothing to gain or lose.

The purpose of case studies is to gain a deep understanding of the phenomena that are the focus of the study and as such, generalization of findings beyond this case is not the intent nor will it be possible. Nevertheless, the findings may be of interest to other universities as they attempt to enhance student learning in this area.

3.9 Ethical Considerations

The City University Research Ethics Board approved my request to access secondary data from the Application Forms (Appendix A) and Final Reports (Appendix B); these data were forwarded to me, following cleansing of any identifying characteristics.

Completion of the student questionnaire was voluntary, and in order to collect these primary data, I obtained Ethics Approval from both City University and the University of Toronto. The Office of the Vice President, Research and Innovation at City University sent out an e-mail to all successful URI Scholars (n=175), inviting them to take part in the study by filling out the questionnaire (Appendix C).
Consent was sought to name the university where the case study program took place, however, consent was not granted and therefore, I have used City University as a pseudonym for the actual institution.

3.10 Summary

The research activity for this study constitutes a comprehensive review and analysis of secondary data consisting of program application forms (n=398) and final reports (n=130) from URI Scholars; primary data consisting of a follow-up questionnaire to give further perspective on the impact of the experience; and interviews with selected participants. The design of the study was to focus on the impact of the model in facilitating learning outcomes, identification of differences based on discipline, gender and student maturity (measured by completion of academic terms), and success in meeting participant expectations, as perceived by the student participants. Chapter 4 is a presentation and analysis of the findings from this case study. Chapter 5 presents some conclusions, implications and recommendations resulting from this case study.
CHAPTER FOUR

Findings and Analysis

This mixed methods case study explored the experiences and perceptions of the first three cohorts of URI Scholarship awardees in the years 2010, 2011 and 2012, to determine the effects and impact of a model for undergraduate research experiences on students from a diverse range of disciplines. Kolb (1984) and Astin (1985) point out that students learn by becoming involved (i.e., experiential learning), which was one of the guiding principles and motivators of the design of the URI program. It was anticipated by the program developer that upon successful completion of the URI program, student participants would have acquired skills in all three domains identified in Bloom`s taxonomy – cognitive, psychomotor and affective (Bloom, 1956). The study was conducted over a three-year period (2010-2012) at City University in Toronto. Study participants were the first three cohorts of successful URI Scholarship awardees.

4.1 Description of Participants

Applications received.

The total number of applications received for the URI program in years 2010, 2011 and 2012 was 139, 113 and 146, respectively (n=398). Table 4 below shows the distribution of applications to the URI program by faculty and academic term. Based on my many years of professional experience in the post-secondary sector, I was not surprised, 39% of all applications came from disciplines within the Faculty of Engineering, Science and Architecture (FESA) (n=155). The overwhelming majority of existing undergraduate experiential learning programs are focused on students in science, technology, engineering and mathematics (STEM)
fields, encouraged by the funding focus of the National Science Foundation (NSF) in the US and by the Natural Sciences and Engineering Research Council (NSERC) in Canada. While there was a wide variation in participant numbers between all of the faculties, discipline representation within each faculty was limited to between seven and nine.

Table 4: Distribution of Applications to the URI Program by Faculty and Academic Term (2010-12)

<table>
<thead>
<tr>
<th>Faculty</th>
<th>First Year 12% (n=49)</th>
<th>Second Year 74% (n=295)</th>
<th>Third Year 14% (n=54)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 terms</td>
<td>3 terms</td>
<td>4 terms</td>
<td>5 terms</td>
</tr>
<tr>
<td>FA</td>
<td>7 2 28 4 44 0 13 0 98</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FDC</td>
<td>2 1 9 2 19 2 4 0 39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FCS</td>
<td>18 1 19 4 35 0 9 0 86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FESA</td>
<td>17 0 62 5 54 0 15 2 155</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FBM</td>
<td>0 1 5 1 4 2 5 2 20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>44 5 123 16 156 4 46 4 398</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Submitted URI Application Forms (2010-2012), City University
Because of the traditional focus on STEM disciplines, significant effort was made to ensure that the marketing of the URI program reached all faculties by a balanced distribution of applications. For example, after the URI program applications had been received for the first year (2010), I held outreach meetings with the Dean and Associate Dean of Research from the Faculty of Design and Communication (FDC) to increase awareness of the program in that Faculty. Interestingly, the number of FDC applications increased almost five-fold between 2010 (n=5) and 2012 (n=24). I was also encouraged by comments in the Final Report such as the following, from an Image Arts student who encouraged the program “to continue providing grants to arts students, and to value the role of research in the artistic process by allowing them to have the same opportunities as those who are in fields more typically thought of as research-based” (C2011DIMAFR2). In a 2008 collection of essays published by Yale University Press, Smith discusses the nature of research in the visual arts and the question of the validity and universality of findings that involve an aesthetic component, concluding that research in this area is, “an integral, necessary, ubiquitous, and yet frequently unacknowledged or undeclared component of the activities of all scholars, academics, curators, and artists” (Holly & Smith, 2008 p. 10). It may be that student uncertainty around the nature of what constitutes a research project proposal may have resulted in fewer applications from the Faculty of Design and Communication initially.
Approximately 74% (n=295) of all applications came from students who had completed between four and six academic terms, or in other words, who were either entering, enrolled in, or had just completed their third year of undergraduate studies. This is what I would have expected. Data provided by program participants obtained from Final Reports indicates that 70% (n=122) of all URI scholars were considering graduate school prior to taking part in the program, a decision that would not usually be made in the first year of undergraduate study, and those entering university would most likely be unaware that the program existed. In addition, one pre-requisite for the program was that the student had to be enrolled in undergraduate studies while holding the scholarship, which would reduce the number of applications from students in the seventh or eighth academic term, since they would have graduated before they could take up the award. These data are shown below in Table 5.

**Awards Distribution.**

Out of a total of 398 applications, 175 URI scholarships were awarded, a success rate of approximately 44%. The program was designed to distribute awards amongst the faculties to create a disciplinary cross-section of students, and thus the funds were distributed to maintain a fairly consistent success rate across all faculties each year regardless of the total number of applications received. Faculties that made the decision to fund additional students did not have their allocation reduced, and there were a minimum number of awards for each faculty.

**By faculty.**

Table 3 below shows the award distribution by faculty. It is from this group of student participants that Final Reports, Questionnaire survey responses and interviews were obtained.
Table 5: URI Awards Distribution by Faculty

<table>
<thead>
<tr>
<th>Faculty</th>
<th>FA</th>
<th>FDC</th>
<th>FCS</th>
<th>FESA</th>
<th>FBM</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awards</td>
<td>(n=50)</td>
<td>(n=18)</td>
<td>(n=38)</td>
<td>(n=57)</td>
<td>(n=12)</td>
<td>175</td>
</tr>
<tr>
<td>Success Rate</td>
<td>51%</td>
<td>46%</td>
<td>44%</td>
<td>37%</td>
<td>60%</td>
<td>44%</td>
</tr>
</tbody>
</table>

Source: Office of the Vice President, Research and Innovation, City University

LEGEND (Faculty Pseudonyms)

FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management

It is interesting to note that in 2010, while the Office of the VP Research and Innovation funded 13 students from the Faculty of Arts, due to the high number of quality applications the Dean of Arts funded an additional 9 students, while the departments of English and Politics and Public Administration funded one additional student each. If we remove those students (n=11) from the statistics in Table 5, then the success rate for the Faculty of Arts becomes 41% for URI Scholarships funded, which is comparable to the other faculties. Similarly, in 2011, the Office of the VP Research and Innovation funded 14 students from the Faculty of Community Studies. However, due to the high number of quality applications within that Faculty, the Dean of FCS funded an additional 2 students. If we remove those students (n=2) from the statistics, then the success rate for FCS is 41% for URI Scholarships funded.

There were a minimum number of awards given to each faculty each year (2010-2012). The fewest number of applications came consistently came from the Faculty of Business and
Management, resulting in a success rate of 100% in 2010, for example. This is the reason that there appears to be a much higher success rate in that faculty. I was not given access to information regarding the minimum number each year.

By gender.

The application forms did not request gender information, which makes it impossible to ascertain whether the data on awarded URI scholarships reflect alignment with the ratio of female to male applications or is solely an indication of the quality of the applications. However, gender data of URI scholarship holders that were collected by the Office of the VP, Research and Innovation show that although the ratio of female to male (53%:47%) (n=93:82) URI scholars in all years reflects a fairly equitable distribution, competition results within each faculty do not mirror the overall ratio as illustrated in Table 6.

Table 6: URI Awards Distribution by Gender (2010-2012)

<table>
<thead>
<tr>
<th>Gender</th>
<th>FA</th>
<th>FDC</th>
<th>FCS</th>
<th>FESA</th>
<th>FBM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>68%</td>
<td>56%</td>
<td>82%</td>
<td>23%</td>
<td>42%</td>
<td>(n=93)</td>
</tr>
<tr>
<td></td>
<td>(n=34)</td>
<td>(n=10)</td>
<td>(n=31)</td>
<td>(n=13)</td>
<td>(n=5)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>32%</td>
<td>44%</td>
<td>18%</td>
<td>77%</td>
<td>58%</td>
<td>(n=82)</td>
</tr>
<tr>
<td></td>
<td>(n=16)</td>
<td>(n=8)</td>
<td>(n=7)</td>
<td>(n=44)</td>
<td>(n=7)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>(n=50)</td>
<td>(n=18)</td>
<td>(n=38)</td>
<td>(n=57)</td>
<td>(n=12)</td>
<td>(n=175)</td>
</tr>
</tbody>
</table>

Source: Office of the Vice President, Research and Innovation, City University

LEGEND (Faculty Pseudonyms)

FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management
Disciplines that tend to be male-dominated, such as those in the Faculty of Engineering, Science and Architecture had almost a (23%:77%) (n=13:44) female to male ratio, whereas more typically female-dominated disciplines such as those found in the Faculty of Community Studies had an 82%:18% (n=31:7) female to male ratio. In the Faculty of Arts, where I did not expect to see such a highly skewed gender distribution in the applicant pool, the ratio favoured females more than 2-to-1 (68%:32%) (n=34:16).

These findings are similar to those from a recent study out of Worcester Polytechnic Institute, which showed that a learning model reflecting a project-based curriculum in STEM fields appeared to be substantially more effective for women than for men, and reported that 63% (n=244) of the women, as opposed to half of the men surveyed said that the model helped them to understand the relationship of technology to society (Grasgreen, 2013).

By academic term.

Competition outcomes by academic term over the first three years are shown below in Table 7. Similar to the distribution of application numbers by academic term, 78% (n=137 of 175) of all URI Scholarships were awarded to students in academic terms four, five or six.

One of the URI scholars from Human Resources Management noted in the Final Report that,

...the benefit of a program like this is for students in second or third year of their undergraduate degree who are undecided what they want to do. If they can be exposed to real research it will certainly give them a first-hand opportunity to learn what academia actually is and if it is something that they want to pursue.

(C2010DHRM/OBFR1)
Table 7: URI Awards Distribution by Academic Term (2010-2012)

<table>
<thead>
<tr>
<th></th>
<th># of Terms Completed by Applicant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First Year 9% (n=15)</td>
</tr>
<tr>
<td></td>
<td>2 3 4 5 6</td>
</tr>
<tr>
<td>Faculty</td>
<td></td>
</tr>
<tr>
<td>Arts</td>
<td>3 0 18 2 22</td>
</tr>
<tr>
<td>FDC</td>
<td>0 1 5 0 10</td>
</tr>
<tr>
<td>FCS</td>
<td>5 0 8 2 19</td>
</tr>
<tr>
<td>FESA</td>
<td>6 0 19 4 20</td>
</tr>
<tr>
<td>FBM</td>
<td>0 0 3 1 4</td>
</tr>
<tr>
<td>Total</td>
<td>14 1 53 9 75 1 20</td>
</tr>
</tbody>
</table>

Source: Office of the Vice President, Research and Innovation, City University

Legend (Faculty Pseudonyms)
FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management

Another participant, this time from the Department of Social Work, indicated that he/she had spoken to his/her supervisor about “venues and opportunities to speak to second and third year students to promote the opportunity” (C2011DSWFR2), suggesting that there is a sense among the students that this is when one would most likely get the most benefit from an undergraduate research experience.
This is further supported by a comment on the Student Questionnaire form. In response to whether or not the URI program had been successful in meeting their expectations, one student reported as follows: “Not completely, as I felt I got lost a bit. I just finished my first year”. That student had indicated their expectations included a formal research experience with complete guidance from the faculty. Interviewees also commented on the timing of the URI experience. All respondents were of the opinion that the most appropriate time to engage in a program of this kind was following the second or third year of academic study. Reasons that were given include the fact that in most programs, methodologies and application are taught in the third year and before that would be challenging for an undergraduate student to grapple with what it means to do this kind of research. Also it was felt that a less advanced student might be interested and engaged, but may not have the right tools, such as relevant coursework, foundational theory and maturity, to succeed. One of the interviewees from the Faculty of Community Studies had applied for the first time while she was still in her first undergraduate year. She was unsuccessful that time but felt that she had learned a lot from the process so that her following application was successful.

One final consideration for the higher number of applications and participants in terms four, five and six could be the design of the program, in which students were required to identify and secure their supervisors from among the faculty. While the cost of student internships are covered by the URI program, there is considerable time, and sometimes financial investment on the part of the supervisor and his/her research program, including training, mentoring and the cost to run experiments. Students who have not completed at least
one full academic year might be seen as a higher risk. They may also be less confident about approaching a professor.

4.2 Research Question #1: What learning outcomes were acquired through participation in the URI Program as reported by participating students?

**Phase 1 – Participants’ comments in the final reports.**

All URI Scholars were requested to complete a Final Report consisting of a number of open-ended questions (Appendix B), within one month following program completion. Out of a total of 175 successful URI Scholars, 130 participants from 5 faculties represented by 40 discrete disciplines, completed and returned the final report, a response rate of slightly more than 74%. Students were overwhelmingly positive with 99% (n=129) reporting benefits from their experience. In all final reports submitted, only one student indicated that he/she did not learn any new skills. Review of this student’s final report showed that the student found the project to be neither challenging nor engaging, and experienced a lack of meaningful mentorship.

**Themes identified.**

Based on individual learning outcomes as reported by participants in their final reports, I identified five major themes from among the reported learning outcomes. The numbers in brackets express the percentage of the total number of student respondents who reported these learning outcomes as gains:-

1) Acquisition of new knowledge (Cognitive) (60%);

2) Improved intellectual skills (Cognitive) (81%);

3) Improved practical skills (Psychomotor) (91%);
4) Improved knowledge of self (Affective) (60%);

5) Improved relationship to others and society (Affective) (64%).

Table 8 depicts the number of participants by faculty who included at least one of the keywords as a learning outcome in their responses. I identified themes on the basis of a number of keywords and phrases that appeared in the student responses in the final report. While the majority of student comments used the exact wording in the keyword, some were subject to interpretation as to which theme was most appropriate. I believe that it is still possible to meaningfully categorize the themes in terms of Bloom’s domain descriptions. Based on this approach, I assigned the first two themes to the cognitive domain; the third to the psychomotor domain; and the fourth and fifth to the affective domain (Bloom, 1956).

There were additional interesting outcomes that were outside the identified themes, including the influence of the program on the decision to attend graduate school; the impact on career choice; the potential for interdisciplinary studies; the importance of mentorship in the learning process; and perhaps most surprisingly, the awakening of a sense of enthusiasm, passion, joy, accomplishment and pride. These are presented and discussed under “Other Findings”, later in the chapter.
Table 8: Learning Outcomes Recorded by Participants in Response to the Final Report Question, “What have you learned from this experience?”

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES AS REPORTED BY PARTICIPANTS (Column A)</th>
<th>Faculties (Disciplines)</th>
<th>FA (9)</th>
<th>FDC (7)</th>
<th>FCS (8)</th>
<th>FESA (9)</th>
<th>FBM (7)</th>
<th>Total (40)</th>
</tr>
</thead>
<tbody>
<tr>
<td># of URI awards</td>
<td>(n=50)</td>
<td>(n=18)</td>
<td>(n=38)</td>
<td>(n=57)</td>
<td>(n=12)</td>
<td>(n=175)</td>
<td></td>
</tr>
<tr>
<td># of final report responses</td>
<td>(n=38)</td>
<td>(n=15)</td>
<td>(n=30)</td>
<td>(n=37)</td>
<td>(n=10)</td>
<td>(n=130)</td>
<td></td>
</tr>
<tr>
<td>Response Rate</td>
<td>76%</td>
<td>83%</td>
<td>78%</td>
<td>64%</td>
<td>83%</td>
<td>74% Av</td>
<td></td>
</tr>
<tr>
<td>% of Total Responders</td>
<td>29%</td>
<td>12%</td>
<td>23%</td>
<td>28%</td>
<td>8%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) ACQUISITION OF NEW KNOWLEDGE

**Keywords:** In-depth knowledge of the specific field of study; knowledge of related fields; knowledge of other fields; knowledge of methodological approaches.

<table>
<thead>
<tr>
<th># reporting specific learning outcome¹</th>
<th>(n=22)</th>
<th>(n=8)</th>
<th>(n=20)</th>
<th>(n=23)</th>
<th>(n=5)</th>
<th>(n=78)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressed as %²</td>
<td>58%</td>
<td>53%</td>
<td>67%</td>
<td>62%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>% Outcome Responders (n/78)³</td>
<td>28%</td>
<td>10%</td>
<td>26%</td>
<td>30%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>% of Total Responders (n/130)³</td>
<td>17%</td>
<td>6%</td>
<td>15%</td>
<td>18%</td>
<td>4%</td>
<td>60%</td>
</tr>
</tbody>
</table>
2) IMPROVED INTELLECTUAL SKILLS
Keywords: critical thinking; problem solving; analytical skills; time management; observation; decision making skills; prioritization skills; organizational skills; developing scholarly arguments; communication skills – writing, speaking and listening; synthesis of information; theme identification; research process and design; scientific method

<table>
<thead>
<tr>
<th># reporting specific learning outcome¹</th>
<th>(n=30)</th>
<th>(n=9)</th>
<th>(n=29)</th>
<th>(n=27)</th>
<th>(n=10)</th>
<th>(n=105)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressed as %²</td>
<td>76%</td>
<td>60%</td>
<td>97%</td>
<td>73%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>% Outcome Responders (n/105)³</td>
<td>29%</td>
<td>9%</td>
<td>28%</td>
<td>26%</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>% Total Responders (n/130)⁴</td>
<td>23%</td>
<td>7%</td>
<td>22%</td>
<td>21%</td>
<td>8%</td>
<td>81%</td>
</tr>
</tbody>
</table>

3) IMPROVED PRACTICAL SKILLS
Keywords: data collection, library use, literature reviews, software skills; laboratory skills; interview skills; transcription skills; website design and maintenance; hard skills; computer programming; record-keeping; statistical abilities; hands-on experience; cataloguing; coding; copy-editing; proofreading; note-taking; field work.

<table>
<thead>
<tr>
<th># reporting specific learning outcome¹</th>
<th>(n=34)</th>
<th>(n=10)</th>
<th>(n=30)</th>
<th>(n=35)</th>
<th>(n=10)</th>
<th>(n=119)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressed as %²</td>
<td>90%</td>
<td>66%</td>
<td>100%</td>
<td>95%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>% Outcome Responders (n/119)³</td>
<td>29%</td>
<td>8%</td>
<td>25%</td>
<td>29%</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>% Total Responders (n/130)⁴</td>
<td>26%</td>
<td>7%</td>
<td>23%</td>
<td>27%</td>
<td>8%</td>
<td>91%</td>
</tr>
</tbody>
</table>
### 4) IMPROVED KNOWLEDGE OF SELF

**Keywords:** personal growth; self-discipline; self-awareness, evaluation and improvement; self-direction; motivation; self-knowledge; reflection; independence and autonomy; confidence; empowerment; passion; excitement; enthusiasm; joy; patience; flexibility; diligence; concentration; perseverance; originality; open-mindedness; creativity and innovation; goal-setting; sense of accomplishment; pride; engagement; dedication; sense of responsibility

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<th>(n=22)</th>
<th>(n=24)</th>
<th>(n=5)</th>
<th>(n=78)</th>
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<td>Expressed as %</td>
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<td>60%</td>
<td>73%</td>
<td>65%</td>
<td>50%</td>
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<tr>
<td>% Outcome Responders (n/78)</td>
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<td>28%</td>
<td>31%</td>
<td>6%</td>
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<tr>
<td>% Total Responders (n/130)</td>
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<td>7%</td>
<td>17%</td>
<td>18%</td>
<td>4%</td>
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### 5) IMPROVED RELATIONSHIP TO OTHERS AND SOCIETY

**Keywords:** teamwork; mentorship; collaboration; sharing ideas; networking; community engagement; cultural awareness; ethical awareness; value of other perspectives and opinions; relationship-building; interpersonal skills.

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<tr>
<td>% Outcome Responders (n/83)</td>
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<td>% Total Responders (n/130)</td>
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<td>8%</td>
<td>20%</td>
<td>18%</td>
<td>4%</td>
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</tbody>
</table>
LEGEND (Faculty Pseudonyms)

1 # reporting specific learning outcome: The number of students within each faculty who reported the learning outcome in Column A.
2 Expressed as %: The percentage of students within each faculty who reported the learning outcomes in Column A.
3 % Outcome Responders (n/x): The faculty percentage of all students who reported the learning outcome in Column A.
4 % Total Responders (n/130): The faculty percentage of the total number of students who identified any learning outcomes.

FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management
Coding of responses.

Each participant response has been coded by Cohort (C), by Discipline (D), and by Final Report (FR). For example, a quote with the code C2011DCompSciFR9 means that the cohort year was 2011, the student was in the Department of Computer Science, and the Final Report was number 9. In the case where there was only one student from a department in a cohort year, the faculty (F) has been used to maintain anonymity. All comments were counted only once, and each learning outcome theme was identified only once, regardless of the number of related keywords that were used by individual participants.

Responses to the online questionnaire are coded by the number assigned to each respondent, which corresponds to the sequence in which the completed questionnaires were received.

The cognitive domain (Themes 1 and 2).

The cognitive domain reflects a particularly rich set of learning outcomes that concern and reflect levels of comprehension, including assessment, analysis, synthesis, and evaluation (Bloom, 1956). Because of the resource-intensive nature of undergraduate research, it is important that learning outcomes from undergraduate student research programs focus on the higher complexity, rather than the lower cognitive functions. If we look at learning outcomes in each of the two cognitive domain themes – acquisition of new knowledge and improved intellectual skills – an interesting finding emerges. Whereas the former was reported by the fewest number of students as a learning outcome (60%; n=78), the latter was reported by the second highest number of students (92%; n=119). These findings confirm a previous study, where under the
theme ‘Thinking and Working like a Scientist’, the two categories similar to my Themes 1 and 2 most closely reported findings of 43% and 57%, respectively (Seymour et al., 2004).

**Theme 1: acquisition of new knowledge.**

The following keywords and phrases from the final reports were used to identify responses that fit within this theme: In-depth knowledge of the specific field of study; knowledge of related fields; knowledge of other fields; knowledge of methodological approaches. These keywords and phrases were cited as a positive impact by 60% (n=78) of all (n=130) students who completed a final report. The following comment is typical and reflects the general tone of the responses that point to the wealth of new knowledge that was gained by URI scholars, in which the student noted, “Although I had anticipated to gain new knowledge – both experiential and theoretical – during the program, there were more nuanced, unexpected practical and academic contributions to my overall thought process that occurred during the research process” (C2012DSocialWorkFR1). Another participant noted that,

Being able to spend this much time on a specific topic has given me the opportunity to acquire in-depth knowledge that goes far beyond that of an undergraduate paper. It has also expanded my knowledge of a field which I had previously known little. (C2010DHistFR1)

Interestingly, some students reflected that the URI experience was just the beginning of their learning. As one student put it, “We enjoy the benefits of several hundred thousand years of human error in this area, which I find humbling” (C2010DImArtsFR1). These observations confirm earlier studies (Kardash, 2000), and although the findings indicate a higher percentage than some other studies (Seymour et al., 2004), I was surprised that this was among the lowest
of the learning outcomes from this study; one difficulty may be attributable to the fact that student responses often cross categories, making it difficult to code with specificity.

**Theme 2: improved intellectual skills.**

The following phrases and keywords were included under this theme: critical thinking; problem solving; analytical skills; time management; observation; decision making skills; prioritization skills; organizational skills; developing scholarly arguments; communication skills – writing, speaking and listening; synthesis of information; theme identification; research process and design; scientific method. The second highest category, 81% (n=105) of all respondents listed positive learning outcomes under this theme. While each gain, represented by the keywords, was noted as a distinct learning outcome, comments suggested that there was a synergy, sequence and coherence to the learning outcomes in this cognitive realm, similar to Kolb’s structural dimensions (Kolb, 1984). This is illustrated in one observation that,

> The research gave me valuable experience in the managing of a project over a period of time, having to develop deadlines and goals to reach and be able to complete objectives on schedule. It was great for making me think critically about problems along the way that were hard to anticipate beforehand.

(C2011DArtsFR1).

This sentiment appeared across most disciplines. For example a student in Theatre commented that,

> The most inspiring aspect of this whole process is that while playing the role of a researcher I have grown simultaneously on levels both creative and intellectual,
increasing my know-how as a scholar and thus as an artist as well.

(C2012DFDCFR1)

A recent student survey by Intel (2013) showed that in order to be successful beyond high school, 26% of college and university students surveyed would advise boosting their time-management skills at an earlier age, and it is also noted that improving organizational skills can lead to more confidence. The Intel survey reported that students at all levels felt they were lacking in these essential areas, and that they were experiencing high levels of anxiety as they advanced in their education because of this limitation (Intel, 2013). These two skills – time-management and organization – were specifically named by 42% (n=55) of URI scholars in their final reports as learning outcomes achieved through their participation in the URI project.

One very interesting finding that was particularly relevant to the initial goals of the URI project was the impact that the URI experience had on student perceptions regarding the nature and importance of research. While 60% (n=78) reported ‘acquisition of new knowledge’ in response to the question, “What have you learned from this experience?” when asked the specific question, ‘Has this experience focused or changed your ideas about research?’ more than 92% (n=120) of the participants responded that their image of research was positively impacted. This was evident across all faculties and is reflected by comments such as, “This opportunity has enriched my vision of what research embodies... where research is not just for the sake of research, but rather to develop a project/concept that will better our society...” (C2010DCivilEngFR1). Another respondent from the Department of History stated, “URI definitely helped me focus my ideas about the various facets of research, such as institutions
that support specific areas of interest, and the resources that are necessary to conduct scholarly inquiry” (C2010DHistFR2).

This suggests that an experience of this type has the potential to become an important policy consideration for universities and governments in educating current students, and hence future citizens, about the social and economic benefits of research, and the importance of funding it. It also suggests that the URI experience, which was shown to have an ‘affective’ impact on 64% (n=83) of the student responders in the area of improved relationship to others and society, has the potential to encourage students to continue to graduate studies, which is discussed in more detail under “Other Findings”.

Findings from this study indicate a similar or higher reporting incidence for this cognitive area as compared to other studies (e.g., Kardash, 2000; Seymour et al., 2004; Russell et al., 2007). A factor that could influence a meaningful comparison is the multi-disciplinary composition of the URI program as opposed to the undergraduate student profile in the majority of studies, which historically have been in STEM disciplines. In fact, the faculties reporting the highest incidence of learning outcomes related to this theme were in the Faculty of Business Management (100% n=10), the Faculty of Community Studies (97% n=29), and the Faculty of Arts (76% n=30).

**The psychomotor domain (Theme 3).**

The psychomotor domain reflects learning that embraces a practical competence to perform skills necessary to advance a research project. The distinctness of Individual research projects, of students’ abilities, and of the skills and training necessary to successfully carry out
the project makes it difficult to identify universal practical skills. Recognizing this limitation, the following is my attempt to do that.

**Theme 3: improved practical skills.**

The following phrases and keywords were included under this theme: data collection, library use, literature reviews, software skills; laboratory skills; interview skills; transcription skills; website design and maintenance; hard skills; computer programing; record-keeping; statistical abilities; hands-on experience; cataloguing; coding; copy-editing; proofreading; note-taking; field work. This was the highest reported learning outcome theme, with 91% (n=119) of all respondents listing learning outcomes under this theme. This is reflected in a typical comment such as this one from a student in the Faculty of Engineering, Science and Architecture,

> The amount of practical knowledge I have gained in terms of how research is conducted is invaluable to me. I learned about the entire process of research through independent work, starting from using library resources to find documented papers and journals to serve as guides through to actually conducting experiments and interpreting their outcomes and results.

(C2011DChem/BioFR2)

This is not an unexpected finding, given that the URI was intended specifically to provide a ‘hands-on’ experience. What is surprising, however, is the number of students who reported learning outcomes related to searching and finding sources of information. Of all respondents, 65% (n=85) reported performing a literature review, more efficient and effective use of library resources, and improved knowledge of available databases as positive learning outcomes. This finding suggests there is a need for more formal training in this area early in the undergraduate
curriculum or even prior to entering the post-secondary system, since one would expect that at this point in their education students would be well-versed in literature searches.

I was unable to find any common template within the literature that classified learning outcomes or skill gains in a universally recognized similar model. Thus, it is difficult to compare findings from this study to other literature in the field. Because of issues of individuality, diversity, discipline-specific language and personality, students use different terms to describe what they have learned and researchers develop themes that are often uniquely tied to the findings of their individual studies. In my study, I used the term practical in its more literal sense of being related to the actual performing, doing or use of something, whereas other studies have included working collaboratively, communication skills, and leadership as practical skills (Seymour et al., 2004; Kardash, 2000).

**The affective domain (Themes 4 and 5).**

The affective domain reflects learning that concerns the way that we deal with things emotionally. This could include our feelings, values, appreciation, enthusiasm, motivation, and attitude (Krathwohl et al., 1964). Learning outcomes in this domain have the potential to greatly influence a student’s personal development, as well as his/her role as a culturally aware, and socially responsible citizen.

**Theme 4: improved knowledge of self.**

The following phrases and keywords were identified under this theme: personal growth; self-discipline; self-awareness, evaluation and improvement; self-direction; motivation; self-knowledge; reflection; independence and autonomy; confidence; empowerment; passion; excitement; enthusiasm; joy; patience; flexibility; diligence; concentration; perseverance;
originality; open-mindedness; creativity and innovation; goal-setting; sense of accomplishment; pride; engagement; dedication; sense of responsibility. Of all respondents, 60% (n=78) listed learning outcomes in this category. Interestingly, the number of positive FESA respondents was above average (65%), and the second highest in this category behind FCS (73%). This is discussed further under Research Question #2.

This theme included one of the most novel and exciting findings with respect to Research Question 1. A number of open-ended questions were asked in the Final Report (Appendix B), resulting in responses that sometimes pointed to clearly identified, yet unexpected student perceptions of the learning outcomes gained. My findings indicate that the students perceived that the learning experience was valuable beyond what is explicitly stated in the rubrics of either the United States or of Ontario, and which is closely related to Wiggins’ theory of authentic assessment, which is the self-knowledge gained through the process of experiential learning (Wiggins, 1990). One student in the Faculty of Community Studies expressed this as follows:

I am a changed person from completing this research project….I learned about myself... I learned about my limitations and learned about my inner strengths through this project. After this I feel like I can accomplish anything I put my mind to... I see now what a powerful impact research can have on the researcher in developing professional skill-sets and learning about strengths and vulnerabilities for improvement of one’s self. (C2011DSWFR1)

This appears to be both self-revealing and self-affirming, and is also connected to increased confidence, which was cited by 32% (n=25) of all respondents within this theme. From my own experience, self-knowledge and confidence have an important impact on other areas as well,
such as decisions regarding graduate school. Seymour et al., in a study analysing student-identified benefits of undergraduate research experiences based on 76 student interviews, listed confidence under the heading of personal/professional gains, which were reported by 27% of all students’ observations (Seymour et al., 2004). Similarly, Mabrouk reported that 36% of student respondents cited self-confidence as the most beneficial gain (Mabrouk & Peters, 2000). An interesting aspect of the Seymour study is the breakdown into categories of the characteristics of confidence, which included ability to do research, increased understanding of the nature of science, better writing skills, ability to contribute to science, and feeling like a scientist (Seymour et al., 2004). As in my study, Seymour found that overwhelmingly, the most distinctive characteristic of an undergraduate research experience of this type, as self-reported by students, is the “powerful affective, Behavioural and personal-discovery” journey that it took them on and the significance of this to their own identity and sense of future direction (Seymour et al., 2004 p. 531)

Theme 5: improved relationship to others and society.

The following phrases and keywords were identified under this theme: teamwork; mentorship; collaboration; sharing ideas; networking; community engagement; cultural awareness; ethical awareness; value of other perspectives and opinions; relationship-building; interpersonal skills. Learning outcomes in this category were reported by 64% (n=83) of all participants.

In spite of the fact that there was no question about mentorship on the Final Report, 22% (n=18) of the respondents in this category commented independently about the impact of their supervisors. In my professional opinion, the importance of positive mentoring, not only by the
supervisor but also by other members of the research team, cannot be overstated. In many cases, the mentor was given credit for facilitating positive learning outcomes not only under this theme, but across all themes, as indicated in comments such as, “Through it [the URI] I have built a relationship with one of my professors that I could not have developed in the classroom. I certainly feel as though I have become part of the department through this research opportunity” (C2010DCJCFR1); and

My supervisor was very supportive and patient and she provided excellent guidance to help me learn and grow throughout the research process. She stimulated my critical thinking and encouraged me to overcome the challenges. My other research colleagues and other lab colleagues were also very dedicated and supportive. I have realized that teamwork is an integral part of research, and I am very grateful and honoured to be part of a wonderful research team. (C2010DNutrFR1)

This finding is supported throughout the literature (e.g., Laursen et al., 2012; Seymour et al., 2004; Russell et al., 2007; Contag, 2009; Pascarella & Terenzini, 2005). This is especially well detailed in a publication of the Council on Undergraduate Research, where the authors discuss the importance and value of mentoring, pointing to the impact they have in intellectually stimulating the student, developing a career focus, sense of belonging to a community of scholars, and lifelong skills (Temple et al., 2010). Research has shown that from the students’ perspective, positive mentorship qualities such as enthusiasm, availability and patience are more valuable than the intellectual brilliance of the supervisor (Mabrouk & Peters, 2000).
Community engagement was another interesting theme, reported by 35% (n=29) of responders in this theme, and whereas it would be assumed to be common in Faculties such as Arts and Community Studies, it sometimes came from other and unexpected sources. A student from the Faculty of Business and Management made the observation that, “My study involved a lot of communication and interaction with the community. Most of all, this put into perspective the importance and impact that my research may have on individuals” (C2011DFBMFR1). This finding is consistent with the literature that community-based research engages undergraduate students, and is a powerful tool for social change (Paul, 2006). Community engagement has also been linked to interdisciplinary research (Temple et al., 2010).

There is some evidence in the findings that supports the inclusion of the section – awareness of limits of knowledge - in Ontario’s framework that is not addressed in the US VALUE rubric model. This was not overtly stated as a learning outcome, especially since students might think it more of an admission of ignorance than a learning outcome, but the data suggested that this was, indeed, among the outcomes of the URI program, as indicated by one of the students’ comments that “I myself know very little of anything and this has spurred me to conduct more research to further my knowledge” (C2010DImArtsFR1).

Phase 2 – Survey questionnaire.

The Office of the Vice President, Research and Innovation at City University sent out an e-mail to the URI scholars (n=175) on my behalf, with the link connecting to the online questionnaire (Appendix C). Six of the e-mails bounced back, leaving a total pool of 169 students who received the request. Following the initial e-mail and a reminder, the response rate
remained low at 7% (n=12). In order to increase the number of responses, I announced that respondents’ names would be entered into a draw for an iPad. Following this incentive, the response rate rose to 28.4% (n=48).

While the majority of questions on the survey questionnaire related specifically to UUDLEs (Research Question #3), there were two questions in the online survey that elicited responses related to learning outcomes more generally. In response to the first of these, “If applicable, did the URI experience provide you with useful workplace skills?” (Online question #9), 85% (n=34) of the 40 students who responded to this question indicated that they had acquired useful workplace skills from the URI experience. The skills that were identified reconfirmed findings from the Final Report, and included time management; organization; project management; literature searches; conference presentations; matching abstract exploration with systematic investigation; survey design and research methodology; analytical, interpretive and design skills; communication skills; independence; networking; software skills; computer applications; decision-making skills; social skills; political awareness; leadership skills; confidence; problem-solving; teamwork; passion; dedication; practical hands-on skills. The following comment from a student in the Arts program is reflective of many of the comments that were posted.

I learned to work around a problem if a supervisor was not present, and I feel I learned to distinguish between when to make a decision and try to push forward, and when it was best to wait until you know for sure. I feel that my ability to transition between different subject matters, focuses, or technical aspects of a project improved greatly, and my confidence in my abilities were
also improved. I think these are important leadership skills that I will be utilizing throughout my career. (Online Questionnaire Respondent #34)

In response to the second question, “Please indicate any learning outcomes from your participation in the URI experience that may not have been covered by the UUDLEs above, or that you feel are particularly important outcomes from this research experience?” (Online question #11), 100% (n=16) of the 16 students who responded to this question identified skills that reconfirmed findings from the Final Report, including: confidence gained through the trust placed by the supervisor in the students’ ability to develop a research proposal; community involvement; teamwork; hands-on skills; the importance of mentorship; research design; data collection; communication skills.

**Phase 3 – Student interviews.**

The purpose of the interviews was to clarify some of the concepts that arose out of the responses to the Survey Questionnaire, as well as to expand on some of the findings by asking some open-ended questions that allowed the interviewee to develop their ideas. I conducted interviews with the four students who indicated that they would like to participate in an audio-recorded interview. The interview questions are attached as Appendix F. Similar to the goals of the survey questionnaire, I did not want to duplicate information from interviews that I had already acquired elsewhere, and questions did not focus on learning outcomes. Interviewees did, however, offer some interesting insights on this subject.
Interviewee #1.

The first student interviewee participated in the URI program in 2012. She had just completed her third year in a Theatre Arts program. Her comments regarding learning outcomes that she could ascribe directly to her summer undergraduate research experience both confirm the study findings, as well as reveal some of the nuances of the learning outcomes. The distinctive viewpoint of this student was in that her conservatory and studio curriculum courses comprised considerable hands-on methods of instruction. This student took the URI program, which she saw as the academic side of her education, to allow her to blend the two aspects – theory and practice – in her academic writing. Influenced by reading accounts from others whom she admired, she also wanted the opportunity to see whether in the future, she might have the ability to make ground-breaking discoveries as well. She indicated that in the early stages of her URI experience, it felt a little like pretending to be a researcher, at the same time it gave her a sense of importance and feeling in control of the situation. She stated that she had learned how to use her research as a tool or vehicle for discovery, higher thinking and revelation, and found the process to be very important for self-discovery.

In terms of impact on career choice, including graduate school, this student indicated that the URI program had a huge impact on her. She was able to identify and confirm her interests, and after delivering a paper at a meeting, she gained the confidence that she could actually accomplish her goals and make a contribution to the body of knowledge in her field. At the moment, she is actively looking for the right opportunity and funding to attend graduate school.

The most challenging aspect for this student was self-doubt and fear of failure, which she indicated were overcome simply by knowing that she had to keep going. Among the most
beneficial learning outcomes, this student cited self-awareness, and a sense of discovering her own style and approach that could be carried forward in life and applied to further education and both personal and professional development. Presenting an academic paper based on her URI project was the height of the URI experience and made her feel like a real artist – in control. She was also excited to present her own discoveries, which had started in an abstract way, as legitimate academic research. From the project as a whole she cited sense of direction, new confidence, and reassurance of ability to accomplish the project as key learning outcomes. She cited lifelong practical skills such as organization, time management, perseverance, confidence and calmness in the face of stress as tools that she will carry to other projects.

Interestingly, she identified a larger vocabulary so that she can keep up with more senior-level colleagues and talk intelligently about the area, as the most useful workplace skill.

*Interviewee #2.*

The second student interviewee participated in the URI program in 2011, following his third year in the Theatre Arts program. He is currently enrolled in a graduate program at the University of Toronto. This student is a mature learner, so his observations about the program were from a different context than the majority of other participants. One comment that I found interesting related to the aspect of the program that was the most challenging. This student wished that there was more structure to the program. He considered that his faculty mentor, with whom he met every other week, was hands-off. Thus the student felt as though he was in charge of the whole project and responsible for where it was going, which made him feel intimidated even though he enjoyed the URI experience. This brings up an interesting point.
Since the program was intended to be student-driven, what is the right balance of responsibility between student and faculty advisor? There are many factors that would influence this, including the goals of the program, learner maturity and assessment of progress. This suggests that part of the learning is how to deal with the uncertainties, so that program design needs to be explicit enough for people to know what they’re doing, but open enough to allow for creativity and innovation.

In terms of beneficial learning outcomes as a result of the URI experience, this student pointed out he had already acquired many skills from his past education and workplace experience, and that the URI program had confirmed, rather than taught, those skills. Similar to Interviewee #1, this student talked about “playing” at being an academic in a professional academic context. One learning outcome that he did attribute to the URI program was the ability to follow an academic question to a particular place through the research process, which was confidence-building. The experience of having a publication as an undergraduate was very meaningful to him, and believes it was a beneficial addition to his resume when he applied for and was accepted into graduate studies at the University of Toronto.

As an example of a different kind of workplace skill as a result of the URI experience, this student indicated that presenting one’s own work in a professional context was very different than giving a presentation of other people’s findings. He further mentioned praxis as a workplace skill – being able to combine your theory and your activity within your practice – that was at the intersection of the abstract and the concrete. Interestingly, as a mature student, he observed that developing a question, researching the context, applying it to practice, and disseminating the results is a generalizable skill beyond the very specific window of research.
This student enjoyed interacting with other URI scholars who were researching in different fields, although he indicated that he did not have the sense that it was one of the mandates of the program. He engaged in discussion with another URI student from Nursing, and they discussed the potential impact of applying findings from each study to that of the other.

**Interviewee #3.**

The third student interviewee participated in the URI program in 2010. She had just completed her second year in the Food and Nutrition Program, after having already completed a Bachelor of Science degree. Since then, she has finished a Master’s degree in Public Health and Epidemiology at Columbia University in New York and is working with the Department of Health in New York City. She had previously participated in a summer research internship program at one of the Toronto teaching hospitals.

This student was very self-motivated and as part of her preparation for the URI experience, enrolled in a survey design course at another Toronto university that she knew would be applicable to her project. In addition, she met with the subject librarian at City University and read books on methodology. She appeared to be very self-directed and took the time to delve into the strategies behind the research methodologies that hadn’t been covered as part of the curriculum.

The most challenging and frustrating aspect of the URI program for her was that she was hoping to have more structure in how the program was run and in the absence of that, would like to have experienced more support and guidance from her mentor. She appreciated that the project was purposefully self-directed, but would have valued more structure and input from her
mentor. To cope with these challenges, the student looked to find other resources that she needed to complete the project, and indicated that discovering that she could figure it out by herself helped very much with her level of confidence.

In terms of the overall impact of her experience as a participant in the URI program, she pointed to the excitement that she felt about her research, which made her realize that it was something that she wanted to do in some shape or form in whatever career she ended up with. This came about in an interesting way. She was exempted from the research portion of a course because of her URI experience, and not participating in the research made her realize how much she missed it. She indicated that this is the reason she went back to do a Master’s degree, that is, to get more training in research. Ultimately, she wants to have a career that balances a clinical and research approach to issues. She further indicated that it was the URI experience that helped her understand what she wanted to do with her career. She particularly valued the feeling of not only creating knowledge for knowledge’s sake, but also of contributing to the discipline and driving the field forward. She credited City University’s emphasis on career, practice and community for this accomplishment.

In terms of lifelong and workplace skills, she cited that because she needed to be self-directed, she learned how to set goals, break down tasks and work deliberately towards them in order to produce something, how to manage timelines, and how to approach work in an organized way, including defining the plan, identifying relevant variables, establishing milestones and following the right steps. She indicated that even in clinical work, one can become overwhelmed so it is important to be clear about your plan of what you want to accomplish.
The interviewee indicated that a side effect of participating in a program like this was that you have empathy with other people going through the process and want to assist in data collection by participating in surveys such as this one.

*Interviewee #4.*

The fourth student interviewee participated in the URI program in 2011. She had just completed her second year in the Nursing Program and is currently in a Master’s of Nursing program at a Toronto university. The interviewee saw herself as shadowing her mentor at the outset, but being reminded by her mentor that she was a novice researcher, she began to feel as such. She found the idea of being a novice uncomfortable at times, in the sense of not knowing everything, but being on the path to becoming a researcher. The most challenging aspect the URI experience for this student was being involved in a methodology that she was not comfortable with. She was researching a project in an emergent area that did not offer a lot of guidelines and very little source information in the literature. She felt initial discomfort about what she would be able to show at the end of the 12-week period but was reassured by her mentor that because of the process of exploration, results would appear much later.

She noted that there were many skill sets embedded within the URI program. In her view, one of the greatest benefits of the URI program was the opportunity it gave to students to enter into academic research early on. She also acknowledged the advantages of being able to work closely with a faculty member to build a strong relationship as well as gaining social capital. Through meeting and continual interaction with a lot of people, she was able to look through the lens to see what academic life would be like. She also found that the opportunity to
communicate by presenting results of her own work and getting feedback from colleagues helped to build confidence. She found this program to be very different from research courses that were part of the curriculum, which focus on different methodological approaches to give you a landscape of what research is about. The URI experience gave her a set of skills related to research, and unlike the URI program, curriculum courses do not often teach you how to prepare a manuscript, how to apply for a grant, how to write an abstract, and how to build your professional communication as you interact with funding and organizational bodies. It is difficult to fully understand the process of analysis unless you get to take the lead – reading about it is not the same. This student got to take part in the full research process from creating a manuscript, to applying to present the findings, to presenting at two symposia (one international). From this exposure she was invited to publish a book chapter.

This student was interested in both teaching and bedside care. Exposure to a number of role models through the URI program gave her a new outlook on career options. She stated that she would not have felt strongly about applying for graduate school had she not had the URI experience. It instilled in her the confidence that it is something she was capable of and wanted to do. She also credits her mentor with helping her to clarify her goals.

**Summary**

Findings from this study confirm that principles of best practice, among other things, should encourage active learning and contact between students and faculty, and require the commitment of both parties (Chickering & Gamson, 1987). Consistent with the observation by Morrison et al that, “Instructional Design is a process for solving skills and knowledge
deficiencies...” (2011 p. 4), research experiences can address this particular gap in the current system, resulting in value for both the learner and society.

In comparing learning outcome themes identified in this study with Bloom’s domain theory and Kolb’s framework, I found not only that there is alignment of theory with practice, but also that there is a potential process for a synergistic and ongoing cycle of impact and outcomes. Analysis of learning outcomes reported from the URI model shows that they are consistent with recorded outcomes from other studies (e.g., Seymour et al., 2004; Russell et al., 2007; Lopatto, 2007; Osborn & Karukstis, 2009; Mabrouk & Peters, 2000; Webb, 2007). There is, however, a wide variation in the literature in the way that researchers choose to group the specific skills, and I was unable to find a common rubric. This is not surprising, given that the formal development of valid learning assessments for these outcomes has been quite recent.

Interestingly, the Organisation for Economic Co-operation and Development recently completed a Feasibility Study for the Assessment of Higher Education Learning Outcomes (AHELO), which aims to determine whether it is practically and scientifically feasible to directly evaluate what students in higher education know and can do at the global level (OECD, 2013). Seventeen countries are involved in the study, and from Canada, Ontario is the participant. AHELO assessment aims to directly evaluate student performance at the global level and be valid across diverse cultures, languages and different types of institutions. While much smaller in scope, I hope in this case study to provide higher education institutions with data that links specific programs to students’ learning outcomes, taking individual and program diversity into account.
4.3 Research Question #2: To what extent do students’ perceptions about the learning outcomes they acquired through participation in the URI Program vary by Faculty/Discipline?

Assessments in the literature of the benefits of undergraduate research experiences such as the URI program have, for the most part, focused on science, technology, engineering and mathematics (STEM) disciplines. I was unable to find comparable studies for Arts and Humanities in the literature. In a personal communication with Elaine Seymour, whose work is seminal in evaluating current studies of the benefits of undergraduate research in STEM and SBES fields, she indicated that she was also unaware of any such studies, and posited that “the structure of university research experiences in the humanities and social sciences is different from that in the STEM disciplines simply because the nature of research is different” (Seymour, Personal Communication, 2013, Dec. 3). The traditional model for undergraduate research in the humanities is the thesis, which is built into the curriculum. At the College of Wooster, in Ohio, for example, undergraduate research has been part of the curriculum for over sixty years, in the form of a year-long capstone project for seniors, the learning outcomes from which are meant to include a capacity for critical inquiry, creation of new knowledge within a discipline, and communicating the learning with a broader audience (Crawford et al., 2011). At the University of Southern Florida, a hybrid program was developed that adapted the traditional undergraduate research model in the sciences to disciplines in the humanities (Klos, 2011), consisting of a six-week summer research training experience, thematically-linked courses, and a concluding colloquium.
Phase 1.

At the time when the study subjects took part in the URI program, there were five Faculties at City University: Arts; Design and Communication; Community Studies; Engineering, Science and Architecture; and Business and Management. This represents a broad sampling of disciplines from which to analyze similarities and differences in students’ perceptions of their experiences. The open-ended nature of the majority of questions on the Final Report promoted individualized recounting of experiences that were generally within the context of the particular field of study. Table 9 is a summary of the total number of applications received and awards distributed by each Faculty.

Table 9: URI Applications Received and Awards Distributed by Faculty (2010-2012)

<table>
<thead>
<tr>
<th>Faculty</th>
<th>FA</th>
<th>FDC</th>
<th>FCS</th>
<th>FESA</th>
<th>FBM</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications</td>
<td>n=98</td>
<td>n=39</td>
<td>n=86</td>
<td>n=155</td>
<td>n=20</td>
<td>n=398</td>
</tr>
<tr>
<td>Awards</td>
<td>n=50</td>
<td>n=18</td>
<td>n=38</td>
<td>n=57</td>
<td>n=12</td>
<td>n=175</td>
</tr>
<tr>
<td>Success Rate</td>
<td>51%</td>
<td>46%</td>
<td>44%</td>
<td>47%</td>
<td>60%</td>
<td>44%</td>
</tr>
</tbody>
</table>

Source: Office of the Vice President, Research and Innovation, City University

LEGEND (Faculty Pseudonyms)
FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management
Responses.

The difference in this study is in the broad range of disciplines (n=40) and faculties (n=5) that are represented by student participants, which enables a cross-disciplinary analysis of the perceived impact of an undergraduate research experience. Based on the number of responses, the contribution of each faculty to the overall findings ranges from a low of 8% (FBM) to a high of 29% (FA). Interestingly, FA, FCS and FESA are fairly equally represented in the findings, at 29%, 23% and 28%, respectively. Figure 3 below shows the percent contribution per faculty of the total number of student responses. It should be noted that although the response rate from participants in the Faculty of Arts was 76%, which was the second lowest of all five faculties; because of the large number of awards held by FA students, this faculty has the highest representation (29%), as shown in Figure 3.

Faculty of arts (FA).

Awardees from the Faculty of Arts came from the following nine disciplines - Arts and Contemporary Studies; Criminal Justice and Criminology; Economics; English; Geography; History; Politics and Public Administration; Psychology; and, Sociology.

Of the total number of students from the Faculty of Arts who participated in the URI program, the response rate for submitting a Final Report was 76% (n=38 of 50), representing 29% of the total pool of 130 respondents (see Figure 3).

Students in this Faculty reported learning outcomes that were below the overall average in all five themes (Table 2). The least recorded learning outcomes were in the two themes in the affective domain, and were the lowest values of all faculties. Both improved knowledge of self and relationship to others were recorded as learning outcomes by only 47% of student’s in the
Faculty of Arts; well below the averages for these two themes, which were 60% and 64%, respectively.

**Figure 3: Distribution of Student Responses by Faculty**

![Pie chart showing distribution of student responses by faculty.]

Source: Final Report Forms, URI Scholars’ Program (2010-2012)

As indicated in Table 2, perceived learning outcomes related to practical research skills (psychomotor domain) were the highest (90%). This is not what I expected. Closer examination revealed that the majority of the psychomotor learning outcomes reported by FA students related to literature searching (n=11; 34%) and data collection (n=20; 59%). The comment below is indicative of this finding.
My participation in this research project allowed me to expand the depth and breadth of my academic knowledge, as well as gain valuable experience in developing my research skills. I was able to broaden my knowledge through the research and reviews of pre-existing information through books and journals, in order to understand the nature, history and essential foundation of these social issues. (C2012DArtsFR1)

Faculty of design and communication (FDC).

Awardees from the Faculty of Design and Communication came from the following seven disciplines - Dance, Fashion, Image Arts, Interior Design, Journalism, Media and Theatre.

Of the total number of students from the Faculty of Design and Communication who participated in the URI program, the response rate for submitting a Final Report was 83% (n=15 of 18), representing 12% of the total pool of 130 respondents (see Figure 3).

Surprisingly, among all faculties, FDC students recorded the lowest percentage in learning outcomes related to practical skills. In a follow-up interview with a student from the Theatre School, she volunteered that her curriculum provided all of the ‘hands-on’ experience needed, and that her interest was in pursuing the academics involved in research. Whereas I had assumed initially that students applied to the program in order to have exposure to the practical side of education and to apply conceptual and theory-based learning from the classroom within an experiential learning environment, I realized that what motivates students to participate in an undergraduate research experience can be quite different, depending on the discipline. In other words, the connection between theory and practice is not linear. Students, for whom the regular
curriculum constitutes the practice of their profession, see undergraduate research as an opportunity to explore the more theoretical aspects of their chosen area of study.

The lowest recorded learning outcomes within this faculty were in the cognitive domain. In contrast to the Faculty of Arts, learning outcomes in the affective domain regarding relationship to others and society were the highest (73%; n=11 of 15) for FDC and were the second highest recorded for all faculties.

**Faculty of community studies (FCS).**

Awardees from the Faculty of Community Studies came from the following eight disciplines - Child and Youth Care, Disability Studies, Early Childhood Education, Midwifery, Nursing, Nutrition, Occupational and Public Health, and Social Work.

Of the total number of students from the Faculty of Community Studies who participated in the URI program, the response rate for submitting a Final Report was 78% (n=30 of 38), representing 23% of the total pool of 130 respondents.

Students in this Faculty reported learning outcomes that were at or above the average in all five themes (Table 2), and in four of those themes, they recorded the highest incidence of learning outcomes of all faculties (Table 2). Paradoxically, while the least reported learning outcome for FCS was in the acquisition of new knowledge (67%) (n=20 of 30), it was the highest reported compared to all other faculties. What was not surprising was that compared to all other faculties, FCS reported by far the highest rate of learning outcomes in the affective domain, with 87% (n=26 of 30) reporting improved relationship to others and society. An interesting observation came from a Midwifery student, who commented that she had “a new appreciation for the tremendous importance placed on gaining trust when speaking with
members of many Aboriginal communities... Once you encourage people to speak about their health care needs.... you can see where the deeper problems lie” (C2011DMidwifFR2).

**Faculty of engineering, science and architecture (FESA).**

Awardees from the Faculty of Engineering, Science and Architecture came from the following nine disciplines - Aerospace, Architecture, Chemical Engineering, Chemistry & Biology, Civil Engineering, Computer Science, Electrical & Computer Engineering, Physics and Mechanical and Industrial Engineering.

The response rate for this faculty was much lower than for other faculties (64%; n=37 of 57), and represents 28% of the total pool of 130 respondents. Similar to FA, and not unsurprisingly, respondents from FESA reported the highest learning outcomes in the psychomotor domain (95%; n=35 of 37). Closer examination of these skills, however, revealed that they differed substantially from those recorded in the FA. The majority of practical skills were reported in FESA as technical, experimental and methodological skills (77%; n=27 of 35), computer software and programming skills (34%; n=12 of 35) and use of equipment (29%; n=10 of 35). The general impact can perhaps best be seen in the following quote indicating that the URI program “employs the student precisely in the field of his or her studies and provides the practical experience that industry employers are so adamant for” (C2011DFESAFR1).

One finding that I found both surprising and interesting was that improved knowledge of self (affective domain) was the second highest (65%) of all faculties and the third highest reported within the faculty (n=24). One student connected this to his/her mentor, noting that, “my supervisor provided me with such a unique opportunity and that increased my confidence in the research environment and my plans for the future” (C2010DMIEFR3).
Faculty of business and management (FBM).

Awardees in this Faculty came from the following nine disciplines - Business Management, Finance, Global Management, Hospitality and Tourism, Human Resource Management and Organizational Behaviour, Information Technology Management, and Marketing.

FBM had the highest response rate (83%; n=15 of 18) along with FDC, but because of their small numbers, represent the smallest percentage (8%; n=10) of the total pool of 130 respondents. Perhaps more than any other faculty, learning outcomes from FBM were somewhat perplexing, which may be related to the small pool of respondents. Paradoxically, within the two themes that belong to the cognitive domain, 100% (n=10 of 10) reported improved intellectual skills, but only 50% (n=5) reported acquiring new knowledge. Similar to students in FA, improved knowledge of self and relationship to others and society scored the lowest, each at 50% (n=5). Improved intellectual skills and improved practical skills scored the highest, both at 100% (n=10), and in both cases were the highest of all faculties.

Other findings.

Impact on student intentions to apply for graduate school - All Disciplines

A particular comment from a student embodies many other students’ perceptions when he states that although he “had experienced laboratory experiments in his undergraduate studies, this was the first time he was allowed to experience an original experimental procedure developed partially by himself, not as just a spectator, but as an experimenter” (C2011DFEASFR1). In their article, Helping Students Get Into Graduate School Fischer and Zigmond (2004) comment that in graduate school you move from being a consumer of
knowledge to becoming a creator of knowledge. Comments such as the one above and such as the following from a student in the Faculty of Business Management, “This experience was unlike one that can be found in a classroom... Usually for our courses, a research topic and standard procedure is outlined by the professor, which leaves very little room for creativity and exploration” (C2011DFBMFR1), suggest that undergraduate research opportunities such as the URI program expose participants to the experience of creativity that is at the heart of research, regardless of the discipline in which it is conducted.

One of the motivating factors involved in creating the URI scholarships was to encourage students to consider graduate school as an option once they had completed their undergraduate degree. Other studies have also investigated whether undergraduate research encourages greater interest in attending graduate school (e.g., Gates et al., 1998; Humphreys, 1998; Powers & Black, 1976). However, because of the high GPA required (≥ 3.5) in order to participate in the URI program, one limitation of this aspect of the study is that a higher than average number of students would already be inclined to attend graduate school. Not unexpectedly, therefore, 70% (n=86) of the 122 URI applicants who responded to this particular question in the Final Report indicated that they were already considering graduate school before taking part in the URI program. What is astonishing, however, is that when asked whether they were considering graduate school after taking part in the URI program, that number jumped to 93% (n=114), an increase of 23%. This was a result of two factors: 84% (n=16) of students who indicated that they were not thinking of attending graduate school, changed their minds following participation in the URI program; 71% (n=12) of undecided students reported that the URI experience influenced their decision to attend graduate school.
Fischer and Zigmond also liken graduate school to an apprenticeship, where new technical and intellectual skills are learned, and new ways of thinking encountered and explored and they encourage students to try to get some exposure to what graduate school is like (Fischer & Zigmond, 2004) before making any career decisions. The URI experience is one way to give interested students that exposure. Table 10 shows the impact of the URI experience on students’ perceptions of their learning experience on their intent to continue to graduate school.

Table 10: Impact of URI Program on Intention to Apply to Graduate School – All Disciplines (n=122)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Undecided</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were you considering graduate studies before taking part in this program?</td>
<td>86</td>
<td>19</td>
<td>17</td>
<td>122</td>
</tr>
<tr>
<td>Are you considering graduate studies after taking part in this program?</td>
<td>114</td>
<td>3</td>
<td>5</td>
<td>122</td>
</tr>
</tbody>
</table>

Source: Final Report Forms, URI Scholars’ Program (2010-2012)

There were a number of factors identified by students as having impacted their views. Even from amongst those who were already considering graduate school as an option, many indicated that the program had strengthened their decision, and used words such as ‘reaffirmed’, ‘reinforced’, confirmed’, and ‘solidified’ to describe that impact. Among this group there were a number of students who were unsure about their abilities to be successful if they chose that path. For this group, as well as for those who had initially rejected graduate school as an option, the key factors that seem to have made a difference were increased confidence in their skills, passion, strengthened interest, better idea of what to expect, practical exposure to see whether
research is the right choice, preparedness and forward planning. Many students believed at the outset that they were interested in the research world but were unsure of their capabilities, and what the URI experience did was justify their belief in themselves and their abilities. In other words, their belief in themselves received affirmation. Student responses overwhelmingly support this and the importance of this aspect is exemplified in the following comment from a student in the Department of Sociology, which is representative of many students’ comments: “I feel confident now in my capabilities as a student and an academic, and feel much more confident in my decision to pursue graduate studies” (C2012DSociologyFR1). Another response that illustrates these influences came from a student in the Faculty of Engineering, Science and Architecture:-

Many students struggle in their first year of university, because they do not know what to expect... Similar problems may happen to entry level graduate students but such programs as URI help those who are interested and serious about their graduate studies to have better direction before they enter their first year of graduate program. With the schedules that we have during the school year, it is rather difficult to find a time to engage in studies beyond what is offered through our courses. And as I mentioned above, many of such approaches through undergraduate courses are very limited. A program like this helps the student to put a step further without worrying about grades. (C2010DFEASFR1)

A similar comment from a student in the Faculty of Community Studies supports this, “With the experience I had this summer I believe that I am more prepared to pursue a graduate degree. I
now have more confidence in my skills and am able to work more independently on research projects” (C2010DFCSFR1).

Students’ expression of discovering passion and excitement in what they were doing and pride in their accomplishments was also surprising. All of these – passion, pride and confidence – are part of the affective domain and measurable only by proxy based on the testimony of participants. Student testimonies include comments such as, “This experience has given me a true passion for research” (C2010DFCSFR1); as well as “I’ve never worked as hard as I have over my 12 week research period. However at the same time, I’ve never been more proud of the work I accomplished” (C2011DFBMFR1).

Impact on student intentions to apply for graduate school - Individual Faculties

In this category, the URI program had the greatest impact in the Faculties of Community Studies and Engineering, Science and Architecture. For these two faculties, 100% (4/4) and 92% (11/12), respectively, of those students who were not thinking of graduate school before taking the URI program, changed their minds afterwards. Table 11 below indicates the impact for all faculties.

A comment from one of the students exemplifies the reaction of many of the participants in the URI program.

This experience clearly showed me that if I need to improve my knowledge in my field, I need to continue my education. I believe this program is a big investment for the future. Personally, I obtained a new view towards my future education and career benefitting from this program. (C2011DFESAFR1)
Table 11: Impact of URI Scholarship Program on Intention to Apply to Graduate School – By Faculty

<table>
<thead>
<tr>
<th>Final Report Question</th>
<th>Responses</th>
<th>FA</th>
<th>FDC</th>
<th>FCS</th>
<th>FESA</th>
<th>FBM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were you considering graduate studies before taking part in this program?</td>
<td>Yes</td>
<td>26</td>
<td>9</td>
<td>22</td>
<td>23</td>
<td>6</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>12</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Undecided</td>
<td>9</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>46</td>
<td>14</td>
<td>30</td>
<td>36</td>
<td>8</td>
<td>122</td>
</tr>
</tbody>
</table>

| Are you considering graduate studies after taking part in this program?             | Yes       | 32 | 14  | 26  | 35   | 7   | 114   |
|                                                                                      | No        | 0  | 0   | 1   | 1    | 1   | 3     |
|                                                                                      | Undecided | 4  | 0   | 1   | 0    | 0   | 5     |
| Total                                                                                |           | 42 | 14  | 28  | 37   | 9   | 122   |

Source: Final Report Forms, URI Scholars’ Program (2010-2012)

LEGEND (Faculty Pseudonyms)

FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management

Similarly, another student commented that, “Having the opportunity to engage in research and launch my own research project made me realize that I would like to continue to conduct research at the graduate level” C2012DPsychFR2.

Impact on career decisions - All Disciplines

According to a survey by Future Shop, nearly half (43%) of all Canadian PSE graduates pursue a different career than originally intended (Future Shop Consumer Insights, 2013). The
final reports did not ask respondents to comment on the impact of the URI program on their career decisions beyond graduate school; however, a number of responses indicated that the program did impact their thinking. Examples of this are found across all disciplines. For example, a student from the Faculty of Arts indicated that, “The experience also made me examine my future career goals honestly and truly think about what role the skills I’ve learned in the position might play in any future jobs or careers that I might seek out” (C2010DPsychFR6); and another student from the Faculty of Community Studies, reported that, “Realizing that I do have interest and passion for research has changed the plans I had in mind for what I wish to accomplish after my undergraduate degree.” (C2010DNursingFR2)

For many participants, the experience gave them skills that opened up awareness and possibilities for other career choices, as exemplified in the following comments from a Human Resource Management student:

The skills and knowledge that I have gained ... will benefit me in virtually every piece of school work that I do at the graduate level and in future jobs. The experience of starting something from nothing and seeing it take shape and evolve has truly been rewarding. (C2010DHRM/OrgBehFR1)

These findings are consistent with those in the Seymour study, in which 14% (n=169) of the students surveyed reported that an undergraduate research experience had contributed to the clarification, refinement and confirmation of pre-existing choices of career, including graduate or professional school (Seymour et al., 2004).
Impact on Career Decisions – Individual Faculties

This question was not specifically asked in any of the source material, so that a ‘before and after’ comparison is not possible. Surprisingly, however, and in spite of the fact that they were not asked to comment on the influence of the program on their career decisions, 52% (n=67) of all 130 students who responded indicated that the URI experience had helped to clarify their ideas about the kind of career that they wished to pursue. Table 12 breaks down these numbers by faculties.

Table 12: Impact of URI Program on Clarifying Career Direction

<table>
<thead>
<tr>
<th>Final Report</th>
<th>FA</th>
<th>FDC</th>
<th>FCS</th>
<th>FESA</th>
<th>FBM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mention of Impact on Career Direction</td>
<td>55%  (n=21)</td>
<td>60%  (n=9)</td>
<td>60%  (n=18)</td>
<td>41%  (n=15)</td>
<td>40%  (n=4)</td>
<td>51%  (n=67)</td>
</tr>
</tbody>
</table>

Source: Final Report Forms, URI Scholars' Program (2010-2012)

LEGEND (Faculty Pseudonyms)

FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management

Potential for interdisciplinarity - All Disciplines

One of the unexpected sub-themes that I identified was that of interdisciplinarity. David Leach, Director of the Technology and Society Program at the University of Victoria remarked
that, “One of the dangers of disciplinary thinking is that you can get narrowed into a certain jargon that is familiar to your group of experts but virtually meaningless to other people” (Erin Millar, 2013 p. 1). In the URI program, although each student worked on his/her own project within a discrete research setting, there was opportunity for them to engage with each other during the workshops, as well as at a social event at the beginning of the summer and the event showcasing a poster presentation at the end. There are numerous comments from students in all faculties that suggest this would be an exciting area to pursue. For example, one student from Image Arts commented that,

The experience I shared with [my supervisor] and the engineering team has broadened my understanding of research and its significance within and outside the institution. Not only did my URI experience demonstrate a specific connection and integration of visual art and technology, but it has made me consider the possible applications that such project could bring forth... taking into consideration commercialization. (C2010DIImAFR2)

Among others, two students from the Faculty of Nursing commented about interdisciplinarity. One indicated that “there is a huge potential for the employment of arts-informed research methods in health-care research and that it can be a complementing balance to the evidence-based paradigm of medical research” (C2011NursFR2). Another noted that “More importantly, I learned how interdisciplinary researchers can cooperate with each other to develop an intervention that can benefit many people who live in the community” (2010NursFR2).

In addition to these and many similar comments, there were also suggestions that the program could be improved by creating an opportunity for interdisciplinary, collaborative
undergraduate research student teams to apply for these awards in future years. An application that embraced this kind of approach was being considered for future rounds of the URI program. There are examples of curriculum teaching models to introduce interdisciplinary concepts to undergraduate students such as the recent National Experiment in Undergraduate Science Education (NEXUS), that bring together multiple institutions with the goal of creating and sharing effective models for teaching interdisciplinary science (Howard Hughes Medical Institute, 2011).

The challenge, which the authors readily acknowledge, is that while scientists and researchers are accustomed to working through disciplinary boundaries, university classes have been the same for decades, so any design would need to include not only the assessment of students’ factual knowledge, but also their ability to demonstrate scientific competencies, such as applying knowledge to analyze a problem (Howard Hughes Medical Institute, 2011). Larson goes even further to say that not everyone can engage in interdisciplinary research, and that while universities may embrace the idea, strategies for preparing and supporting faculty, who need to master specific competencies, are lacking (Larsen et al., 2011).

**Potential for interdisciplinarity – Individual Faculties**

The program was designed to bring students from across all disciplines together for Workshops on topics that were universally relevant to research. The expectation in doing this was to encourage interdisciplinary discussions amongst the participants. It is evident, however, that more direction is needed in order to effect this outcome. While some comments indicated that there was potential, the vast majority of students 79% (n=103) either made no mention of it, or pointed to the wish for more interaction between URI scholars and perhaps more opportunities for cross-disciplinary applications to the URI program). Interestingly, STEM
disciplines by far saw the least opportunity, while the more creativity-associated faculty, the
Faculty of Design and Communication, saw the greatest potential for interdisciplinary
exploration of ideas. This is an area that needs to be further explored. Table 13 shows the results
by faculty.

**Table 13: Potential for Interdisciplinarity**

<table>
<thead>
<tr>
<th></th>
<th>Final Report</th>
<th>FA</th>
<th>FDC</th>
<th>FCS</th>
<th>FESA</th>
<th>FBM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mention of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential for</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interdisciplinarity</td>
<td>29% (n=11)</td>
<td>40% (n=6)</td>
<td>23% (n=7)</td>
<td>3% (n=1)</td>
<td>20% (n=2)</td>
<td>22% (n=27)</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Final Report Forms, URI Scholars’ Program (2010-2012)*

**LEGEND (Faculty Pseudonyms)**

FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management

**Connecting theory to practice – All Disciplines**

Student comments and the research literature lead me to believe that in practice, there is
a symbiotic relationship between the educative, traditional curriculum on the one hand, and the
training gained through research experience on the other. It appears that there exists a
philosophical divide within universities over the nature of their mission and mandate, and not
the delivery methods of instruction. One needs to think of experiential learning not as ‘training’
students, but as giving them the tools that they need to convert the theory that has been
learned in the undergraduate classroom into the skills they will need to succeed in life. I believe that this is an important point and have thus included several comments that support this concept.

Before doing research, I always thought the material I learned in the classroom was irrelevant and too elementary for research purposes. However, I found the contrary to be true. My lab experience has allowed me to develop my analytical thinking skills as well as apply the knowledge I learned through my courses.

(C2010DChemBioFR4)

Another student put it this way:

My experience with the URI Scholars Program has been both challenging and rewarding. It has allowed me to gain perspective on the application of theoretical knowledge to real world problems. Although school classes can provide a strong foundation, they lack the depth one can achieve when performing research on a particular field. (C2010DCompSciFR2)

Similarly, a student from the Psych program stated:

Before I became part of the program, I mainly learned about research from textbooks. The URI award, however, offered me a unique opportunity to put my theoretical knowledge of research into practice. I have never thought how much research can do to help people and how important it is to change their lives in a positive way. This discovery made me appreciate the URI experience even more, as it gave me the chance to make a difference in someone’s life through research. (C2010DPsychFR5)
The connection between theory and practice can be seen in different ways. For example, in the ongoing debate between teaching and research, in the application of learning outcomes from higher education to the workplace, or in the transfer of ideas to innovative solutions to real-world problems. Based on my own experience and on comments from the students, these are not distinct, but reflect a continuum. The early and active involvement of undergraduate students in appropriate research programs that help make the connection between theory and practice, or knowledge consumption and creation, is one way of recognizing and developing a holistic approach to higher education.

**Connecting Theory to Practice – Individual Faculties**

Whereas I had made the assumption that the connection between theory and practice would be in the direction from the former to the latter, in fact, I was surprised to discover that it could also be in the opposite direction. For example, the comment from a journalism student that, “I rediscovered a more theoretical, classical style of education. I come from a very hands-on program, so it was almost refreshing to immerse myself in academics for twelve weeks” (C2010DFDCFR1), leads me to believe that the experiential component of programs of this type is about more than hands-on, practical experience. It is as much about the symbiotic nature of the elements that go into a complete education. Interestingly, the faculty with the highest response in this category was the Faculty of Design and Communication. Other faculties are shown below in Table 14.
Table 14: Connecting Theory to Practice

<table>
<thead>
<tr>
<th>Final Report</th>
<th>FA</th>
<th>FDC</th>
<th>FCS</th>
<th>FESA</th>
<th>FBM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mention of Theory and Practice Connection</td>
<td>37% (n=14)</td>
<td>53% (n=8)</td>
<td>63% (n=19)</td>
<td>54% (n=20)</td>
<td>40% (n=4)</td>
<td>50% (n=65)</td>
</tr>
</tbody>
</table>

Source: Final Report Forms, URI Scholars’ Program (2010-2012)

LEGEND (Faculty Pseudonyms)

FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management

Engagement – Individual Faculties

Similar to other unsolicited findings, no question was asked regarding whether or not students became more engaged with research as a result of the URI experience. Nevertheless, I find it interesting that almost half of the students (48%; n=62) indicated that as a result of their experience, they became passionate about what they were doing. A typical comment comes from Social Work, in which the student states,

In short, this opportunity proved to be, for me, a crash course in ‘how to be an academic’. I have learned firsthand, the excitement and passion that comes from being able to research and explore topics which are of primary interest to the researcher. This has been in direct contrast to some student/professor interactions in
which the student must complete a project or assignment as determined by the
professor. (C2011DSocWorkFR2)

Other adjectives used include joy, enthusiasm, and inspiration, sense of wonder, empowerment,
motivation and excitement. Table 15 breaks this category down by faculty.

Table 15: Enthusiasm and Passion

<table>
<thead>
<tr>
<th>Final Report</th>
<th>FA</th>
<th>FDC</th>
<th>FCS</th>
<th>FESA</th>
<th>FBM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mention of Sense of Engagement</td>
<td>40% (n=15)</td>
<td>67% (n=10)</td>
<td>50% (n=15)</td>
<td>54% (n=20)</td>
<td>20% (n=2)</td>
<td>47% (n=62)</td>
</tr>
</tbody>
</table>

Source: Final Report Forms, URI Scholars' Program (2010-2012)

LEGEND (Faculty Pseudonyms)

FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management

Opportunities to engage in publications, grant applications, and poster/oral presentations –

Individual Faculties

Twenty-six percent (n=34) of 130 student respondents took part in the preparation or
presentation of publications, posters and/or grants. This number is broken down by faculty in
Table 16.
Table 16: Participation in Publications, National/International Poster or Oral Presentations or Grant Applications

<table>
<thead>
<tr>
<th>Final Report</th>
<th>FA</th>
<th>FDC</th>
<th>FCS</th>
<th>FESA</th>
<th>FBM</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students participating in publications, poster/oral presentations outside the institution or Grant Applications</td>
<td>21% (n=8)</td>
<td>26% (n=4)</td>
<td>40% (n=12)</td>
<td>18% (n=7)</td>
<td>30% (n=3)</td>
<td>26% (n=34)</td>
</tr>
</tbody>
</table>

Source: Final Report Forms, URI Scholars’ Program (2010-2012)

LEGEND (Faculty Pseudonyms)

FA: Faculty of Arts
FDC: Faculty of Design and Communication
FCS: Faculty of Community Studies
FESA: Faculty of Engineering, Science and Architecture
FBM: Faculty of Business Management

Summary

I was unable to locate studies that had assessed and compared learning outcomes from an undergraduate research experience such as the URI program on students in the Social Science and Humanities disciplines in the same way as has been done in the STEM disciplines. Reasons for this may include that experiences of this type (summer apprenticeship model) are less common in Social Sciences and Humanities. Healey, for example, notes the diverse environments and cultures associated with different disciplines in research and teaching (Healey, 2005). Nevertheless, findings suggest that the benefits accrued from participation in an undergraduate research experience such as the URI program, benefits students across all disciplines that were
part of the study. Affective benefits were reported more by STEM students than by all other disciplines; improved practical skills were almost the same for students in Arts and Community Studies as they were in STEM. Skills and learning outcomes as they relate to the workplace and a country’s economic prosperity in a global, knowledge economy will be discussed further in Chapter 5.

4.4 Research Question #3: To what extent do perceived learning outcomes as a result of participation in the URI program satisfy objectives set out in the University Undergraduate Degree Level Expectations (UUDLEs)?

Phase 2 – online questionnaire survey.

The response rate for the questionnaire was 28.4% (n=48 of 169). Responses from cohorts years 2010, 2011 and 2012 were 25%, (n=12), 35% (n=17) and 40% (n=19), respectively. This is to be expected, since earlier participants may not access their university e-mail accounts on a regular basis. Fifty-six percent (56% n=27) of the respondents were female, 42% (n=20) were male, and 2% (n=1) indicated other. In terms of the Faculty composition of the responses, 31% (n=15) came from the Faculty of Engineering, Science and Architecture (FESA), 31% (n=15) from the Faculty of Community Studies (FCS), 21% (n=10) from the Faculty of Arts (FA), 12% (n=6) from the Faculty of Design and Communication (FDC), and 4% (n=2) from the Faculty of Business and Management (FBM).

Participants were asked the following question (Survey Question #10) relating to UUDLEs: “The following is a list of Ontario undergraduate degree level expectations. To what extent did the URI program contribute to the development of your skills in the following areas? Please check all that apply.”
Each of the undergraduate degree level expectation categories, including the more
detailed classifications (Ontario Universities Council on Quality Assurance, 2012 pp. 30-32) (also
Appendix C) were listed with the choice of “Not at all; Somewhat; Considerably; and To a great
extent. All student responses (n=48) of their learning outcomes for each of the detailed
expectations are presented in Figures 6-30.

Individual pie charts indicating the outcomes for each faculty are attached as Appendix I.
In addition, I have included a chart in the summary section, with details of the data illustrated in
the figures (Table 17).

University Undergraduate Degree Level Expectations

Category: Depth and Breadth of Knowledge (Ontario Universities Council on Quality
Assurance, 2012 p. 30)

Figures 6-11 (Appendix I) show the extent to which respondents reported that the URI
program had contributed to their skill development in six areas that were included under the
category of ‘Depth and Breadth of Knowledge’. Between 94% (n=43) and 100% (n=48) of
respondents indicated some contribution to the development of learning outcomes in each of
the sub-sections of this category as a result of participation in the URI program. The areas in this
category that were most frequently reported as having contributed ‘to a great extent’ were:
critical thinking and analytic skills (56%; n=27); ability to gather, review, evaluate and interpret
information (54%; n=26); and knowledge of an experience in research (49%; n=23). These
learning outcomes fall within the cognitive domain. Findings are shown in detail below.

Category: Knowledge of Methodologies (Ontario Universities Council on Quality
Assurance, 2012 pp. 30-31)
Figures 12-14 (Appendix I) show the extent to which respondents reported that the URI program had contributed to their skill development included under the category, ‘Knowledge of Methodologies’. Between 96% (n=46) and 98% (n=47) of respondents indicated some level of contribution to the development of skills in each of the sub-sections of this category as a result of participation in the URI program. The effect of the URI program on learning outcome development in this category did not have the same intensity of impact as the previous category. The outcome most frequently recorded as having contributed ‘to a great extent’ was in using the methodology to devise and sustain arguments or to solve problems (30%; n=14). These learning outcomes fall within the cognitive domain. Findings are shown in detail below.

**Category: Application of Knowledge (Ontario Universities Council on Quality Assurance, 2012 pp. 30-31)**

This category falls into two sub-categories, the first of which identifies an ability to review, present and critically evaluate qualitative arguments (Figures 15-18; Appendix I) and the second, which identifies the ability to use a range of established techniques (Figures 19-22) (Appendix I). Between 94% (n=45) and 98% (n=47) of respondents indicated some level of contribution of the URI program to the development of learning outcomes in the first category; between 90% (n=43) and 96% (n=46) of respondents indicated some the same for the second category. The learning outcome that was most cited in either sub-category as having been developed ‘to a great extent’ by the URI experience relates to using qualitative and quantitative data to develop lines of argument (46%; n=22). These learning outcomes fall in either the psychomotor or cognitive domain. Findings are shown in detail below.
Category: Communication Skills (Ontario Universities Council on Quality Assurance, 2012 p. 32)

Figure 24 (Appendix I) shows the extent to which respondents reported that the URI program had contributed to the development of their communication skills. Ninety-four percent (n=45) of respondents indicated some contribution to the development of learning outcomes in this category as a result of participation in the URI program. Learning outcomes in this area fall within the cognitive domain. Findings are shown in detail below.

Category: Awareness of Limits of Knowledge (Ontario Universities Council on Quality Assurance, 2012 p. 32)

Figure 25 (Appendix I) shows the extent to which respondents reported that the URI program had contributed to development of their awareness of the limits to their own knowledge. One hundred percent (n=48) of respondents indicated some contribution to the development of learning outcomes in this category as a result of participation in the URI program.

Category: Autonomy and professional capacity (Ontario Universities Council on Quality Assurance, 2012 p. 32)

Figures 26-30 (Appendix I) show the extent to which respondents reported that the URI program had contributed to the development of their autonomy and professional capacity. There were five questions in this category. Interestingly, this category was one of the most highly impacted in terms of perceived learning outcomes. Between 96% (n=46) and 98% (n=47) of respondents indicated some contribution to the development of skills in each of the sub-sections of this category as a result of participation in the URI program. A minimum of 81% (n=39) and a
maximum of 90% (n=43) of students reported that the URI experience contributed to their development in all areas of the category, either ‘considerably’ or ‘to a great extent’. These learning outcomes fall within the affective domain.

Summary

These findings, which are summarized below in Table 17 suggest that every university undergraduate degree level expectation, as expressed in the Quality Assurance Framework, was met to some degree by a minimum of 90% of responding students who participated in the URI program, as perceived by students. In many cases, the number is much higher. In an age of increasing accountability, my goal in asking student participants about the UUDLEs was to find out the extent to which a well-designed experiential program could increase the likelihood that graduating students left university with the learning outcomes and skills that were deemed necessary and of value for the future.

There is also a very timely discussion occurring now between government, academia and industry, concerning the connection between learning outcomes and skills resulting from a university education, and those skills that are needed in the workplace. For example, are the skills outlined by UUDLEs and those valued in the workplace the same, and if so, why is there a “Skills Gap”? Is it that the UUDLEs are the wrong skills or that students are leaving university without acquiring them. The implications of this issue will be addressed in Chapter 5.

The findings from Research Question #2 suggest that undergraduate participation in a research program such as the URI could be one way to provide the right opportunity to achieve the learning outcomes and skills that are lacking.
Table 17: Summary of student perceptions regarding perceived learning outcomes resulting from participation in the URI program as set out in the university undergraduate degree level expectations (UUDLEs)

<table>
<thead>
<tr>
<th>UUDLES</th>
<th>FINDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at All</td>
</tr>
<tr>
<td><strong>Depth and breadth of knowledge</strong></td>
<td></td>
</tr>
<tr>
<td>Developed knowledge and critical understanding of the key concepts, methodologies, current advances, theoretical approaches and assumptions in a discipline</td>
<td>4% (n=2)</td>
</tr>
<tr>
<td>Developed understanding of many of the major fields in a discipline, including, where appropriate, from an interdisciplinary perspective, and how the fields may intersect with fields in related disciplines</td>
<td>6% (n=3)</td>
</tr>
<tr>
<td>Developed ability to: i) gather, review, evaluate and interpret information; and ii) compare the merits of alternate hypotheses or creative options, relevant to one or more of the major fields in a discipline</td>
<td>4% (n=2)</td>
</tr>
<tr>
<td>Developed, detailed knowledge of and experience in research in an area of the discipline</td>
<td>0% (n=0)</td>
</tr>
<tr>
<td>Developed critical thinking and analytical skills inside and outside the discipline</td>
<td>2% (n=1)</td>
</tr>
<tr>
<td>Ability to apply learning from one or more areas outside the discipline</td>
<td>4% (n=2)</td>
</tr>
<tr>
<td><strong>Knowledge of Methodologies</strong></td>
<td></td>
</tr>
<tr>
<td>An understanding of methods of enquiry or creative activity, or both, in their primary area of study that enables the student to evaluate the appropriateness of different approaches to solving problems using well established ideas and techniques; and</td>
<td>4% (n=2)</td>
</tr>
<tr>
<td>An understanding of methods of enquiry or creative activity, or both, in their primary area of study that enables the student to devise and sustain arguments or solve problems using these methods; and</td>
<td>2% (n=1)</td>
</tr>
<tr>
<td>An understanding of methods of enquiry or creative activity, or both, in their primary area of study that enables the student to describe and comment upon particular aspects of current research or equivalent advanced scholarship</td>
<td>2% (n=1)</td>
</tr>
<tr>
<td>Application of Knowledge (Part I)</td>
<td>4% (n=2)</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>The ability to review, present and critically evaluate qualitative and quantitative information to develop lines of argument;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2% (n=1)</td>
</tr>
<tr>
<td>The ability to review, present and critically evaluate qualitative and quantitative information to make sound judgments in accordance with the major theories, concepts and methods of the subject(s) of study;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6% (n=3)</td>
</tr>
<tr>
<td>The ability to review, present and critically evaluate qualitative and quantitative information to apply underlying concepts, principles, and techniques of analysis, both within and outside the discipline;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4% (n=2)</td>
</tr>
<tr>
<td>The ability to review, present and critically evaluate qualitative and quantitative information to where appropriate use this knowledge in the creative process;</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application of Knowledge (Part II)</th>
<th>9% (n=4)</th>
<th>17% (n=8)</th>
<th>50% (n=24)</th>
<th>24% (n=12)</th>
<th>91% (n=44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ability to use a range of established techniques to initiate and undertake critical evaluation of arguments, assumptions, abstract concepts and information;</td>
<td>4% (n=2)</td>
<td>29% (n=14)</td>
<td>42% (n=20)</td>
<td>25% (n=12)</td>
<td>96% (n=46)</td>
</tr>
<tr>
<td>The ability to use a range of established techniques to propose solutions;</td>
<td>10% (n=5)</td>
<td>23% (n=11)</td>
<td>35% (n=17)</td>
<td>31% (n=15)</td>
<td>90% (n=43)</td>
</tr>
<tr>
<td>The ability to use a range of established techniques to frame appropriate questions for the purpose of solving a problem;</td>
<td>4% (n=2)</td>
<td>21% (n=10)</td>
<td>48% (n=23)</td>
<td>27% (n=13)</td>
<td>96% (n=46)</td>
</tr>
<tr>
<td>The ability to use a range of established techniques to solve a problem or create a new work;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4% (n=2)</td>
<td>19% (n=9)</td>
<td>36% (n=17)</td>
<td>40% (n=19)</td>
<td>96% (n=46)</td>
</tr>
<tr>
<td>The ability to use a range of established techniques to make critical use of scholarly reviews and primary sources.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication Skills</th>
<th>6% (n=3)</th>
<th>13% (n=6)</th>
<th>49% (n=24)</th>
<th>32% (n=15)</th>
<th>94% (n=45)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ability to communicate information, arguments, and analyses accurately and reliably, orally and in writing to a range of audiences.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Awareness of limits of knowledge</th>
<th>0% (n=0)</th>
<th>7% (n=3)</th>
<th>41% (n=20)</th>
<th>52% (n=25)</th>
<th>100% (n=48)</th>
</tr>
</thead>
<tbody>
<tr>
<td>An understanding of the limits to their own knowledge and ability, and an appreciation of the uncertainty, ambiguity and limits to knowledge and how this might influence analyses and interpretations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Autonomy and professional capacity

| Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring the exercise of initiative, personal responsibility and accountability in both personal and group contexts; | 2% (n=1) | 15% (n=7) | 38% (n=18) | 46% (n=22) | 98% (n=47) |
| Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring decision-making in complex contexts; | 4% (n=2) | 15% (n=7) | 35% (n=17) | 46% (n=22) | 96% (n=46) |
| Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring the ability to manage their own learning in changing circumstances, both within and outside the discipline and to select an appropriate program of further study; and | 2% (n=2) | 10% (n=5) | 50% (n=24) | 38% (n=18) | 98% (n=47) |
| Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring behaviour consistent with academic integrity and social responsibility. | 2% (n=1) | 9% (n=4) | 47% (n=23) | 43% (n=21) | 98% (n=47) |

**Source:** Online Questionnaire Survey (Question #10)
4.5 Research Question #4: To what extent are student expectations being met by the URI program?

I thought it would be of interest to examine the extent to which the URI program met the expectations of the students, and not only the learning outcomes expected by the institutions, since one indicator of the efficacy of an educational program is how well it meets student expectations.

Phase 2: Online Questionnaire

I asked the following three questions related to expectations of students participating in the URI program (Online Questions #6, #7 and #8). All respondents answered all questions, and percentages reflect the number out of the total of forty-eight respondents:

6) Why did you apply for the URI Scholarship?
   a. Summer employment;
   b. Hands-on experience;
   c. Interest in graduate studies;
   d. Interest in specific research topic;
   e. Useful for future employment;
   f. Other.

7) What, if any, were your expectations of the URI experience?

8) Was the URI experience successful in meeting your expectations?

In response to the first question, participants were asked to check all boxes that applied, and to add any additional reasons. The findings are shown in Table 18.
Table 18: Reasons for Applying to the URI Program

<table>
<thead>
<tr>
<th>Why did you apply for the URI Scholarship?</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer Employment</td>
<td>81% (n=39)</td>
</tr>
<tr>
<td>Interest in Graduate Studies</td>
<td>77% (n=37)</td>
</tr>
<tr>
<td>Hands-on Experience</td>
<td>75% (n=36)</td>
</tr>
<tr>
<td>Useful for Future Employment</td>
<td>71% (n=34)</td>
</tr>
<tr>
<td>Interest in Specific Research Topic</td>
<td>69% (n=33)</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
</tbody>
</table>

*Source: Student Questionnaires (2010-2012)*

These findings suggest that the URI program serves a variety of purposes, including the immediate and long-term need for employment, and is consistent with the UCLA-based Higher Education Research Institute's 2012 Freshman Survey, in which almost 88% (n=169,762) of respondents cited being able to get a better job as a very important reason for attending college (Pryor et al., 2012).

In response to the second question, student comments reflected a wide variety of expectations from the URI program itself. Fifty percent (n=24) of the 48 students who responded to this question mentioned expectations related to aspects of experiential learning, including gaining experience in research practice and the process of design, implementation and completion (23% n=11), hands-on practical and applied experience (13% n=6) and improved research skills (14% n=7). The opportunity to work closely with a supervisor/mentor was also mentioned quite frequently, especially in association with support while pursuing independent research projects (31% n=15). Fifteen (31%) of the respondents indicated that they hoped to gain valuable experience that would help them succeed in graduate studies.
Fourteen percent (n=7) expected to be exposed to the experiential learning aspects of industry-academia collaborative research and potential for entrepreneurial research.

The four students who volunteered to be interviewed were not asked specifically about their expectations of the program, but did speak about this in the course of the interview. Interviewee #1 had been approached by a faculty member and asked to apply, and indicated that she had no particular expectations herself. Interviewee #2 indicated that he had gone into the experience fairly open-minded, and that the experience had consolidated the idea that he was interested in conducting research, that he was capable of doing it, was confident, and gained further understanding of his own intention to engage in research as a career. Interviewee #3 specifically applied because there was a particular faculty member that she wanted to work with, and who encouraged her to apply so that she would have funding. This interviewee indicated that she had some ideas for her own research and that she would receive mentorship in her decision to lead a project of her own. Interviewee #4 had also been approached by a faculty member, and with her encouragement was able to lead and be at the forefront of the research process. She kept an open mind about the experience she would gain from participating in the URI program and the form that it would take.

Finally, with respect the third question, which asked whether expectations had been met, 90% (n=43) of the respondents indicated that the URI program had met or exceeded their expectations. Five students (10%) reported that the experience had either partially or fully failed to meet their expectations. The following comments help to explain the reason for this. Two students felt that they would like to have had more interaction with their supervisor - one expressed that it was too early in their academic career for them to fully benefit (first year
student) without closer mentorship; another student did not find the work as interesting as he/she thought it would be; technical difficulties were experienced with the equipment needed for one of the projects so that the student did not have the opportunity to use the machinery as expected; and finally, a project was abandoned when expected extra funding was not secured. I believe that the biggest lesson we can learn from this relates to the most advantageous time to take up the URI scholarship. Comments throughout all three Phases of the findings suggest that it is most appropriate for students who have or will have completed two full academic years at the time of holding the scholarship. It is also important for both the supervisor and the student to prepare and anticipate potential issues or requirements that might arise from undertaking the project.

Findings from this study suggest that most of the students who applied for the program were aware of its benefits as well as from other models of its type. However, the association between programs of this type and post-graduation workplace or graduate school skills is mostly intuitive, as there is a dearth of information in Canada that supports the claim, especially in social sciences and humanities disciplines.
CHAPTER FIVE

Conclusions, Implications and Recommendations

In a 2012 OECD study, it was reported that, “Researchers today need skills relating to communication, problem-solving, team-working and networking, business, and management know-how (OECD, 2012). These skills give them workplace competencies that are relevant for a broad job market, although the skills they need may vary in different sectors” (Box, 2013 9). The purpose of this study was to evaluate and describe the experiences, perceptions and attitudes of participants in a case study of the Undergraduate Research Initiative (URI) conducted at City University in Ontario, to determine the scope of effects on skills and learning outcomes across a diverse range of disciplines from the student perspective. Particularly, it was meant to examine what learning outcomes were achieved as reported by participating students; the extent to which students’ perceptions varied by faculty/discipline; the extent to which the URI program contributed to the development of university undergraduate degree level expectations (UUDLEs) as set out in Ontario’s Quality Assessment Framework; and the extent to which students’ expectations were met by the URI program. An additional area of interest was to examine the interconnection between the reported learning outcomes, university degree level expectations, and the workplace-identified skills that are currently the subject of the ‘skills-gap’ debate.

Findings from this study showed that perceived learning outcomes as a result of participation in the URI program, covered a broad spectrum of themes that were identified by the students and that included outcomes in all three of the domains (cognitive, affective, and
psychomotor), as identified by Bloom (1956). What is important to note is that these themes were student-identified as what was perceived as a learning outcome, as opposed to the UUDLEs, which were developed as a guide to what should be the outcome. The fact that the URI experience led to the perceived development of skills recommended by the UUDLEs guidelines speaks to the potential value of the program for university accountability purposes. The universality of the impact of the URI program across disciplines was somewhat unexpected, but is a strong argument for the importance of program design in meeting learning objectives.

Populating Kolb’s framework with various elements of the URI program, I discovered a potentially virtuous cycle of inputs, impacts and outcomes that I have tried to illustrate in Figure 4 below. The starting point is the student, located in blue at the top of the diagram. As the student enters the higher education system, he/she brings certain skills acquired to that point, which differ from person to person and are impossible to quantify. Learning outcomes and expectations that accrue from a traditional university education are documented in Ontario as UUDLEs, but there is currently no mechanism for measuring the extent to which these are successfully acquired or developed. With the implementation of a well-designed undergraduate research program that has been shown to produce desired learning outcomes, in addition to the traditional classroom instruction, the chances of a graduating student having acquired the learning outcomes and skills for a future career could be increased. This career path could involve direct entry into the workplace, professional schools, graduate school, or various entrepreneurial endeavours.
Figure 4: Model of Inputs, Impacts and Outcomes in Higher Education
As suggested by the findings from this case study, student respondents overwhelmingly identified positive benefits associated with participation in the URI program. Ninety percent (n=43) reported that their expectations of the program had been met. Reflecting current economic conditions, it is not surprising that 71% (n=34) of the respondents indicated its usefulness for future employment and 67% (n=32) credited the program with providing them with useful workplace skills.

What follows is a discussion of the implications for policy, praxis, research and theory and some specific recommendations for action.

5.1 Policy

One of the most interesting observations around this study has been the lack of information and coordination both within institutions and between them with respect to undergraduate research. Providers of undergraduate research experiences in Canada currently lack any central, national or provincial hub to coordinate efforts whereby they can share experiences, discuss the latest research findings, implement best practices and lobby appropriate groups about the benefit of these programs to the student, the employer community, academia and government.

I would strongly urge the creation of a Canadian Council on Undergraduate Research that would bridge all three granting councils and collaborate with the Council on Undergraduate Research (CUR) in the United States. Although the US Council focuses on STEM disciplines, this case study has shown the potential benefits of undergraduate research for disciplines not represented by that acronym. The CUR brings a wealth of research that could help inform our own practices. Best practices need to be shared, not
only among departments and faculties within institutions, but also between institutions, and between countries.

It is perceived that graduate students in natural sciences and engineering are more familiar with NSERC than their social sciences and humanities (SSH) counterparts are with SSHRC, possibly in part due to the fact that the former has a dedicated program to support undergraduate research. SSHRC Leaders, at their 2009 annual meeting, expressed the need to bring undergraduate students into the SSH culture sooner, and I would encourage SSHRC to explore taking a lead role in funding undergraduate student research in the same way as their counterpart councils, NSERC and CIHR do for their disciplines (Social Sciences and Humanities Research Council, 2009).

Canada should also create a policy framework, consistent with provincial educational priorities, goals and objectives that will help guide program development, based on a set of experiential learning tenets that are known to be effective.

Universities, government and employer stakeholders need to be made aware of the benefits to each of their communities, and encouraged to fund more opportunities to support undergraduate students in appropriate research programs and symposia celebrating the accomplishments of the students. While currently there are departmental and sometimes institutional celebrations of undergraduate research and discovery, I would strongly recommend that multi-disciplinary provincial and national annual conferences be held to convey the importance of this undertaking. By inviting the employer community, institutions could showcase the talent coming out of our universities and help make network connections for students. This is something that is coordinated by the COU in the US and
could be an undertaking of a Canadian Council on Undergraduate Research.

Given the overwhelming evidence from studies that show the across-the-board benefits of undergraduate research programs with respect to work readiness, lifelong learning facilitation, and graduate school preparation, it is essential that government policy makers, institutions of higher education and representatives from the employer community come together to agree on some definitions of skills, and identify which of the ostensibly missing skills and learning outcomes can be provided by a university education as opposed to public and private colleges, without compromising academic mission.

5.2 Practice

There were a number of praxis-related findings from this study, one of which was the number of students it attracted who were already planning to go to graduate school. Even more dramatic, however, and of great interest to me was that it seemed to convince almost all respondents that graduate school was the next logical step. Since this was one of the aims of the program, this is very exciting indeed. It should be recognized, however, that because of the high GPA requirements for eligibility to the URI program, this study addressed a subset of gifted students. One recommendation for further research and practice would be to do a comparative study between these students and those who applied for, but were not accepted into the URI.

The role of faculty in mentoring students is central to the initiative, and they are pivotal to ensuring the success of the student undergraduate research experience. In many cases, the impact of the mentoring experience lasts far beyond the program itself (Temple et al., 2010). Good mentoring, however, can be challenging, requiring a significant investment
of time, realistic goal-setting and expectations – neither too much nor too little, a supportive and encouraging environment, a collegial relationship that is focused on helping the student to understand what it is to be a researcher. In the current system, the annual PTRs of university researchers are assessed on a combination of teaching, research and service. It is incumbent on institutions to recognize the value and reward the activities of mentorship in programs such as the URI.

The URI program stipulated a ‘one-time-only’ participation per student. However, following the success of the first year, and in response to inquiries from students about continuing with their mentor, we initiated a program called Returning Research Opportunities (RETRO). This program encouraged faculty mentors to leverage the training that had already been provided to the student through the URI experience. To participate, the faculty member needed to provide 50% of the salaried costs of the student, and 100% of any research or travel expenses. Unfortunately, I was not provided access to the data, but it would be interesting to know, for example, not only how many researchers took advantage of this, but whether it favoured any particular disciplines, since the research funding budgets of NSERC and CIHR are higher than SSHRC, which is reflected in individual research grants.

While there is growing evidence of the benefits of undergraduate research programs, one of the challenges for programs such as URI, where no academic credit is given, is to find a way to reflect the value so that the student is able to market and leverage the experience. At the University of California at Davis, a new system is being implemented that gives students such an opportunity. They are creating a digital badge system that would capture much of the experiential learning that goes on in internships, field work and research, but
that is not formally part of the curriculum (Fain, 2014).

Findings from this study also suggest that the URI model of undergraduate research experience at City University may fill a gap in the demand-supply chain of skills training. From the point of view of the students, the program effectively provided a range of skills across all disciplines that they felt helped prepare them for the workplace. The following comment from a student is indicative of student responses.

I think this is a great program, it really helps undergraduate students prepare, not just for graduate school, but for any job they plan on pursuing after their degree. I think it is very smart that City University has this program, because for the students who get the opportunity to do the URI they will graduate being much more prepared for graduate studies or entering the work force and they will likely be more successful than if they hadn’t had this experience.

(C2012DPsychFR1)

Industry demand for skilled workers should not be the driver of post-secondary education. The sheer pace of technological change makes it only reasonable that industries themselves train/retrain in response to these changes. What universities can give to students are the meta-skills, identified by both workplace and institutions of higher education, which give the students the tools to learn, relearn, train and retrain.

Both in Canada and the United States, a paradigm shift occurred when higher education became linked to economic prosperity in the sense that global competitiveness became interconnected with knowledge and the innovative transformation of that knowledge, which is a result of a university education (Clark et al., 2009; Bok, 2003). That
knowledge is not only in the form of ideas and discovery. It is also in the creation of highly qualified personnel (HQP). The knowledge-based global economy has increased Canada’s need for undergraduate students to acquire certain workplace skills in order to be competitive, and these skills have been shown to result from engagement in research. While we are arguing over whose responsibility it is to teach those skills, we are lagging behind our international competitors and perhaps failing to provide our graduates with what they need to succeed. In other words, in a knowledge economy, what students are capable of learning after they graduate is just as important as what they know when they graduate and providing those lifelong learning skills is the one of the primary missions of the university. One recent report stresses that the current quality-assurance system in higher education is poorly aligned with work-force needs and that there is no guarantee for employers that graduates with know much about their actual workplace skills (Bergeron, 2013).

The Globe and Mail Newspaper recently published an article on the Rhodes Trust, which in 2013 awarded 83 Rhodes Scholarship globally (Bradshaw, 2013). In that article, Canadian awardees were asked to comment on the one change that they would make to education. Comments such as this from a student graduating from Dalhousie University reflect a growing desire for experiential training,

“Opportunities such as getting to work in a lab and with a research team have allowed me to understand how the things I learn in the classroom can be put into practice in the real world. I think there should be better access to these sorts of hands-on experiences.” (Bradshaw, 2013 #A15)
This remark from a University of Victoria student epitomizes the learning outcomes and skills development that are embodied in the URI program. This student states that,

“\textit{We must transform our educational institutions such that they create a culture that fosters the development of interpersonal skills, values creativity, and supports a spectrum of learning styles. By supporting students to pursue what they’re most passionate about, and training them how to work collaboratively, we can create an environment that prepares students to solve problems. It is at this intersection of passion, knowledge, and communication that innovation occurs. (Bradshaw, 2013 #A15)}”

A McGill University student is quoted as saying that “\textit{there needs to be a shift in university education that focuses not only on assignments and deadlines, but also on enabling students to discover their interests, passions and capacity to contribute meaningfully to their local or international community}” (Bradshaw, 2013 #A15). These impressions, from among the finest examples of graduates of our universities, indicate to me that the evolution of our universities will be ongoing. I believe that findings from this study suggest that the Undergraduate Research Initiative program at City University goes a long way to creating a vision of what future education should be. In his 2010 report, Miner warns of a looming crisis of unskilled workers seeking employment and a large number of jobs that will be unfilled, and points to the need to increase skill levels of the workforce to adapt to the knowledge economy (Miner, 2010).

These skills help link ideas to real-world practice, are transferable from one career to another and comprise reported learning outcomes of participants in the URI program. A
comment from one of the students in their Final Report exemplifies this. “Due to this experience, I was able to see how graduate students are exposed to opportunities for attaining experience in ways that are not possible during an undergraduate degree. I became more aware of how this would make them more attractive candidates for future employers” (C2011DMIEFR3). Table 19 indicates workplace skills that are in demand, the comparable university undergraduate expectations, perceived learning outcomes and skills resulting from participation in the URI program and OECD-identified transferable research skills, which are consistent with the learning outcomes of the URI program.

Findings from this case study suggest that undergraduate research training not only satisfies the learning expectations identified by educators, but covers the full extent of skills identified as needed by the workplace. If we accept that undergraduate experiential learning programs are within the universities’ mandate, then not only are universities who offer them already contributing to nurturing workplace skills without compromising their core mission, but they can do so to an even greater extent through the expansion of undergraduate research experiences. There are, of course, many ways to provide experiential learning opportunities to students, of which the URI program is only one model.

One of the questions that interested me during the conduct of this study was the issue of responsibility. The Province has formalized degree level expectations that meet international quality assurance standards and are more publically accountable, to which universities must adhere. Workplaces have identified skills that they believe are essential for employable graduates. Students are looking for jobs. Whose responsibility is it to ensure that graduates possess the skills identified as critical for success in the workplace?
Table 19: Workplace Skills Demand Compared to UUDLEs, URI Learning Outcomes and OECD Transferable Research Skills

<table>
<thead>
<tr>
<th>Workplace Skills in Demand (Chegg Inc., 2013; Microsoft Partners in Learning et al., 2013)</th>
<th>University Undergraduate Degree Level Expectations (UUDLEs) (Ontario Universities Council on Quality Assurance, 2012)</th>
<th>URI Outcomes by Theme &amp; Identified Keywords</th>
<th>OECD Transferable Research Skills* (Box, 2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A demonstrated initiative to lead</td>
<td>The exercise of initiative, personal responsibility and accountability in both personal and group contexts; Decision-making in complex contexts</td>
<td>Improved Intellectual Skills (Decision-making Skills) Improved Knowledge of Self (Independence and Autonomy, Motivation, Confidence, Sense of Responsibility)</td>
<td>Research management and leadership</td>
</tr>
<tr>
<td>Collaboration/ Teamwork</td>
<td>Working effectively with others</td>
<td>Improved Relationship to Others and Society (Teamwork, Mentorship, Collaboration, Networking)</td>
<td>Working with others/teamwork</td>
</tr>
<tr>
<td>Prioritization and self-regulation</td>
<td>The ability to manage own learning in changing circumstances</td>
<td>Improved Knowledge of Self (Self-Discipline, Self-Direction, Independence and Autonomy) Improved Intellectual Skills (Prioritization, time management)</td>
<td>Time management</td>
</tr>
<tr>
<td>Ability to make a persuasive argument</td>
<td>Ability to review, present and critically evaluate qualitative and quantitative information to develop lines of argument</td>
<td>Improved Intellectual Skills (Developing Scholarly Arguments)</td>
<td>Negotiating skills</td>
</tr>
<tr>
<td>Reasoning skills Knowledge construction</td>
<td>Ability to use a range of established techniques to initiate and undertake critical evaluation of arguments, assumptions, abstract concepts and information; Developed critical thinking and analytical skills inside and outside the discipline</td>
<td>Acquisition of New Knowledge (Knowledge of methodological approaches) Improved Intellectual Skills (Critical Thinking, analytical skills)</td>
<td>Creativity and the ability for abstract thought</td>
</tr>
<tr>
<td>Problem solving</td>
<td>An understanding of methods of enquiry or creative activity, or both,</td>
<td>Improved Intellectual Skills (Problem Solving)</td>
<td>Problem solving</td>
</tr>
<tr>
<td>Area</td>
<td>Description</td>
<td>Improved Skills</td>
<td>Further Skills</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Communication skills</td>
<td>The ability to communicate information, arguments, and analyses accurately and reliably, orally and in writing to a range of audiences.</td>
<td>Improved Intellectual Skills (Communication Skills (writing, speaking, listening))</td>
<td>Communication/presentation skills – written and oral</td>
</tr>
<tr>
<td>Participation in extracurricular activities related to field of study</td>
<td>Developed, detailed knowledge of and experience in research in an area of the discipline</td>
<td>Improved Practical Skills (Fieldwork, hands-on experience)</td>
<td>Formal Training</td>
</tr>
<tr>
<td>Innovation</td>
<td></td>
<td>Improved Knowledge of Self (Originality, Creativity and Innovation)</td>
<td>Innovation &amp; Entrepreneurship</td>
</tr>
<tr>
<td>Organization</td>
<td></td>
<td>Acquisition of New Knowledge (Methodological Approaches)</td>
<td>Organizational skills</td>
</tr>
<tr>
<td>Working independently</td>
<td></td>
<td>Improved Knowledge of Self (Self-direction, independence and autonomy, confidence, evaluation and improvement, self-discipline)</td>
<td>Project and time-management skills</td>
</tr>
<tr>
<td>Technology use</td>
<td></td>
<td>Improved Practical Skills (Technical, Experimental, Methodological, Equipment, Software)</td>
<td>Knowledge of research methods &amp; technologies</td>
</tr>
</tbody>
</table>
In Figure 5, I have tried to illustrate how the gap created by the lack of synergy between workplace demand and university responsibility can be managed by the introduction of undergraduate research programs.

Figure 5: The Intersection of Responsibilities
In an effort to shape the program to the maximum benefit of students, as one of the questions in the Final Report, the participants were asked to provide any feedback, comments, or recommendations they may have had that would be beneficial to improving future rounds, and further experiences. Some of the suggestions were not feasible for the case study, but all of them are excellent recommendations to strengthen the program from the perspective of the student. Suggestions included the following:

- Offer a common workspace and infrastructure such as desks or office space;
- Provide more opportunity to connect with established researchers and with other URI scholars and learn about their research subjects;
- Create a Facebook page for interacting with other scholars;
- Provide more opportunity for communication and interaction with other URI scholars to create a support system for advice and guidance and a network for others going through the same experience as illustrated in the following comment from a student who said that “My experience during the summer was, at times, quite solitary and I would have benefited from interaction with peers going through similar academic research experiences” (C2010DEngFR4);
- Have a mid-point check, so that if there was any confusion or problems of any kind, it would be helpful to have someone from the Scholars Program ensuring things were on track;
- Give more advance notice for students to find professors willing to mentor them, and for the application process itself;
• Extend the time period from 12 to 16 weeks;

• Consider a source of extra funds for supplies, travel to conferences;

• Provide additional programming in the form of research skills sessions (including a session on grad school) as well as a ‘meet the researcher’ series. Events such as these as well as networking and social opportunities where the students in the URI Scholars Program have the opportunity to meet each other and meet established researchers would definitely enhance students’ experience;

• Supplement the Workshops, for example:
  o Writing abstracts
  o Creating poster presentations
  o Research skills
  o Graduate School

• Include opportunities for more than one student to work on a project;

• Include opportunities for multi-disciplinary collaborative projects;

• Advertise the program more widely;

• Better communication about all participants, not just a few scholars, as exemplified in the comment from the following student that “Some URI scholars were highlighted in the Newsletter of City University, but it was not extensive coverage, nor did it deliver a comprehensive look at the entire group of research project” (C2010DCJCFR1);

• Smooth out the administrative difficulties around contract and time-sheet reporting
• Consider providing research exposure within a secondary school environment to encourage high school students to become more engaged in the R&D sector of the future.

• Small breakout groups of students from different disciplines with a faculty facilitator to brainstorm about interdisciplinary approaches to a problem.

One institutional consideration is where to situate the organizational and administrative responsibility for the program – at the centre or in the faculties. The goals of the URI program went beyond the learning outcomes that might result from discipline-specific individual research projects (conducted at the departmental and faculty level), and sought to incorporate knowledge and understanding of the broader principles of good research practice. The compulsory workshops that were held in order to provide this meta-layer overview were centrally organized and coordinated with input from faculty Associate Deans of Research. There were a number of benefits to this approach, including exposure to the potential for interdisciplinarity, efficiency in delivery (holding one workshop instead of one for each faculty) and networking.

Another reason for locating the URI program in the Office of the Vice President, Research and Innovation, was that in this study, I was particularly interested in the extent to which learning outcomes as a result of participation in the URI program met provincially-mandated learning outcomes, since presumably these would be reflected in faculty, departmental and program level planning to varying degrees. In addition, the administration wanted a discrete program whereby the students imagined, committed to, and led the project
as ‘researchers in training’. We didn’t consider making it for credit as there are many issues surrounding credit courses that we didn’t want to interfere with the experiment (pressure on marks; lack of personal input into the topic; time commitment of other courses; the fact that we were paying them to participate). If a course credit was given for participation in the program, then there would need to be a different kind of involvement at the departmental level to ensure that expected learning outcomes were achieved.

5.3 Theory and Research

A potentially limiting feature of the URI program is that it chose the most elite students and then gave them a scholarship to carry out their projects. While the success of this initiative was based on the perceptions of a highly select group of students, the majority of learning outcomes, including teamwork, importance of mentorship, practical skills and self-awareness, were not in traditional academic areas, and seemed to be discipline-independent. If there were not positive outcomes for these students then it would be less encouraging to extend the model to others. Further research is needed to provide the data to show whether research programs geared to the appropriate level would have learning outcomes that satisfy the criteria as well.

Experiential learning theory, a hands-on approach to learning, is often looked down upon as far too practical for the academic mind, but experiential learning theory is more than a teaching methodology. It is an approach to learning rooted in personal discovery. Findings from this study are confirmatory of experiential learning theory, and show that there is harmony in its ideas, and significance in its results.

One of the problems that I encountered during this study was the lack of a common
framework in the literature to describe and report skills and learning outcomes. There is a need for better coordination among key stakeholders and assessment developers in aligning expectations and outcomes. Programs are being evaluated to determine whether they produce certain outcomes, but there is no systematic, organized methodology for the assessment of whether the expected outcomes are being achieved.

Based on my own informal survey of university offerings for undergraduate research opportunities, I found an enormous variation in how undergraduate research opportunities are designed, administered and funded. There is a plethora of ideas that need to be shared in order to create the best undergraduate research experience possible. From my investigations, it does not appear that any formal assessment of student learning outcomes as a result of participation in the programs has been undertaken in Canada at the departmental, faculty or institutional level. I would therefore strongly recommend that a coordinated effort be made to validate learning outcomes from undergraduate research experiences, especially in the Social Sciences and Humanities, to ascertain and follow best practices in program design and execution in a coordinated manner across provinces. I also think that universities should investigate including these types of experiences on transcripts even though they are not part of the curriculum.

The URI program, or something like it, if recreated at another institution, should endeavour to facilitate more interdisciplinary discussion among the participants. This is an unexplored area, and strides could be made to introduce the idea of interdisciplinarity into the thinking of undergraduate students.

City University comprises a diverse student population. One study that I think would be particularly interesting is to see whether there are advantages tied to experiential learning from
an undergraduate research opportunity that decreases the effects of a language barrier. In other words, by doing something, do they learn better than by reading or hearing about it because of language barriers.

One immediate need, based on the fact that this is the first study of its kind in Canada, is that policy makers should consider further evaluation of learning outcomes, not only from programs, like the URI, which are outside the curriculum, but of other experiential programs as well. A stronger evidence base will ensure better decision-making and program design. Further research is needed to determine how many students did go to graduate school and the impact of the research experience on that decision. The role of faculty in mentoring students is central to the initiative, and one of the limitations of the study is the fact that no data was sought from the faculty on their satisfaction with the initiative, their assessment of student learning outcomes, as well as their sense of the outcomes for their work as researchers.

5.4 Specific Recommendations

1) Create a Canadian Council on Undergraduate Research that would bridge all three Canadian granting councils.

2) Collaborate with the Council on Undergraduate Research (CUR) in the United States to take advantage of the wealth of research that can inform our own practices.

3) Canada should create a policy framework to guide program development.

4) The Social Sciences and Humanities Research Council of Canada (SSHRC) should join NSERC and CIHR in establishing undergraduate research programs.

5) A coordinated effort should be made to validate learning outcomes from undergraduate research experiences, especially in the Social Sciences, Humanities
and Fine Arts.

6) Institutions should establish a way to reflect the value of non-curricular research programs to enable participating students to market and leverage their experience.

Learning is not a static event; it is an ongoing cycle of observation, experimentation, analysis and application where abstract theory and concrete activity collide. This research study sought to determine and analyze the scope and diversity of learning outcomes resulting from an undergraduate research experience across a broad range of disciplines. The case study suggests the value of participation in such an undergraduate research initiative, and extends current research by examining and comparing perceived learning outcomes within a multidisciplinary environment. The main findings are aligned with principles of best practice that encourage active learning, meaningful contact between students and faculty, and committed engagement from both, demonstrating that these principles hold true across many disciplines. The study further shows the extent of the positive impact of undergraduate research on students across all disciplines represented in this study. The findings also suggest that participation in undergraduate research could lead to learning outcomes that not only substantially meet the undergraduate degree level expectations as outlined in Ontario’s Quality Assurance Framework, but that can help the student develop workplace-identified skills that are in demand by employers. University initiatives, government policy and business investments need to find a common platform to work collaboratively to promote success for future generations of graduates. After two centuries of scholarly research, it is time to coordinate efforts in a systematic way, benchmarked by best practices, to reap the benefits that undergraduate research can offer.
Reference List


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APPENDIX A

Undergraduate Research Initiative (URI) Scholars

Program Guidelines and Application Form
Undergraduate Research Initiative (URI) Scholars Program

APPLICATION GUIDELINES:

Eligibility

The Principal Investigator (PI) of the project must be a City University full-time tenured or tenure-track faculty member, who will provide required space and equipment for the URI Scholar.

Applicants must be City University students and meet the following criteria:

- Cumulative GPA of 3.5 or above
- Preference will be given to students who have completed the equivalent of at least two full years of study at the time the award is held and plan to continue studies in Fall 2010
- Canadian citizenship or a valid student work visa for the full Summer term
- Program report submission on or before September 15th

Value and Duration

Each URI Scholar will receive $5,000 for a 12-week period.

Evaluation and Selection of Proposals

A review panel will evaluate all applications and select the winning proposals through a competitive process. To assess the overall quality of the proposal, the committee will consider the following:

- The overall completeness and clarity of the proposal;
- The involvement of undergraduate students in an appropriate level of SRC activity that contributes in a meaningful way to the advancement of the project.

Research Project Description

Provide a brief outline of the proposed project. Describe how the proposed project relates to any SRC initiatives currently underway, or, if it is a new initiative, how it will further the SRC of the PI, the Department/School and the Faculty; how the initiative will be sustained at the end of the grant period; how undergraduate students will be involved in the project in a meaningful way, including their relationship with other participants; and how the outcomes of the research will be shared with others, including other undergraduate students.

Application Deadline

A completed application form must be submitted by March 31st, 2010.
Office of the Vice President, Research and Innovation  
Undergraduate Research Initiative (URI) Scholars Program  
Application Form

### Undergraduate Student Information

<table>
<thead>
<tr>
<th>Family name:</th>
<th>Given name:</th>
<th>Student Number:</th>
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<table>
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<tr>
<th>Current Address:</th>
<th>Permanent Mailing Address (if different from current address)</th>
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<th>Email address:</th>
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### Academic Background

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<th>Faculty and Department:</th>
<th>Cumulative GPA:</th>
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</table>

How many academic terms will you have completed towards your degree program when this award is held?

### Signature

I hereby agree to abide by City University policies and regulations governing awards

Student

### Supervisor Information

<table>
<thead>
<tr>
<th>Name and Title:</th>
<th>Faculty and Department:</th>
<th>Email:</th>
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</table>

### Proposed Research Project

<table>
<thead>
<tr>
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<th>Proposed Start Date:</th>
<th>Proposed End Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

Description of proposed research project (See Application Guidelines). Additional pages may be attached.

### Signature

I hereby certify that the student will participate in research and development activities during the proposed period of tenure.

Signature of proposed supervisor  
Printed name and signature  
Head of department
APPENDIX B

Undergraduate Research Initiative (URI) Scholars

Program Final Report Form
# City University Undergraduate Research Initiative (URI) Scholars Program

## Final Report Form

### A: Personal Information

<table>
<thead>
<tr>
<th>Name:</th>
<th>Email Address:</th>
<th>Student Number:</th>
<th>Faculty:</th>
<th>Department:</th>
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<table>
<thead>
<tr>
<th>Name of Supervisor:</th>
<th>Start Date:</th>
<th>End Date:</th>
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</table>

Title of Research Project:

PLEASE RESPOND TO EACH OF THE FOLLOWING QUERIES USING AS MUCH SPACE AS YOU REQUIRE

### B: Description of Research Activities

Please provide a description of the research project in which you were involved, and your role within it

Were you involved in submitting or preparing any publications or proposals for presentation at any conference or symposium? If so, please list below.

### C: Account of personal experience in the URI Scholars Program

What have you learned from this experience?

How has this experience focused or changed your ideas about research?

a) Were you considering graduate studies before taking part in this program?

b) Are you considering graduate studies after taking part in this program?

If applicable, explain how this experience has affected your decision regarding graduate school.

### D: Future Opportunities

Would you be interested in attending an event that would bring together all of the URI Scholars?

Would you be interested in an opportunity to display or present elements of your research results at such an event?

### E: Feedback

Please provide any feedback, comments, or recommendations you may have that would be beneficial to improving future rounds, and further experiences.
APPENDIX C

Student Questionnaire
A Case Study of the Perceptions of Student Participants in the Undergraduate Research Opportunities (URI) Initiative at City University

QUESTIONNAIRE

The research will be carried out in accordance with the University of Toronto and City University ethical standards for research. Participation or non-participation in this study will not affect your status in the program now or in the future. You are free to decline to answer any question(s) or withdraw from this study at any time without explanation or penalty of any kind. Because the questionnaire is anonymous, however, once it has been submitted, then withdrawal from the study to remove data cannot be done at a later time. All data will be securely stored and accessible only to the principal investigator, and all data will be completely deleted/shredded five years after completion of the study. No participant will be identified or so described as to be identifiable in any reporting of the findings.

1) In what year did you take part in the URI Scholar program?

2) Gender – male, female, other

3) How many academic terms had you completed towards your degree program when you held the URI award?

4) In which Faculty were you enrolled when you applied for the URI Scholarship?
   a. Arts
   b. Design and Communication
   c. Community Studies
   d. Engineering, Science & Architecture
   e. Business and Management

5) In which discipline were you studying when you applied for the URI Scholarship?

6) Why did you apply for the URI Scholarship?
   a. Summer employment
   b. Hands-on experience
   c. Interest in future graduate studies
   d. Curiosity about a specific research topic
   e. Useful for future employment
   f. Other

7) What, if any, were your expectations of the URI experience?

8) Was the URI experience successful in meeting your expectations?

9) If applicable, did the URI experience provide you with useful workplace skills?
The following is a list of Ontario undergraduate degree level expectations. To what extent did the URI program contribute to the development of your skills in the following areas? Please check all that apply.

| 1. Depth and breadth of knowledge | a) Developed knowledge and critical understanding of the key concepts, methodologies, current advances, theoretical approaches and assumptions in a discipline overall, as well as in a specialized area of a discipline  
b) Developed understanding of many of the major fields in a discipline, including, where appropriate, from an interdisciplinary perspective, and how the fields may intersect with fields in related disciplines  
c) Developed ability to: i) gather, review, evaluate and interpret information; and ii) compare the merits of alternate hypotheses or creative options, relevant to one or more of the major fields in a discipline  
d) Developed, detailed knowledge of and experience in research in an area of the discipline  
e) Developed critical thinking and analytical skills inside and outside the discipline  
f) Ability to apply learning from one or more areas outside the discipline |
| 2. Knowledge of methodologies | An understanding of methods of enquiry or creative activity, or both, in their primary area of study that enables the student to:  
a) evaluate the appropriateness of different approaches to solving problems using well established ideas and techniques; and  
b) devise and sustain arguments or solve problems using these methods; and  
c) describe and comment upon particular aspects of current research or equivalent advanced scholarship. |
| 3. Application of knowledge | The ability to review, present and critically evaluate qualitative and quantitative information to:  
a) develop lines of argument;  
b) make sound judgments in accordance with the major theories, concepts and methods of the subject(s) of study;  
c) apply underlying concepts, principles, and techniques of analysis, both within and outside the discipline;  
d) where appropriate use this knowledge in the creative process;  
The ability to use a range of established techniques to:  
a) initiate and undertake critical evaluation of arguments, assumptions, abstract concepts and information;  
b) propose solutions;  
c) frame appropriate questions for the purpose of solving a problem;  
d) solve a problem or create a new work;  
e) to make critical use of scholarly reviews and primary sources. |
<table>
<thead>
<tr>
<th>4. Communication skills</th>
<th>The ability to communicate information, arguments, and analyses accurately and reliably, orally and in writing to a range of audiences.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Awareness of limits of knowledge</td>
<td>An understanding of the limits to their own knowledge and ability, and an appreciation of the uncertainty, ambiguity and limits to knowledge and how this might influence analyses and interpretations.</td>
</tr>
</tbody>
</table>
| 6. Autonomy and professional capacity | Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring:  
   a) the exercise of initiative, personal responsibility and accountability in both personal and group contexts;  
   b) working effectively with others;  
   c) decision-making in complex contexts;  
   d) the ability to manage their own learning in changing circumstances, both within and outside the discipline and to select an appropriate program of further study;  
   e) behaviour consistent with academic integrity and social responsibility. |

11) Please indicate any learning outcomes from your participation in the URI initiative that may not have been covered above, or that you feel are particularly important outcomes from this research experience.

**Interviews:** I would like to interview several students from each cohort. If selected, would you be willing to participate in an audio-recorded interview? If so, please send a separate e-mail to l.vranic@mail.utoronto.ca

**Compensation:** If you wish to enter a draw for a new iPad once you have completed the questionnaire, simply send your contact information to me separately at l.vranic@mail.utoronto.ca. I will not be using any personal information in any way other than for the draw and will not contact any of the participants except to advise the winner of the draw.
APPENDIX D

Letter of Invitation and Consent
July 22nd, 2013

**Title of Study:** A Case Study of the Perceptions of Student Participants in the Undergraduate Research Initiative (URI) Model at City University

**Researcher:** Linda Vranic, B.A., M.Ed., Ph.D. (Candidate); Department of Leadership, Higher and Adult Education; University of Toronto lvranic@mail.utoronto.ca

**Thesis Supervisor:** Katharine Janzen, Ed.D. Coordinator, M.Ed. in Higher Education Leadership, Leadership Higher and Adult Education Department, OISE/UToronto katharine.janzen@utoronto.ca

**Purpose:** This study is designed to identify and assess the impact of the URI program at City University and improve our understanding of the expectations and learning outcomes of this model of undergraduate research experience.

Dear URI Scholar:

I am conducting this research study in partial fulfilment for my Ph.D. degree under the supervision of my thesis supervisor, Dr. Katharine Janzen.

I am contacting you, as a current or former URI Scholar at City University, to invite you to participate in a research project - A Case Study of the Perceptions of Student Participants in the Undergraduate Research Initiative (URI) Model at City University – to identify the program’s impact and increase our understanding of the expectations and outcomes of the URI program at City University. Before you give your consent to be a volunteer, it is important that you read the following information and ask as many questions as necessary to be sure you understand what you will be asked to do.

The research will be carried out in accordance with the University of Toronto and City University ethical standards for research. Participation in this study is entirely voluntary; participation or non-participation in this study will not affect your status in the program now or in the future. You are free to decline to answer any question(s) or withdraw from this study at any time before you submit your responses, without explanation or penalty of any kind. Because the questionnaire is anonymous, however, once it has been submitted, it will not be possible to remove your data. All data will be securely stored and accessible only to me and my thesis supervisor, and all data will be completely deleted/shredded two years after completion of the study. No participant will be identified or so described as to be identifiable in any reporting of the findings.
Your comments, insights, and general feedback will help in the assessment of the value of undergraduate research in the curriculum across a wide array of disciplines. The study involves an online questionnaire to all successful undergraduate students who have been named URI Scholars since the initiation of the program in the summer of 2010, to determine the impact of the URI program including meeting student expectations and facilitating learning outcomes. It is anticipated that completion of the questionnaire will take approximately 20-30 minutes.

**Risks or Discomforts:** The questions will ask you to recall your personal experiences with the URI program. Questions may recall negative feelings or an array of emotions, but you do not need to answer any questions if you choose not to.

**Benefits:** Students are increasingly relying on post-secondary education to help prepare them for the workplace and postsecondary institutions are interested in developing the most effective programs to accomplish this goal. The URI Scholars program at City University is unique in its approach because it is cross-disciplinary in practice, yet homogeneous in learning outcomes. This study seeks to assess the impact of this specific program based on your own observations, and it is hoped that your experience can be used to benefit more students like yourself.

**Questions:** If you have any questions about the research, please contact Linda Vranic l.vranic@mail.utoronto.ca or Dr. Katharine Janzen katharine.janzen@utoronto.ca or 416 978-1232

If you have questions regarding your rights as a human subject and participant in this study, please contact the Office of Research Ethics at City University or the University of Toronto dean.sharpe@utoronto.ca

**Please indicate your consent to participate:** I have read and understand the Information Letter to Students and the above comments and I agree to participate by completing and submitting the questionnaire.

- [ ] Please click here to begin the survey
- [ ] I do not wish to participate in any way
APPENDIX E

INTERVIEW CONSENT FORM
Interview Consent Form

URI Scholar:

Thank you for participating in the questionnaire for the research project - A Case Study of the Perceptions of Student Participants in the Undergraduate Research Opportunities (URI) Initiative at City University. Before you give your consent to be a volunteer, it is important that you read the following information and ask as many questions as necessary to be sure you understand what you will be asked to do.

The research will be carried out in accordance with the University of Toronto and City University ethical standards for research. Participation or non-participation in Phase Two will not affect your status in the program now or in the future. You are free to decline to answer any question(s) or withdraw from this Phase of the study at any time without explanation or penalty of any kind.

**Investigator:** Linda Vranic, B.A., M.Ed., Ph.D. (Candidate); Department of Leadership, Higher and Adult Education; University of Toronto l.vranic@mail.utoronto.ca  Thesis Supervisor: Katharine Janzen, Ed.D.  Coordinator, M.Ed. in Higher Education Leadership, Leadership Higher and Adult Education Department, OISE/UToronto katharine.janzen@utoronto.ca

**Purpose:** This study is designed to identify and assess the impact of the URI program at City University and improve our understanding of the expectations and learning outcomes of this model of undergraduate research experience. The purpose of the interview is to provide additional perspectives and deeper insights into the effectiveness of the program and its impact on participants. Your comments, insights, and general feedback will help in the assessment of the value of undergraduate research in the curriculum across a wide array of disciplines.

**Description:** This phase of the study involves an interview which will take between 30 and 60 minutes. The interview will be held at the Department of Leadership, Higher and Adult Education, OISE, 252 Bloor Street West, 6th and 7th Floor or a similar location that provides privacy unless you request another location. The interview will be audio recorded to ensure accuracy of recording your responses. During the interview you will be asked about your experiences with the URI program. You will have an opportunity to review the transcript and make any changes you wish.

**Confidentiality:**
All data will be securely stored and accessible only to the principal investigator, and all data will be completely deleted/shredded five years after completion of the study. No participant will be identified or so described as to be identifiable in any reporting of the findings. Participant names will not be used and their identity will not be revealed. Participants will be asked for consent for the use of direct quotes using codes or pseudonyms.

**Risks or Discomforts:** During the interview we will discuss your personal experiences with the URI program. Questions may recall negative feelings or an array of emotions, and you do not need to answer any questions if you choose not to.

**Benefits:** Students are increasingly relying on post-secondary education to help prepare them for the workplace and postsecondary institutions are interested in developing the most effective programs to accomplish this goal. The URI Scholars initiative at City University is unique in its approach because it is cross-disciplinary in practice, yet homogeneous in learning outcomes. This study seeks to assess the impact of this specific programme based on your own observations, and it is hoped that your experience can be used to benefit more students like yourself. You may not gain any direct benefit from participating in the interview.

**Questions:** If you have any questions about the research, please contact Linda Vranic l.vranic@mail.utoronto.ca or at either 416-978-4126 or 647-929-6757 or Dr. Katharine Janzen Katharine.janzen@utoronto.ca or at 416 978-1232.

If you have questions regarding your rights as a human subject and participant in this study, please contact the Office of Research Ethics at City University or the Office of Research Ethics at University of Toronto (dean.sharpe@utoronto.ca)

**Please indicate your consent to participate:** I have read and understand the Interview Consent.

O I agree to be interviewed

O I agree to have the interview audio-recorded

Signature of Interviewee    Signature of Interviewer

Date

Please keep a copy of this form for your records
APPENDIX F

INTERVIEW QUESTIONS
URI Interview Questions

1. What were you hoping to gain from taking part in the URI Scholarship Initiative?
   a. Did you have any preconceived notions?
   b. Did your expectations change once you had spent some time in the programme?

2. To what extent and in what way did the URI experience teach you skills that you had not gained from undergraduate courses in the curriculum?

3. What did you find to be the most challenging or frustrating aspect of this learning experience?
   a. Would you say that you met the challenge?
   b. If so, how did you do this?
   c. If so, did you gain confidence in skills? In abilities?

4. What did you find to be the most beneficial aspect of this learning experience?

5. Did you learn any lifelong skills? Workplace skills?

6. Did you find the Workshops useful?

7. Did you apply to graduate school?
APPENDIX G

LEARNING OUTCOMES BY FACULTY AND DISCIPLINE AS REPORTED BY PARTICIPANTS IN THEIR FINAL REPORT
ARTS (38 responses/9 disciplines)

Arts & Contemporary Studies

C2010DACSFR1
In-depth knowledge of the specific field of study
Knowledge of related fields
Self-motivation
Time management
Improved research skills
Resource searching such as search terms, leads, databases and library catalogues

C2010DACSFR2
Preparing a curatorial proposal
The importance of dialogue as well as books
That research can be intuitive and shifting
Importance of following creative threads
Importance of exploring cultural intersections
Created a program to connect artists in similar fields

Criminal Justice & Criminology

C2010DCJCFR1
In-depth knowledge of the specific field of study and related areas
Exposure to an alternative for justice focusing on healing and peacemaking, attempting to identify and address the root causes rather than effects
Understanding concept of restorative justice
Challenges of measuring concepts and definitions
Challenges of translating policies into positive impact
Disconnect between policy makers and communities
Cultural awareness
Hard skills such as use of computer programs such as Endnotes, Adobe Professional Software
Literature searches
Learning to navigate the library website and catalogue
How to develop an electronic database
Bibliographic organization

C2010DCJCFR2
Improved research skills in field of study
Improved analytic skills, Analysis of documents to answer criteria questions, Case study analysis
Confidence in skills
Patience
Importance of looking at problem from more than one perspective
How to implement human rights directly into strategy, policy, processes and procedures, communications, training, measuring impact and auditing, as well as reporting
Learned that interests in two areas could be combined into one career
Impact of technology on day-to-day practice

Economics

C2010DEconFR1
Knowledge of new databases
Significant knowledge gain on topic

**C2010DEconFR2**
Collecting of data
Data Analysis
In-depth knowledge of the specific field of study
New sources of databases
Expanded research skills
More comfortable with computer programs such as Excel
Improved writing skills
Learning to navigate the library catalogue and access scholarly articles
Discovering new databases
Organization of data
How to conduct a literature review
Synthesizing information
Capturing main ideas
Extracting important information
Extracting relevant information

**C2010DEconFR3**
That research is a slow and precise building process
Importance of a clear and logical theory on the subject
Importance of valid, unbiased information
Process of research (issue to results, to importance of reproducing results)
In-depth understanding of research subject
Importance of record-keeping
Most important is the improvement in organizational skills

**C2011DEconFR1**
Improved research skills
Use of common search engines
Familiarization with databases in area of study
Manipulating access database software
Real world experience through working with supervisor

**C2011DEconFR2**
More in-depth knowledge of subject area
Building theoretical models
Analytical skills
Use of software
Improved logical thinking
Broader knowledge in the field of statistics
Systematic approach to problem-solving
Attention to detail

**C2011DEconFR3**
In-depth knowledge of field
Data analysis
Efficiency and effectiveness while searching databases
Necessity and Importance of lit reviews
Exposure to academic language
Building economic models
Time management

**C2011DEconFR4**
Knowledge of own field as well as the broader research area
Familiarity with major economic data sources
How to organize and classify Data
Improvement in Excel and E-view
Data Analysis skills

**C2011DEconFR4**
Relationship of research to experience
Wealth of new Knowledge about specific field of research
Literature review
Data analysis
Scholarly writing skills
Research skills
Better sense of work that will be required in grad school or as a professional economist

**English**

**C2010DEnglFR1**
Performing research on scholarly editing
Writing textual summaries
Checking transcribed manuscripts against original documents
Using library resources
Photocopying
Formatting footnotes
Creating a bibliography
How editorial decisions impact the meaning of a work and how it is received
In-depth knowledge of the field of study

**C2010DEnglFR2**
I do not feel that I developed any new skills or knowledge from the work I did” 2010

**C2010DEnglFR3**
Digital encoding with Extensible Markup Language (XML)
Pictorial Mark-up
Development of a standardized vocabulary set
Editing
Basic cataloguing
Coding for content analysis
Analysis of research field
Working with Archival documents and copy-editing
The importance of asking for help or clarification
Improved communication skills
The importance of details and consistency
Bibliographic searches
Improved proof-reading skills
Improved organizational skills

C2010DEnglFR4
How to do an environmental scan for up-to-date knowledge
How an idea can turn into a research project and then be funded
Dynamics of the supervisor/student relationship
The importance of asking questions for direction
Patience
Understanding that one does not know what will be found in the process, if anything

C2011DEnglFR1
Knowledge of specific field of study
Teamwork – sharing with and learning from community of academic colleagues

C2011DEnglFR2
Knowledge of specific field of study
Rules and methodologies of the field
How to physically prepare a transcription document
Strengthened writing skills
Archival skills

Geography

C2011DGeoFR1
Knowledge of specific field
Knowledge of broader field
Self-discipline
Time-management
Goal-setting
Critical thinking
Gained valuable work experience

C2012DGeoFR1
Field work skills
Non-linear regression and geospatial statistics
Data analysis
Skills that will help in career
Independence
New computer software programs
Mapping tasks
Hands-on experience
Statistical abilities
Time management
Stronger writing skills

History

**C2010DHistFR1**
- In-depth knowledge
- Expanded knowledge of the field
- Efficient ways to document and store data, setting up filing systems
- How to use new computer programs such as Dropbox
- What goes into submitting an article through peer-review
- Sense of accomplishment and pride

**C2010DHistFR2**
- Literature searches
- Annotated bibliographies
- Writing summaries and overviews of content and significance to a project
- Organizing timelines
- Deeper understanding of qualitative research methods
- Critical inquiry
- Data Collection
- Synthesis
- Organization
- Presentation skills

Politics and Public Administration

**C2010DPPAFR1**
- Need for burden of proof required to publish a research paper on a subject
- Importance of impartiality in research
- Primary source investigation
- Photocopying

**C2010DPPAFR2**
- The value of teamwork
- Importance of researching both sides of an issue to come to a more complete conclusion
- Time management skills
- Organizational skills
- Identifying key information to keep focused and clear

**C2011DPPAFR1**
- Interview skills
- Improved scholarly writing skills
- How to generate new research ideas
- Data collection
- Richer understanding of the specific field

**C2012DPPAFR1**
- Literature Reviews
- Interview skills
Data entry
Transcription
Data analysis
Personal growth
Helped academic career
First-hand experience
Expanded depth and breadth of academic knowledge
Improved research skills
Broadened knowledge of field
Hands-on experience
How this subject matter fits into the wider policy framework
Self-assurance
Confidence
Confirmation of career path
Independence
Teamwork

Psychology

**C2010DPsychFR1**
Data collection and input
Research ethics application
Collaboration with academics, other labs and professions
Community involvement
Assessment screenings
Develop new skills; hone old skills
Giving back to the community
How to take what is observed to pursue new research
Lifelong learning skills

**C2010DPsychFR2**
How to organize research
How to effectively gain and maintain subject participation
The value of an established and concrete methodology as the basis of research
Time management
That there are many facets of research and each has its pros and cons
Different systems of the brain involved in music and sound cognition
Expanded knowledge about field of research
Put into practice research skills learned in classes
File and data collection
Designing and maintaining the website

**C2010DPsychFR3**
Literature Review
Preparation of a grant application

**C2010DPsychFR4**
Process of undertaking a research project
Greater appreciation for the process of doing research
Designed procedures, including measures and questionnaires for participants
Script creation
Preparation of Ethics protocol
**C2010DPsychFR5**
Training in literature review
Research design
Statistical analysis using SPSS
Study results write-up
Improvement in written and oral communication
Improvement in critical thinking
Improvement in analytic skills
Importance of research for society
Learned that research is interesting
Teamwork
**C2010DPsychFR6**
How much work is required to create a study
How vast the field of Psychology and Law is
Saw research and field of Psychology from many perspectives
Developed clearer ideas and deeper understanding of factors behind real-world issues
More in-depth understanding of research
Stronger foundation of research experience
Examine future career goals and what role the skills learned might play
Scoring psychometric tests
Fundamental of grant applications
Literature search
Preparing Ethics Protocol
Devising procedures, including measurements to be carried out, questionnaires to be used
Created scripts used to teach participants the different cognitive techniques
Creator and performer of script used for study materials in order to make them more realistic
**C2012DPsychFR1**
Literature review
Data collection
Data analysis
Improved computer skills
Research Process
Confidence
Preparation before meetings
Organizational skills
Prioritization
Time management
Passion
Importance of creating hypotheses/theories
Preparation for workforce
**C2012DPsychFR2**
Research process
Literature review
Preparing and creating an ethics application
Data entry
Interviewing skills
Community engagement and recruitment
How to conduct telephone screens
Improved Excel skills
Improved computer skills
**C2012DPsychR3**
How to develop measures to evaluate constructs
Improved software skills
Project design
Data analysis
Knowledge of implicit measures
How to code responses
Data interpretation
Improved computer skills
Critical thinking
The importance of asking questions
Improved research skills
Confidence
**Sociology**
**C2011DSocFR1**
Ability to conduct secondary research
Data analysis
Adaptation skills
Patience
Attention to detail
Meaningful relationship-building
**C2012DSocFR1**
Data coding
Mentorship
Independence
Confidence
Initiative
Research is challenging and rewarding
Importance of documentation
Passion
**C2012DSocFR2**
Coding skills
How to develop a database
Data analysis
Manuscript preparation and writing
Enthusiasm
Importance of relationships with supervisor – mentorship
Confidence
Inspiration
Flexibility and open-mindedness - that research can take you in unexpected directions
Critical thinking
Adaptation
Improved research skills

DESIGN AND COMMUNICATION (15 responses/7 disciplines)

Dance
C2012DDanceFR1
Cultural awareness
Confidence
Self-knowledge
Inspiration
Perseverance

Fashion
C2011DFashFR1
In-depth knowledge of subject area
Learning about the research process overall
Unpredictability of research
Adaptation and adjustment skills
Patience
Time-management
C2012DFashFR1
How vast the field is & how little the participant knows
Improved research skills

Image Arts
C2010DIMAFR1
Proofreading skills
Report writing
Website creation
Blog maintenance
Video editing
New software
Subtitle translating
New computer programs such as Dreamweaver, JavaScript, HTML, CSS, Final Cut, Photoshop
Using the library efficiently
Organizational skills
Creating graphs
Cultural etiquette related to Indigenous communities
Community involvement
Awareness about Canadian politics involving the environment
Impact of water crisis
More effective research skills
Time management
Passion
Various skills that will be essential for future graduate studies
Organizing
Categorizing
Using proper formats for bibliographies

**C2010DIMAFR2**
Website updating
Diagram and sketch creation
Networking
Collaboration
Creation of a curated installation piece
Practical experience
Technical skills
Scholarly researching
Excitement of research
Hands-on experience
Discovery and meaning
Passion
Broadened scope
Analyse information
Building on prior knowledge

**C2010DIMAFR3**
Compiling extensive viewing notes
Applying for copyright and cultural clearances
Staff liaison
Networking skills with other researchers and curators
Understanding of the ethics and practices that govern research
Awareness of culturally-sensitive materials
Methods of Archival research
Literature reviews
Expanded knowledge of a specific field of history and theory
Greater practical skills in approaching research work
Enriched understanding of the field
Insight into contemporary and future applications
Exposure to new areas of the field

**C2011DIMAFR1**
How to write an ethics review application
How to work independently
Interview skills
In-depth knowledge of subject
Research process
Working with community
Importance of art in telling our past

Videography and video editing
Stereoscopic imaging and equipment
Hands on skills
Use of new camera equipment and editing equipment
Improved technical skills
Knowledge application

Generosity of people in sharing knowledge
Importance of mentor
In-depth knowledge of subject area

How to analyze and interpret news coverage
How to recognize bias
How to maintain objectivity in reporting
Technical skills such as Excel
Literature review
Methodological review
How to work with empirical data
Statistical Analysis

Coding for content analysis
Analysis
Run data tests with SPSS
Strategizing on running variables
Academic writing
Skills training with SPSS Analytical Software
Collaboration
The importance of brainstorming new and innovative ideas with a group of scholars in order to get the best possible results out of your research

Academic process
Improved research skills
Software use
Self-motivation
Time management
Mentorship
Media Arts

C2012DMediaFR1
Field research
Data searches
Independence
Motivation
Excitement of research and making new discoveries

Theatre

C2012DTheatreFR1
Cultural understanding
Performance artists can also be scholars
Intellectual depth
Manuscript preparation and writing
Time management
Juggling artistic, creative aspects with research
Creative growth
Intellectual growth
Enhanced understanding of subject area
Motivation
Interdisciplinarity
Confidence
Self-awareness
Personal growth

FACULTY OF COMMUNITY STUDIES (30 responses/8 disciplines)

Child and Youth Care

C2010DCYCFR1
Recruitment practises
Interview techniques such as semi-structured interview styles and probing skills
Audio tape transcription
Data analysis of interviews
Use of new software such as Nvivo
Coding transcripts
Identifying common themes in strategies, interventions and outcomes
Aspects of qualitative research, identifying themes and commonalities
Improved typing skills
Increased comfort level
Improved writing skills
Improved analytic ability

Disability Studies

C2011DDSFR1
Independence
Ethics review & standards
Connection between theory and experience
Sense of empowerment (confidence)

Early Childhood Education

**C2010DECEFR1**
- Transcribing interviews
- Database development
- Use of software such as PASW, Nvivo and RefWorks
- Data analysis
- Conducting and writing literature reviews
- Proposal writing
- Collaboration skills
- Teamwork
- In-depth knowledge of field of study
- Passion for research (while not explicitly stated, this idea of becoming passionate about something is a very strong theme)
- Strong understanding of qualitative techniques
- Strong understanding of quantitative techniques
- Knowledge of research process
- Ethics application
- Grant submissions
- Data collection

**Midwifery**

**C2010DMwFR1**
- Presentation skills
- Familiarity with databases
- Broader Perspective of midwifery in practice
- Exposure to current debates in the field
- Networking and relationship building

**C2011DMwFR1**
- Research skills
- Qualitative research
- Navigating the bureaucracy of institutions
- Importance of networking
- Time management
- Patience
- Collaboration skills
- Teamwork
- Community interaction
- Passion
- Role of research in professional practice
- Multidisciplinarity of approaches

**C2011DMwFR2**
- Sharing ideas with the community
- Importance of trust in research subjects
- Role of political and medical ideology in resolving issues
Lack of government funding
How to develop an interview guide
Ethics considerations
Consent forms
How to conduct interviews
Literature review

C2011DMwFR3
Flexibility in vision
Time management
Importance of a combination of quantitative and qualitative research
Literature Review
Interview recruitment
Conducting interviews
Coding
Data analysis
Sense of wonder for richness of research

Nursing

C2010DNursFR1
Broadened vision of research area
Importance of interdisciplinarity to understanding an issue
Consolidation of research knowledge gained from nursing research courses in qualitative and quantitative research
Theme identification
Improved skill with SPSS
Transcription of data
Analysis of themes
Development and organization of a pilot study
Research ethics approval preparation
Participant recruitment
Communication skills
Screening skills
Data coding
Data analysis
Teamwork

C2010DNursFR2
Community awareness
Reflective learning journal
Literature review
Translating research results into possible interventions
Working with multiple stakeholders to establish equitable community partnerships
Teamwork
Collaboration
Discipline
Working under pressure
Application of principles and concepts learned in previous undergraduate year
Motivation
Diligence
Literature review and evaluation
Focused vs. broad research
Patience
Open-mindedness
The importance of constant and clear communication
Importance of both qualitative and quantitative research
Critical thinking
Improved writing skills
Passion
Organizational skills
Use of new software such as RefWorks
Empowerment
Knowledge translation
Knowledge of research process in general
That research can be exciting
Putting evidence into action to influence social conditions
Self-evaluation of strengths and weaknesses
Observing community interaction
Difficulty of working with others when many opinions are involved
How collaboration between different individuals can be empowering and effective
Exposure to new topics
Cultural differences
Problem-solving skills based on supervisor’s feedback
How to collaborate with research team members and community members
Self-direction
Time management
Provided a skill set for success

C2011DNursFR1
Literature review
Ethics application
Survey design data analysis
Descriptive analysis for theme development
Research report writing
Recruitment methods
Results analysis
Collaboration
Professional behaviour
Empowerment
Open-mindedness
Motivation
Work ethic
Positive attitude towards challenging tasks
Confidence
Innovative attitude

C2011DNursFR2
Understanding the research process
How to organize data
Data analysis
Different methodological approaches
Close relationship with supervisor
Collaboration
Teamwork
Presentation skills
How to organize and prepare a manuscript for publication
Mentorship
Sharing ideas
Manuscript framework development
Writing process
Literature review and incorporation
Manuscript preparation

C2011DNursFR3
Personal growth
Professional growth
Learned of new opportunities for nurses
Research coordination
Creativity
Team building
Communication
Organization skills
Better understanding of research methodology
Confidence in skills and abilities
Ability to face fears (public speaking)
Ability to identify irrational ways of thinking
Community involvement
Meeting coordination
Survey feedback
Contributing to group discussion
Ethics board approval
Participant recruitment
Literature searches
Program searches
Note taking
Conducting Focus Group discussions
Getting participant consent
Improved academic writing
Wealth of knowledge in the field of research
Creating a RefWorks account
Conducting relevant literature searches
Creating zip-file
Creating Data extraction tables & performing data extraction
Planning meetings
Communication skills
Collaboration skills
Crafting qualitative research proposal
Submitting Ethics protocol
Participant recruitment
Developing interview questions
Conducting interviews
Transcribing interviews
Using qualitative software to code data
Qualitative data analysis
Finding funding
Applying for grants
Drafting abstract for conference
Presentation skills
Research process
Importance of mentorship
Personal growth
Confidence

Knowledge of field of research
Literature review and the immense amount of work required
Questionnaire design
Ethics approval
Data analysis
Learned more about the faculty
Learned more about research at City
Research process
Identifying the correct people to help
Improved writing skills
Improved research skills
Confidence
Passion
Self-awareness

Knowledge in field of research
Better understanding of how research fits into broader and global perspectives
Literature review
Development of interpretation and discussion sections of a manuscript
Qualitative methods of gathering information
Critical thinking
Inductive reasoning
Transcription of discussion
Theme identification
Created interview questions
Conducting Interviewing skills
Data retrieval
Use of new software to code and analyze qualitative data
Qualitative analysis of findings
Thematic analysis
Developed a coding frame
Theme identification
Coded transcripts
Critical thinking
How to develop scholarly arguments
Improved writing skills
Refined ethical knowledge
Use and application of conceptual frameworks
How to foster inter-professional intellectual collaboration for future independent practice
Manuscript preparation
Conducting focus group discussions
How to create a focused interview guide
Abstract thinking
Confidence
Professional skills
Time management
Collaboration
Importance of communication within and outside discipline
Interpersonal skills
Open-mindedness
Importance of taking into account multiple perspectives
Interdisciplinarity
C011DNursFR7
Thematic analysis
Collaboration
Improved scholarly writing skills
Data analysis and synthesis
Literature review, analysis and written discussion
Conceptual theoretical knowledge about the field
Understanding implications of specific research on broader issues
Breadth of information that is available
Research process
Publishing process
Qualitative data analysis and interpretation
Use of conceptual framework to guide interpretation
Improved French language skills
Motivation

**C2012DNursFR1**
- How to conduct a research project
- How to conduct a literature review
- Apply for ethics approval
- Create interview questions
- Interviewing skills
- Transcribing and coding data
- Professional behaviour (with a faculty member who was not teaching a course)
- Creativity
- Critical thinking
- Research process
- Relevance to career
- Community involvement
- Relationship building to facilitate recruitment
- Transcription of qualitative data
- Entering and coding quantitative data
- Analyzing quantitative data with SPSS
- Analyzing qualitative data for themes
- Teamwork
- Meeting protocol
- Data analysis
- Analyzing minutes to identify key points and preparing for next steps of research
- Proposal preparation for presentation
- Creating quantitative database

**Nutrition**

**C2010DNutrFR1**
- Operation of a purified MAA isolation methodology in the Food Science Lab
- Preparing, extracting, and filtering the seaweed extracts for the lipid oxidation assay
- Literature searches
- Knowledge of Environmental and Health Safety issues
- Risk management
- Due diligence strategies
- Cautionary labeling and handling of hazardous workplace materials
- Chemical safety
- How to establish a safe and responsible working environment
- Application of basic lab techniques previously learned from courses
- How to operate new equipment such as pH meter, vortex, sonicator, centrifuge, rotary evaporator, filters, water bath, spectrometer)
Learning new lab skills such as measuring and transferring various compounds) with accuracy and precision
n-depth knowledge and more thorough searches
Critical thinking skills
The importance of teamwork and its role in research
Personal growth
Professional Growth

C2010DNutrFR2
How to develop a research question
Literature review
Learned about developing effective search strategies
Survey content development
Completion of an Ethics protocol
Recruitment
Data collection
Research methodologies
Importance of planning
Importance of a well-defined research question of appropriate scope and specificity
How to navigate new databases
Survey design including concepts of survey mode
Knowledge about other research in the field
Emerging research methods and tools such as photo-voice
Participating in large teams (teamwork)

C2011DNutrFR1
Process of research design
Ethics review
Project management
Project design
Expanded knowledge of subject area
Literature review
Hands on experience

C2012DNutrFR1
Scientific writing
Importance of defining terms
Patience
Flexibility
Collaboration
Confidence

C2012DNutrFR2
Literature review
Efficient use of databases
Improved interviewing skills
Importance of mentorship
Self-discipline
Independence
Time management
Research skills
Passion

**Occupational & Public Health**

*C2010DOPHFR1*

- Literature search
- How to conduct risk and exposure assessments
- Data analysis
- Confidence
- Critical thinking
- Academic writing
- Research skills

**Social Work**

*C2010DSWFR1*

- Communicating with study participants
- Arranging and conducting in-depth qualitative interview
- Transcription
- Co-facilitating a focus-group
- Data analysis
- Presentation skills to partner agencies
- Meeting protocol
- Develop and enhance skills in qualitative research
- Develop writing skills; development of written materials
- Opportunity to work with community and disability rights organizations
- Deepened awareness of cultural barriers (immigrants with disabilities)
- Practical experience
- Technical skills in scholarly researching to build a prototype installation piece
- How to create a prototype from early research stages and manufacturing materials

*C2010DSWFR2*

- Major scholarly literature review
- Analysis of quantitative data with SPSS software
- How to do frequency and descriptive analysis
- Cross-tabulation
- How to input data into Excel sheets
- Data cleansing
- Assessing compliance data against new legislative standards
- Analyzed admission data
- Data entry, processing and analysis using SPSS software
- Exploration of large data sets with Risk Assessment, OnLAC & Child in Care Internal Review data
- Risk assessment tool validation
- Theoretical modeling of risk
- Outcome measurements
- Collaborating in a community research/quality assurance setting
Community engagement

**C2011DSWFR1**
Designing and creating a research proposal
Literature review
Ethics approval
Creation of interview questions
Data collection and analysis
Dissemination of findings
Thematic identification
Self-awareness
How to conduct qualitative interviews
Community involvement
Listening skills
I am a changed person from completing this research project
How to research for a major research project
Open-mindedness
Participant recruitment
Self-knowledge
Transcribing
Time management
Organizational skills
Patience
Importance of mentorship
Research process
Excitement about research
Sense of being able to impact communities and people with research

**C2011DSWFR2**
Critical and comprehensive literature review
Improved academic writing skills
Preparation of funding proposals
Abstract preparation
Preparing papers for publication
Identifying and applying for funding
Collaborative process of research
Interdisciplinarity of research
Excitement from being able to explore topics of interest to one’s self rather than a project determined by a professor
Passion for research
The evolution from research to best practice in clinical settings
That research is never “done”

**C2012DSWFR1**
New knowledge of the research field
Research process
Extensive literature review
Interview facilitation
Community engagement
Data collection
Data analysis
Theme identification
Critical discourse analysis
Participant recruitment
Practical applications of theory
Creation of new knowledge through practice
Critical thinking
Reflection & self-knowledge
Flexibility
Independence
Autonomy
Responsibility for own project
That research can be a fluid and changing process

C2012DSWFR2
Transcription
Theme identification
How to write a research proposal
Narrative approach
How to develop research questions
Literature review
Abstract writing
Critical thinking
Critical assessment
Wrote a blog about experiences
Hands-on experience
How to work independently
Practical applications of theory
Difference between learning about research and doing it
Confidence
Time management skills
Self-knowledge
More prepared for graduate school

C2012DSWFR3
Interviewing skills
Data analysis
Literature review
How to develop a research proposal
Ethics review
Behaviour with other academics and professionals
Professional decorum
Strong base of research skills
FACULTY OF ENGINEERING, SCIENCE AND ARCHITECTURE (37 responses/9 disciplines)

Aerospace

C2011DAeroFR1

Literature Review
Design and implementation of an experimental rig
Numeric simulation
New computer software tools
Academic paper presentation
Improved writing skills
Practical focus of theory
More sophisticated and specialized level of knowledge that is different from class or textbook
Hands-on experience with experiments
Experimental design
Problem-solving skills
Creativity skills
Value of mentorship
Mechanics and logistics of research activities
Confidence
Enthusiasm
Stimulated interest

Architectural Science

C2010DArchFR1

International experience
Cultural awareness
Engagement with communities
Surveys through photography and sketching
Collation methodology
Comparing results
Learning to record and study the design and building transitions of another culture
Extracting and compiling information
How to work in a foreign environment, with foreign people and cultures “It has been more than an excellent academic experience it has been a fascinating life experience.”
Learned more about individual process of design
Learned passion for research “I have learnt ... what it is I love about what I study and do”
Interaction with faculty both inside and outside the environment
Access to multiple points of view and opinions
Learning about and discussion of various facets of the research
Excitement of field research

C2011DArchFR1

Knowledge of field of research
Development and implementation of monitoring program
Instrumentation research
Fieldwork
Data acquisition
Data analysis
Developing protocols for raw data
Organizational skills
Importance of mentoring
Relationship between ideas and research

**C2011DArchFR2**
Knowledge of field of research
Critical analysis
Scholarly writing skills
Discovering different methods of research
Organizational skills
Exposure to the research field and beyond
Importance of following own interest in research
Critical thinking
Data analysis
Broader perspective

**C2012DArchFR1**
Literature review
Academic writing
Familiarity with several new computer-based programs
Independence (working independently)
Application of theory to practices
Self-knowledge

**C2012DArchFR2**
Literature review
Summarizing and extracting key points from the data
Teamwork
Collaboration within and outside the institution
How to build positive and professional relationships
Confidence
Better grasp of what is research

**Chemical Engineering**

**C2010DChemEngFR1**
Literature review and analysis
Measurements and calibration techniques
Conducting experiments
Working with new equipment
Patience
The importance of detail and precision

**C2010DChemEngFR2**
Literature Review
Proofreading publications
How to synthesize information from a number of sources
Dramatic improvement in writing skills
Time management
How to be more selective in identifying relevant publication

**C2012DChemEngFR1**
Sequencing methodologies
Gel synthesizing
Centrifugation operation
Data analysis
Preparing presentations
Academic writing
Independent research
Critical thinking
Original thinking
Decision-making ability
Operation of machinery
Confidence
Sharpened writing skills
Motivation
Strong relationship with supervisor

**Chemistry and Biology**

**C2010DChemBioFR1**
Learned new techniques such as emulsification, coacervation, spray drying, spray cooling and extrusion
How to build the foundation in order to grasp the concept
Improved perception and direction on how to work
What to expect as a graduate student
The Scientific method
Literature review
Gaps in personal knowledge
Interaction with fellow researchers
Presentation skills
Meeting protocol
Patience
In-depth knowledge of area of interest

**C2010DChemBioFR2**
Sample collection and extraction
How to make culture dishes
How to use a centrifuge
How to operate new machinery such as PCR
How to extract DNA from soil and water samples
How to use DGGE and Gel Electrophoresis
Patience
Useful lab skills

“Most importantly, I was able to make some connections between the theoretical and practical world.

Improved experimental lab techniques and learning new techniques such as Sublimation, reflux, vacuumed filtration, distillation methods

Understanding of knowledge and principles behind techniques

Chemical analysis

Filling liquid nitrogen tanks

Ensuring clean laboratory

How to work with new machines such as NMR and GPC

Analytical thinking

Critical thinking

Importance of recording every observation

Confidence-building

How to flame-dry glassware

How to handle mercury so as not to make mistakes

Calculation of yield of polymers

Working with air and water sensitive chemicals

Develop analytical thinking skills

Learn proper way of working with equipment such as lab scales, stands and heating devices

Preparing buffer solutions

How to carry out fluorescence spectroscopy on the prepared solutions

Data Search

Literature search

Analyze data

The importance of learning from other people’s experience

Knowledge from books and experience from reality can save lots of time

Frequent need to modify experimental procedures

Experimental outcomes sometimes contradict the hypothesis

In-depth knowledge of subject area

Patience “Lastly but not leastly, the first step was the most important step in an experiment. Even though the first step might take long time of research before actually carrying out the experiment, it was worthwhile the time spent.”

Importance of thorough research prior to beginning lab work

The importance of a literature review

Passion

Patience

Valuable life skills

Working cooperatively

Independence
Public speaking skills
Confidence
Real-world applicability of research
Hands-dirty
How to outline and prepare experiments
Data compilation
Data analysis

C2011DChemBioFR2
Practical knowledge about how research is conducted
Independence
Research process – clarity about what it is
How to use library resources effectively
Data analysis
Interpretation of results
Use of different techniques and processes - Quenching and extraction procedures; How to use common purification techniques in the laboratory; How to use different characterization techniques in the lab’ Proficiency in reading NMR data
Countless pieces of practical information
Collaboration
Knowledge of field and how it fits into a broader framework of study
Funding sources

C2011DChemBioFR3
In-depth knowledge of the field
Advanced biotechnological techniques “The techniques and methods I have learned here will stick with me for a long time…”
Confidence
Independence
Problem-solving
Improved communication skills
Improved teamwork skills
Professionalism
Patience
How each field fits into research as a whole
Excitement of research
Sense of accomplishment
Using theoretical knowledge to solve real life problems

C2011DChemBioFR4
Experience in new laboratory techniques
Valuable instruction, advice and ideas from team members
Importance of teamwork
Technical skills
Academic skills
People skills
Confidence
Diligence
Communication skills
Delegation skills
Time management
Experimentation
Observation skills
Prioritization
Improved writing skills
Optimistic and positive attitude
Hands-on experience

**C2011DChemBioFR5**
Data analysis
Data collection
Networking
Confidence
Responsibility
Strengthened use of common research software
Research process
Teamwork
Cooperation
Patience
Concentration
Great experience for work reference

**Civil Engineering**

**C2010DCivilEngFR1**
Reading and deciphering (interpreting) schematic and engineering drawings
Design criteria and upgrade recommendations
New software exposure such as FLUENT
Greater understanding of specific field
Preparing equipment and quantifying chemicals
Process of fermentation
Centrifugation
Exposure to environment of field and of lab
How to do an annual inventory of equipment, machinery and chemicals
Literature review
That research is a lengthy process
Trial and error
Problem solving skills
Perseverance
Need for accuracy in literature findings
Communication skills
Confidence “I have also discovered a great deal about what I am capable of and how I communicate with my peers and my mentors alike.”
C2011DCivilEngFR1
In-depth knowledge and training in area of study and broader engineering field
Teamwork skills
How to apply theoretical knowledge gained in past education to real projects
Efficient communication
How you connect theoretical and experimental knowledge
Need for precision in design and calculations
How to prepare a safe work environment
Specimen preparation
Cutting and placing reinforcing bars
Surface preparation
Mix design and concrete casting
How to prepare a water pressure chamber
Testing water pressure adequacy
How to conduct testing of specimens
Data acquisition, collection
Preparation of graphs and charts

C2012DCivilEngFR1
Developing scale models
Safety within the lab
Honed and developed interaction and group working skills
Teamwork
Hands-on experience
Use of machinery
ASTM codes for curing and testing concrete
Time management
Increased knowledge in field of research
Collaboration
Self-improvement

Computer Science
C2010DCompSciFR1
Widget design and development
Adding features to existing Android applications
Web development
Application development
How to integrate multiple technologies
Refined skills in Java, PHP, JavaScript and MySQL
Increased understanding of object models in software design and implementation
Working on a constantly evolving system showed the benefits and power of objects once they form part of a sound foundation in the object model

C2010DCompSciFR2
Perspective on application of theoretical knowledge to real world issues
Exposure to many more areas of study
Expertise in technologies such as Java (BlackBerry platform), in web technologies not year covered in classes such as AJAX, PHP, and Java Servlets
Preparation for future learning
How an individual contribution can directly affect the outcome of research

Electrical and Computer Engineering

C2010DECEngFR1
Fix and prepare tissues
Scan tissues
Fix after-scan tissues
Post-processing data and images
Analyzing images
Literature review
Organization skills
Patience “I learned that research is a very thorough job. It is not something that a person can accomplish in one night. It may take years or never to discover novelty medical tools.”
Detailed observation skills

C2011DECEngFR1
The importance of communication skills
Confidence
Experience in presenting ideas
Patience
Practical skills and use of simulation software and programming tools
Literature Review
In-depth knowledge of the research subject
Networking and connections

C2012DECEngFR1
Image processing
Data analysis
Improved writing skills
Expanded knowledge of subject area
Confidence

C2012DECEngFR2
How a research lab operates
Expectations of research
How to turn an idea into a study
Ethics application
Literature review
How to operate and test medical devices
Professional communication with physicians and academics

Mechanical and Industrial Engineering

C2010DMIEFR1
How to gather statistical data
Improved Excel skills
Teamwork
Familiarization with research environment
Using data to estimate future values
How to run energy consumption simulations using HOT2000 software

**C2010DMIEFR2**

How to acquire data
Data analysis
Mastery of measurement and analysis techniques
Comprehensive, in-depth understanding of field of research
That graduate level research can be both a challenging and highly rewarding experience

**C2010DMIEFR3**

How to segment images
Importing model into SolidWorks (CAD Software)
Design a surgical tool for knee implant
Finite element analysis using Abaqud
How to use different software for segmentation of a CT Image
Hands-on experience designing a surgical tool for installation of implant

Teamwork

**C2010DMIEFR4**

Enhanced knowledge of subject
Literature review
Investigated process of micromachining
Learned how to machine
Analyzed erosion data and characterized results using theories from published literature
Used new software such as SolidWorks to design and build an abrasive Jet wheel mechanism
How to characterize and assess surface profiles
How to use equipment to conduct experiments
Attained knowledge on how to use literary references and apply them to real studies
Acquired additional CAD experience

**C2011DMIEFR1**

New techniques
Research process
In-depth knowledge of area of interest
How to do research
Computer application skills

**C2011DMIEFR2**

Effective time management
Prioritization
Collaboration
Communication skills
Social skills
Teamwork
Improved writing skills
Confidence
Responsibility “the success of the project depends on my commitment to it rather than on grades”

Independent thinking
Creativity

**C2011DMIEFR3**
Understanding of the magnitude of commitment required
Importance of interpersonal skills
Collaboration “I was able to see how graduate students are exposed to opportunities for attaining experience in ways that are not possible during an undergraduate degree. I became more aware of how this would make them more attractive candidates for future employers.”

**Physics**

**C2010DPhysFR1**
Assist in experiments
Writing a code
Gather statistically relevant data for creating the algorithm.
Prepared set-up for experiments
Data gathering using new equipment such as a signal generator and oscilloscope
Meeting protocol
Provided input about data
Communication skills
Presentation skills
Wrote an instruction manual for rest of lab
Proficiency in MATLAB programming
Write functions, manipulate matrices and display them graphically
Principles of mixing chemical compounds
How to make gel phantoms
Importance of relevant results
Proficiency in testing equipment

**C2011DPhysFR1**
Cell culture
Apparatus set-up
Research process
Scientific method and how it works in real life
Problem solving
Teamwork
Collaboration
Communication skills
Technical skills
Data analysis

**BUSINESS AND MANAGEMENT (10 responses/7 disciplines)**

**Business Management**

**C2012DBMFR1**
Data collection
Literature review
In-depth knowledge of research subject
Improved writing skills
Improved excel skills
Organization
New software proficiency

Finance
C2010DFinFR1
In-depth knowledge in finance and M&A
Broad knowledge of real finance world

Literature Review
Identify relevant documents and summarize key arguments
Fundamentals of executing research in academia

C2011DFinFR1
Stronger computer skills
Editing
Availability of research tools and databases
Preparing and submitting scholarly papers

Global Management
C2011DGMFR1
Literature review
Survey construction
Data analysis
Community outreach
Research process
Project management
Creativity
Communication skills
Networking skills
Presentation skills

Hospitality and Tourism
C2011DHTFR1
Data collection
Data analysis
Literature review
Research process
Project management

C2012DHTMFR1
Independence
Literature review
Survey question and instrument design
Data collection
Data analysis
Improved writing skills
Importance of mentorship
Responsibility – taking ownership and control of a project
Presentation skills

Human Resource Management/ OB

C2010DHRM/ OBFR1
Data Collection
Analysis of results
Writing skills
Project Management
Communication and people skills
Data Analysis
Research skills
Project design and implementation
Time management
Prioritization
Exposure to new subject areas
Importance of feedback and alternative perspectives from more experienced people
Exposure to culture of legal profession
Confidence to approach new projects
How to prepare research papers

C2010DHRM/ OBFR2
Literature search and review
Identified salient files from Archives of Ontario
Knowledge of data sources
Importance of finding as many sources as possible due to varying connections between them

Information Technology Management

C2011DITMFR1
Literature review
Database creation
Enthusiasm (many students plan to work as volunteers in the lab beyond the term of the URI
Importance of understanding concepts
Pride in own research accomplishments
Respect for research and researchers
Passion
Dedication

Marketing

C2010DMFR1
Literature Review
Manipulating Variables
New sources of information such as social media
Experimental design
Creative aspects of research and design
Exposure to other researchers in the field
APPENDIX H

PROJECT TITLES
PROJECT TITLES

FACULTY OF ARTS
Arts & Contemporary Studies
Romanticism and the Nature of Things: Antiquity, Memory, Modernity
Sonic Poetry Live
Criminal Justice & Criminology
Community-Based Justice Alternatives in Nunavut
Application of Human Rights Impact Assessment to Selected Case Studies
Economics
International Environmental Agreements
The Rise of China as an Economic Power: Effects on Developing Countries
Understanding the Outsourcing of White-collar Jobs and Its Links to Education Policy
National Company Pollution Trends 1994-2009
Revisiting the Theory of Endogenous Merger Formation and its Application on the Recent Merger Wave
Institutions and the Welfare Effects of Trade: The Case of Canada and Mexico
Global Financial Crisis: Implications for the Canadian Rates and Market Dynamics
A Survey of Gender Inequality in Sub Saharan Africa – An Economic Perspective
English
Diary of Emily Holmes Coleman: Print and Digital Editions
The Collected Poems of Miriam Waddington
Launching the Yellow Book: Volume 2 & 3
Looking for Words to Spread the Word: Ideology and Lexicography in 19th century Canadian Mission Work
Launching the Yellow Book Online, Vol. 5
Transcribing the Unpublished War Journals of L.M. Montgomery
Geography
Retail Location Decision Support in Canada
Tracking Spatio-temporal Migration of an Invasive Tree Species in an Urban Woodland
History
Canada, the United States, and War: Twentieth-Century Conflict, Memory, and National Identity
Youth in Post-War British Political Culture c. 1945-1979
Politics and Public Administration
Canadian Election Study Auxiliary Data Collection
Research into Informal Caregivers in Ontario
Public Engagement Through ‘Crowdsourcing’/Orders in Council and the Early Federal Government
Psychology
Toronto Sound Map
Sequelae of Traumatic Brain Injury/NeUReIpsychological Profile of OCD
Getting U.N.S.T.U.C.K.
The Relationship Between Homophobic Victimization and Harassment During Childhood and Risky Sexual Behaviour in Adulthood Among Gay and Bisexual Men
The Role of Alibis in Wrongful Convictions
Assess and Suppress Vulnerability to Insomnia
Impact of Concrete and Abstract Thinking on Catastrophizing
Development and Validation of a New Indirect Measure of Body Satisfaction
Sociology
Changing Child Care Needs and Policies – Rural Ontario and Quebec
Victim’s Perceptions of the Criminal Justice System
Bylines By Her: Feminist Bloggers and Self-publishing in the Context of Women’s Journalism
History

DESIGN AND COMMUNICATION
Dance
Intersection Between Eastern and Western Choreography
Fashion
Universal Sleepwear Design Applications for Women with Lymphedema
Fashion Victims
Image Arts
Water is Lifeblood: History, Ecology and Sociology
When History becomes Histories and the private becomes public: How Amateur Films Pluralize Film Archives and Historiography
Analog Experiments and Sound and Light (Feel Sound Project)
Crisis in the Family Archive
Economies of Scale: Hallam Street
Designing Dynamic Form in 3-dimensions
Interior Design
Less Can Be More
Journalism
Politics and Framing of Child Care
Premediation
The ‘Beer and Popcorn’ Gaffe
Media Arts
Recreating Robb
Theatre
The Women in War Project

Faculty of Community Studies
Child and Youth Care
Assessing the Outcomes of Child and Youth Care Interventions: A Multi-setting perspective
Disability Studies
Documentary Film: Participatory Research
Early Childhood Education
Family Literacy Program for Preschool Children and their Mothers Living in a Residential Home
Midwifery
Keeping Birth Normal: The Experience of Three Toronto Midwifery Practices
Barriers to Maternity Care in the CE LHIN
Including Midwives and Consumers Voices in the Implementation of Midwifery Legislation in Newfoundland and Labrador
Homebirth Increases during SARS: Implications for Midwifery Skills in Ontario

Nursing
Evaluating an Intervention to Promote Psychological Well-being Across Three Populations: A Pilot Study
PHA Empowerment to Address Internalized HIV Stigma
Senior Nursing Students’ Perspectives Regarding the Potential Influence of a Mentorship Relationship with an Alumni Nurse Mentor on Students’ Sense of Self-efficacy
The Music Project: A Patient Concerto of Open-heart Surgery in the Key of Technology
Ontario Women Study HIV Prevention in Women: Community Champion HIV/AIDS Advocates Mobilization Project (CHAMP)
Students’ Perceptions of How Caring is Taught in Undergraduate and Post-diploma Programs in the Daphne Cockwell School of Nursing
Exploring the Perceived Needs of New Graduate Nurses
Philosophies and Experiences of Research and Social Development Projects in Global Health Contexts
Awaking Awareness of Health Literacy Issues of Francophone Linguistic-minority in Ontario, Canada
The Experiences of Student Volunteers on an Inner-city University Support Line

Nutrition
The Antioxidant Activity of Red Algal Constituents
Applicability of Psychotherapy Modalities to Nutrition Counseling
Is the Eating Well with Canada’s Food Guide for First Nations, Inuit and Métis an Appropriate Pedagogical Tool for Preparing Undergraduate Food and Nutrition Students to Work with Indigenous Peoples?
Storytelling as a Method of Diabetes Self-management
Promoting Inter-professional Education Among Food & Nutrition Students: Fostering a New Practice Paradigm

Occupational & Public Health
Human Exposure to Organochlorinated Pesticides Through Contaminated Soil

Social Work
The Experiences of Immigrants with Disabilities Who Consider Themselves Successful
Ontario Child Protection Transformational Analysis
Barriers, Challenges and Life Realities that Female Senior Psychiatric Survivors Face While Living in Supportive House in Parkdale
It’s Complicated: A Critical Re-theorizing of Grief, Loss and Madness
Social Work and Activism Amidst Neoliberal Restructuring: Documenting the Multiple Experiences of Grassroots Activists in a Time of Austerity
South Asian Narratives – The Experiences of Sponsored Seniors in the Canadian Health Care System
How Students Experience Social Justice-based Education in Online Format

Faculty of Engineering, Science and Architecture Science
Aerospace
A Novel Control Method for Hybrid Actuation System: Position Domain Control Implementation
Architectural Science
Studying and Informing Chinese Vernacular Sustainable Systems
Renovation 2050 (Student A)
The Architectural Draft
Renovation 2050: Towards a Sustainable Renovation Rating Index (Student B)
Application of Room Acoustics Metrics for Post-occupancy Evaluation of Classrooms
Chemical Engineering
Surface Modification of Selected Membranes by Ozone and Graft Polymerization
Pretreatment and Enzymatic Hydrolysis of Wheat Straw Lignocellulose
Effects of Mineralizing Agent and Co-solvent on Crystallization Behaviours of Zeolites
Chemistry and Biology
Mucoadhesion and its Application in Controlled Flavor Release
Effect of Pharmaceuticals on Waste Water Treatment Plants
Expression and Purification of MCEF
Synthesis and Characterization of Polymers that Incorporate Sulfur, Nitrogen in their Main Chain
Dual Fluorescence as a Nanoenvironment Probe: The Unusual Case of 3-Hydroxy-2-naphthoic Acid
Impact of Escherichia coli 0157:H7 (EHEC) exposure to bile that is encountered in the small intestine of the human gastrointestinal tract and enhanced resistance of EHEC to a standard human defense mechanism
Developing protocols for Radiolabelling Cystic Fibrosis Drugs
Engineering Genetic Tools to Dissect Molecular Mechanisms of Organelle Identity in Cells
Novel Chiral Oxazoline – Enolates
TRCA Sustainable Housing
Civil Engineering
Optimization of Hydraulic Design of Water Storage Reservoirs
Experimental Testing of Large RC Specimens Under High Water Pressure
ECC Link Slabs for Jointless Bridge Decks
Computer Science
Context Awareness in Public Transit Systems (2 Scholarships)
Electrical & Computer Engineering
Pathology Specimen Scanning and Data Analysis
Measurement of Effective Board Thermal Conductivity Using a High Performance Infrared Thermal Scanning System
Parameters of Lightning Strikes to the CN Tower
Combined VS and EM Guidance for Femoral Vascular Access
Mechanical and Industrial Engineering
Least Cost Analysis for the Canadian New Housing
Experimental Studies of Acoustics in Water-Flowing Pipe
Custom Surgical Tool Design for Bioresorbable Orthopaedics
Abrasive Jet Micromachining of Aluminum
Experimental Heat Transfer Measurement in Advanced Fenestration Systems
Image Feature Tracking for Vision-Based Control of Robotic Manipulators
Microstructure and Mechanical Properties of Rapidly Solidified Cast Aluminum Alloys

Physics
Real-Time Ultrasound Guided HIFU Therapy
Effects of Gold Nano Rods in Living Cells

BUSINESS AND MANAGEMENT

Business Management
Neighbourhood Effects in Toronto House Prices
Finance
Spin-offs and Shareholder Wealth
The Pattern of Foreign Market Entry of Canadian Exporters
Global Management
Transnational Entrepreneurship in Canada: The South Asian Case
Hospitality & Tourism
Sustaining Livelihoods Through Tourism Development in Prince Edward County: Assessing Multi-stakeholder Perspectives
How North American Hotel HR Managers Use Social Media

Human Resource Management/ OB
Gender and Ethnic Composition of Large Law Firms in Toronto – A First Assessment
The Transformation of Labour Policy and Administration in Ontario: From Managing Class Conflict to Promoting Partnership and Competitiveness, 1985 to 2010
Marketing
Social Media Reactions
APPENDIX I

Individual Pie Charts Indicating Student Responses to Specific University Undergraduate Degree Level Expectations (UUDLEs) Categories
Figure 6: Developed knowledge and critical understanding of the key concepts, methodologies, current advances, theoretical approaches and assumptions in a discipline overall, as well as in a specialized area of a discipline (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 7: Developed understanding of many of the major fields in a discipline, including, where appropriate, from an interdisciplinary perspective, and how the fields may intersect with fields in related disciplines (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 8: Developed ability to: if) gather, review, evaluate and interpret information; and ii) compare the merits of alternate hypotheses or creative options, relevant to one or more of the major fields in a discipline (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 9: Developed, detailed knowledge of and experience in research in an area of the discipline (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 10: Developed critical thinking and analytical skills inside and outside the discipline (n=48)

Source: Online Questionnaire Survey (Question #10)

Figure 11: Ability to apply learning from one or more areas outside the discipline (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 12: An understanding of methods of enquiry or creative activity, or both, in their primary area of study that enables the student to evaluate the appropriateness of different approaches to solving problems using well established ideas and techniques (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 13: An understanding of methods of enquiry or creative activity, or both, in their primary area of study that enables the student to devise and sustain arguments or solve problems using these methods (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 14: An understanding of methods of enquiry or creative activity, or both, in their primary area of study that enables the student to describe and comment upon particular aspects of current research or equivalent advanced scholarship (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 15: The ability to review, present and critically evaluate qualitative and quantitative information to develop lines of argument (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 16: The ability to review, present and critically evaluate qualitative and quantitative information to make sound judgments in accordance with the major theories, concepts and methods of the subject(s) of study (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 17: The ability to review, present and critically evaluate qualitative and quantitative information to apply underlying concepts, principles, and techniques of analysis, both within and outside the discipline (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 18: The ability to review, present and critically evaluate qualitative and quantitative information, where appropriate, to use this knowledge in the creative process (n=48)

Source: Online Questionnaire Survey (Question #10)

Figure 19: The ability to use a range of established techniques to initiate and undertake critical evaluation of arguments, assumptions, abstract concepts and information (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 20: The ability to use a range of established techniques to propose solutions (n=48)

Source: Online Questionnaire Survey (Question #10)

Figure 21: The ability to use a range of established techniques to frame appropriate questions for the purpose of solving a problem (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 22: The ability to use a range of established techniques to solve a problem or create a new work (n=48)

![Pie Chart](image1.png)

Source: Online Questionnaire Survey (Question #10)

Figure 23: The ability to use a range of established techniques to make critical use of scholarly reviews and primary sources (n=48)

![Pie Chart](image2.png)

Source: Online Questionnaire Survey (Question #10)
Figure 24: The ability to communicate information, arguments, and analyses accurately and reliably, orally and in writing to a range of audiences

Source: Online Questionnaire Survey (Question #10)
Figure 25: An understanding of the limits to your own knowledge and ability, and an appreciation of the uncertainty, ambiguity and limits to knowledge and how this might influence analyses and interpretations (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 26: Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring the exercise of initiative, personal responsibility and accountability in both personal and group contexts (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 27: Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring working effectively with others (n=48)

Source: Online Questionnaire Survey (Question #10)

Figure 28: Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring decision-making in complex contexts (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 29: Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring the ability to manage your own learning in changing circumstances, both within and outside the discipline and to select an appropriate program of further study (n=48)

Source: Online Questionnaire Survey (Question #10)
Figure 30: Qualities and transferable skills necessary for further study, employment, community involvement and other activities requiring behavior consistent with academic integrity and social responsibility (n=48)

Source: Online Questionnaire Survey (Question #10)