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# Information Literacy Skills on the Go: Mobile Learning Innovation

**Alice Schmidt Hanbidge, MSW, PhD, Associate Professor, Renison University College, Waterloo, Ontario, Canada.**

**Tony Tin, BA, MA, BEd, MLS, Director, Library and Information Services, Renison University College, Waterloo, Ontario, Canada.**

**Nicole Sanderson, PhD, SDS Lecturer, Renison University College, Waterloo, Ontario, Canada.**

## Abstract

Students' understanding and integration of information literacy (IL) skills are fundamental to higher education and lifelong learning. Development and implementation of thirteen mobile lessons application (<http://renmil.ca/>) in the Mobile Information Literacy Tool (MIL) was the result of a unique collaboration between faculty and the library. Lessons demonstrated how to locate, evaluate, and use information effectively. Mixed methods pilot study findings (Hanbidge, Sanderson, & Tin, 2015) informed the Canadian project's second stage analysis to determine fluency in digital literacy skills and testing of the MIL tool. One hundred and twenty-eight undergraduate Arts students from eight different classes majoring in psychology, social work, English or social development studies participated in the study to determine the effectiveness of using mobile technology to enhance their IL skills. Preliminary successes and experiences with overcoming the barriers to support anytime, anywhere student mobile information literacy training are discussed and future directions are recommended.

## Keywords

Canada; e-learning; higher education; information literacy; mobile learning; online learning

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## 1. Introduction

Many university students struggle with information literacy (IL) skills in searching for appropriate information and evaluating the validity of sources when completing assignments. Academic literature has emphasized the value of teaching IL skills, clearly linked with academic and critical thinking skills, as part of a comprehensive university education (Kim & Shumaker, 2015; MacPherson, 2004; Saunders, 2012; Tumbleson & Burke, 2013). It is especially important that students learn how to conduct research and be self-reliant in the electronic information environment at a time when there is less need to consult directly with a librarian or to walk into a library. With the emergence of new technology, ways to develop information and digital literacy skills in the curriculum that interact with mobile technology offers exciting possibilities (Saunders, 2012). Authentic learning materials can be designed through digital technologies to meet students' individual learning needs (Monahan, McArdle & Bertolotto, 2008). It has been suggested that mobile devices may be tomorrow's textbook as the learning tool of choice in the future (Abachi & Muhammad, 2014). An overview of the administration and evaluation of one mobile information literacy tool (MIL) to enhance IL training at Renison University College at the University of Waterloo

located in Canada will be explored in this paper with the aim to contribute to the understanding of the innovative practice for academic mLearning.

mLearning involves the delivery of electronic learning material via mobile devices such as mobile phones and tablets. It has built-in learning strategies to allow access to knowledge from anywhere and at any time. This 'education on the go' expands the boundaries of anytime, anywhere learning and will play an essential role in the development of curriculum and pedagogical approaches in the future (Ally, 2004; Kukulska-Hulme, 2005; Saunders, 2012; Wu et al., 2012). In addition, Candy (2002), Kimmel, Dickinson, and Doll (2014) and Peacock (2001) contend that learning beyond the world of academia is part of the aim of IL as it promotes critical thinking, increases information competencies and equips individuals for lifelong learning. Information literacy is commonly defined as the ability to locate, to access, evaluate, and use information that cuts across all disciplines, all learning environments, and all levels of education (Association of College & Research Libraries' Information Literacy Competency Standards for Higher Education, 2000; Saunders, 2012). Helping student learners improve their information skills using mobile devices shaped the study's research framework. Project objectives were to develop best practices and strategies, from a user perspective, for delivering and accessing information that enhances student IL skills through mobile technology.

Overall, academic research on the educational use of mobile devices is a recent trend and includes limited case studies of different implementations (DaCosta, 2010; Hanbidge, Sanderson, & Tin, 2015; Kim, Mims, & Holmes, 2006), however, it is anticipated that mLearning will grow quickly in the next few years. Customized mobile learning applications aim to facilitate mobile learners' experiences through the 'situated classroom'. This type of classroom is an augmented learning environment developed to relate specifically to the learner's needs (Jeng et al., 2010). With the development of a variety of mobile devices that are more powerful, portable and with better Wi-Fi access, this research will serve as a foundation for designing, developing, promoting and evaluating segments of mLearning among students.

There is an evident gap between the IL skills that faculty actively support and develop and those they want their students to have (Hanbidge, Tin, & Sanderson, 2017). Faculty members and librarians from various disciplines working as collaborators and bridge builders are well positioned to fill such a gap (Bury, 2011; Hanbidge, Sanderson, & Tin, 2015; McKeever, Bates, & Reilly, 2017).

To fill the gap, we advocate for students' learning of these skills. This innovative short-term project will enhance the design and implementation of a mobile digital learning tool project to support and enhance mLearning pedagogy in higher education. Grafstein (2002) argues that librarians bring unique expertise to course development and that the delivery and teaching of IL should be delivered throughout an institution rather than solely through the library. This paper highlights a unique collaborative effort between faculty and librarians to bring IL to a university setting. The Middle States Commission on Higher Education (MSCHE, 2003), provides clear guidelines to integrate IL throughout the curriculum to develop progressive IL skills in American university students. This educational organization's initiative marks the beginning of such a collaborative bridge building process.

Further testing of the MIL tool and the learning analytics aims to deepen student learning while enhancing IL skills. University undergraduate students participated in a mixed method non-experimental research design study to understand the frequency of access to the IL tool and the change in fluency of IL skills using mobile devices. Study participants completed thirteen online mobile IL lessons, pre- and post-tests and a questionnaire. Collaborative efforts between faculty and library staff will enhance the opportunity to support anytime, anywhere mLearning.

## 2. Mobile information literacy literature

Thanks to mobile devices such as mobile phones and tablets, mLearning or education 'on-the-go', expands the boundaries of anytime, anywhere learning and is situated clearly in the future of learning (Keegan, 2002; Soykan, & Uzunboylu, 2015; Wu et al., 2012). Educators aim to provide interactive, multimedia content geared to students' learning needs (Clough et al., 2008; Monahan, McArdle & Bertolott, 2008). As it is an emerging field, the potential of mLearning is still untapped and best-practice guidelines for mLearning are still evolving. Although using mobile technology for IL training is limited, there are several program examples in universities and colleges in the United States, England and Australia that include infusing IL and technology into the educational experience of for-credit courses and a certificate is provided upon graduation for completion of the lessons (DaCosta, 2010; Kraemer, Lombardo & Lepkowski, 2007; Salisbury & Ellis, 2003; Warnken, 2004).

Academic literature emphasized the value of teaching IL skills, clearly linked with critical thinking skills, as part of a comprehensive university education (Kim, 2013; MacPherson, 2004). Many students struggle with IL in searching for appropriate information and evaluating the validity of sources. Bingham, Wirjapranata and Chinnery (2016) contend that IL skills are fundamental for social work practitioners so they can effectively locate, evaluate, use and apply the 'best evidence' in their clinical and community practices.

Research on educational mobile learning is a recent development and there have been limited research surveys conducted (Attewell, 2005; British Educational Communications Technology Agency, 2004; Keegan, 2002; Savill-Smith & Kent, 2003). Sound critical thinking skills underpin the cluster of IL skills, which highlight the importance of being able to navigate the wealth of information available to today's university students. The Australian and New Zealand Information Literacy Framework (Bundy, CAUL & ANZIL, 2004) was developed to identify higher education IL competency levels. A study on the integration of IL skills in the curriculum in England, the United States and in Canada in selective higher education centres found limited information in the curriculum (DaCosta, 2010). Although IL skills were deemed as important tools for students by teaching faculty, there were limited opportunities in these countries to teach these skills, as they were not integrated into the curriculum (DaCosta, 2010).

There appears to be no consensus among faculty on when students should learn these skills or if they need to be explicitly taught IL in the curriculum (DaCosta, 2010). This highlights the gap between understanding the level of importance of the IL skills and embedding them into the curriculum. Another identified challenge is the misperception by some faculty that computer literacy equals information literacy (Salisbury & Ellis, 2003). Osmosis does not work for the development of such skills, rather pedagogical collaborations between faculty and librarians need to be fostered and instituted to assist in incorporating IL into higher education curriculums. This highlights the gap between the level of importance of the skills and embedding them into the curriculum.

Typically, IL competencies are highly valued by faculty in various disciplines at colleges and universities, however little has been written on IL outside of the library literature and the transformation of IL from a library-centred issue to a mainstream educational issue is only beginning (Bury, 2008; DaCosta, 2010). Often, there is limited interaction between faculty and librarians (Latham et al., 2016; Saunders, 2012) and the seeming unwillingness of academic faculty to partner with librarians may have less to do with a lack of respect for the position, and more to do with a lack of understanding of how librarians can contribute to and support their instruction. This study aims to enhance the collaborative efforts between these two roles in sharing responsibility for teaching students IL skills in an innovative way. In fact, IL has relevance for faculty members, students, librarians, administration and the organisation as a whole. IL could

serve to link together the expectations for student learning in the institution by providing an overarching framework of becoming information literate.

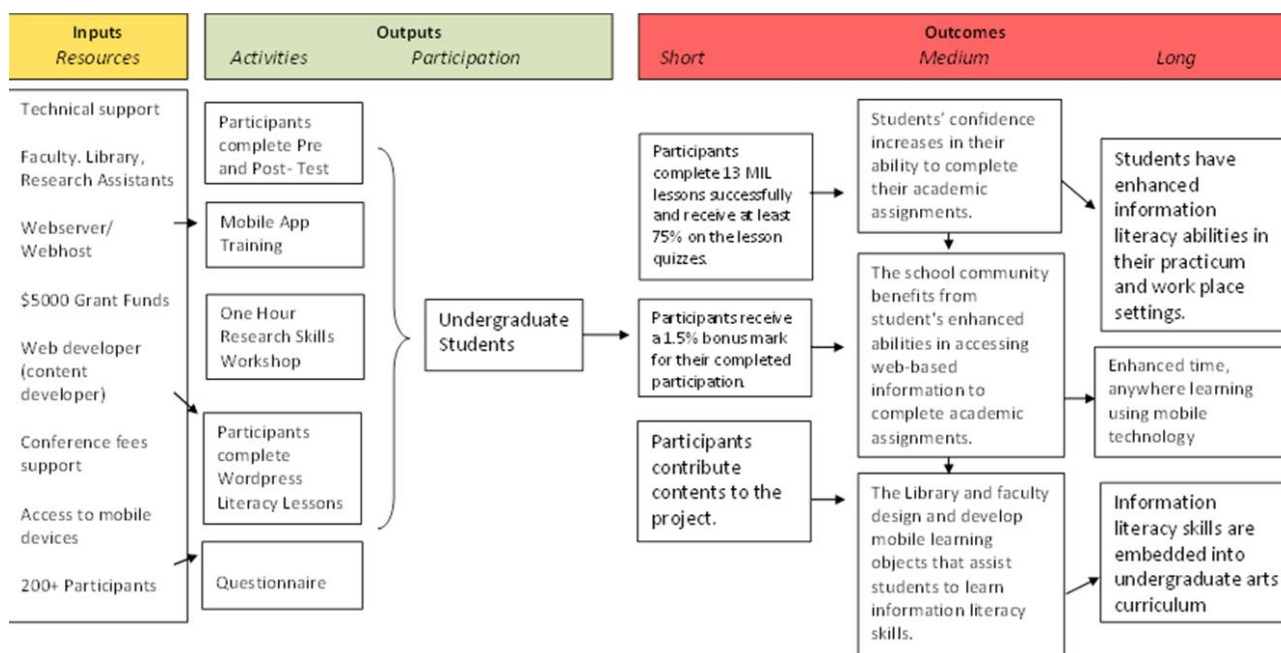
More research, from a user perspective, is needed to discover the best strategies for maximising mLearning, including discovering the best mobile device for accessing digital information tools such as the MIL tool, and what form the content needs to take to contribute to effective mLearning. The passion to help student learners improve their information skills using mobile devices is a unique opportunity to shape a research framework for this pilot project and to study the effectiveness and efficiency of using mobile technology to enhance student's digital literacy skills.

Outcomes of this project will have several meaningful and significant contributions to the emerging knowledge in the field of mLearning. To be successful and independent learners for life, students must graduate with the ability to successfully navigate electronic environments. They must understand and use both the information and technology related to their fields of study. Saunders (2012) insists that information and digital literacy skills must be developed to maximise the benefit from learning with technology. With the emergence of new technology, there are exciting possible ways for mobile IL education and the curriculum to interact.

### **3. Study Design and Logic Model**

A Logic Model diagram (Figure 1.) provides a visual representation of the project and its goals and objectives. Despite the aspiration towards pedagogical innovation in higher education, the inclusion of IL in undergraduate education often remains an objective rather than a fully realised accomplishment. The rationale for the development of the MIL Tool emerged from the observation that students are frequently using academic material both on and off campus and that there is a demonstrated need to provide easily accessible tools to assist students so that they have the ability to effectively locate, evaluate, and use the needed information. Assumptions that ground this project are that osmosis does not work for the development of such skills, but rather pedagogical collaborations between faculty and librarians can be encouraged and established to assist in incorporating IL into higher education curriculums. Therefore, the goals for the project are to develop strategies for enhancing student IL and to increase their access, retrieval and evaluation skills to ascertain and understand reliable and credible academic information. Through short to long term outcomes, students will be better equipped to work with the 'Information Age'.

**Figure 1: Mobile Information Literacy (MIL) Logic Model** ©



One hundred and twenty-eight undergraduate arts and humanities students in seven classes in psychology, social work, English, or social development studies in a Canadian university participated in the phase two pilot research study to determine the effectiveness of mobile technology in enhancing students' IL skills and learning experience to date. The study was a mixed-method (quantitative and qualitative) non-experimental approach, including both pre- and post- digital literacy tests and student questionnaires. This project and the survey instruments were approved by the Research Ethics Board at the University of Waterloo located in Waterloo, Ontario, Canada. All study participants received a 1.5% bonus mark in their courses at the end of the completion of the study. Bonus marks were increased from 1% in the pilot study to 1.5% in this study based on feedback from the pilot study participants. They indicated that a 1% bonus mark was not a sufficient motivator for the volume of work required to complete the MIL lessons and pre and post-tests in the research study. Data analysis indicates the degree of change in frequency of mobile device IL access and fluency in IL skills. The research hypothesis is that IL skills will increase relative to the use of the IL mLearning.

The study methodology was repeated from the pilot study A for the second iteration of testing the MIL tool and IL skills of students, study B. A larger sample was recruited for the second study in this project, increasing participant numbers from ninety-one in the pilot study to 128 students in the second phase of the study. The MIL tool remained the same to ensure sufficient data was collected before any amendments were made to the MIL tool. As a result of the current study, the researchers will move ahead to make significant changes to the MIL tool, including the location of the host web platform.

Participants ranged in year of study from their first year to their fifth year. Undergraduates in seven participant groups completed a pre-test, thirteen mobile IL lessons (online) before completing the post-test and questionnaire. These students accessed their personal smart phones and tablets to complete the exercises in their spare time (e.g. while riding a bus). Students in the comparison group (N=18) completed the pre and post digital literacy test, but they did not complete the thirteen online literacy lessons.

The librarian provided a short training session on the use of the MIL tool to students before they completed the on-line lessons. At the start of the session, participants completed paper-based pre-tests to determine a baseline understanding of IL. Online student participants completed pre-test/post-test surveys through a web link accessed through their course newsfeed in the university's online course management learning system. Survey questions explored participants' knowledge about accessing data, including the university's library database system, Primo. Administration of pre and post-test surveys occurred during the first week of classes and in the final week of the term. Additionally, students provided an assessment of their use of the MIL tool at the end of the semester.

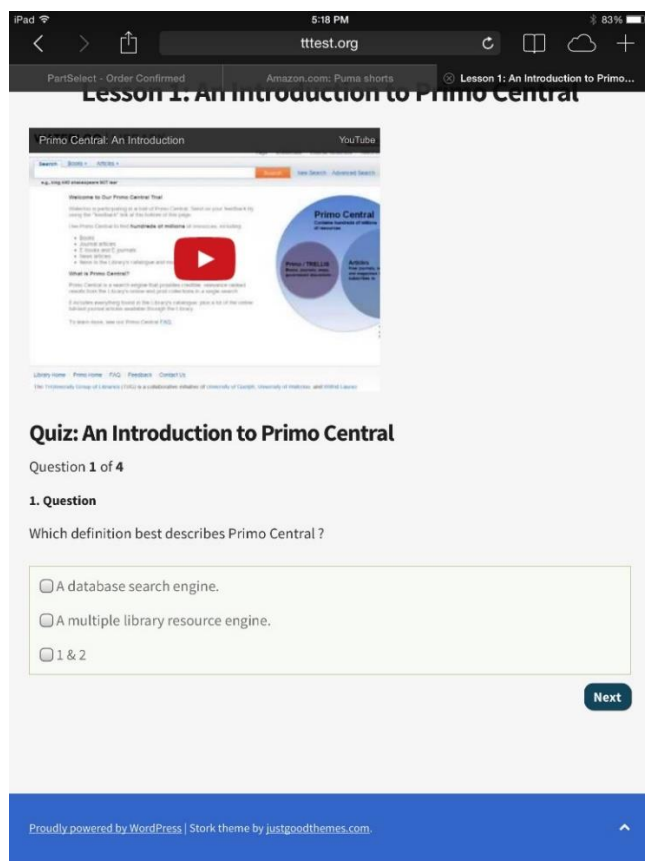
Both qualitative and quantitative data were collected in this study. The statistical analysis of the completed surveys and questionnaires was done using SurveyMonkey's Analyze tool, Excel spreadsheets, and a systematic review of the raw data completed through Wordpress (<https://wordpress.org/>). Open ended questions were coded and thematically analysed while usage of the MIL web app tool (see Figure 2a) was explored through Google Analytics. The data was analysed for program improvement, MIL tool enhancement and expansion, and as basic evaluation research in the emerging field of IL academic instruction. In Figures 2b and 2c, screenshots identify two of the types of questions that study participants were expected to respond to (Figure 2b Multiple Choice and Figure 2c True or False).

**Figure 2a:** MIL web app homepage

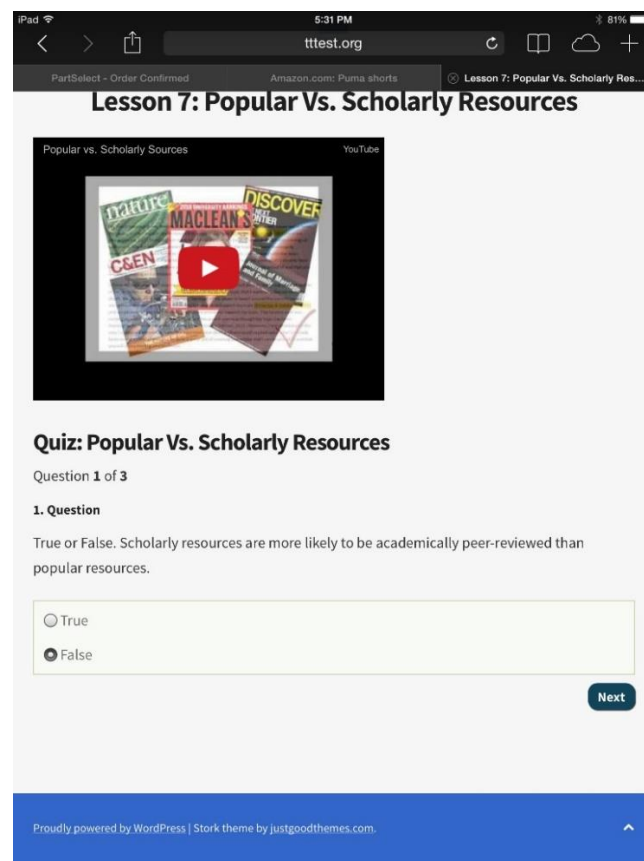




**Figure 2b: Multiple choice question**



**Figure 2c: True or false question**



The web app tracks the amount of time that students spend completing the exercises. The web app supports knowledge construction, dissemination and collective intelligence, by encouraging students to post their search tips at the mobile friendly site. Many IL studies indicate that interactivity and assessment can help to reinforce concepts learned (Grassian & Kaplowitz, 2001; Yarmey, 2011). For these reasons, each MIL lesson has interactive exercises providing instant feedback including True or False, Multiple Choice, Text Input, and Drag and Drop questions. The tool currently has over 20 videos that teach about topics such as Boolean Operators, database functions, and writing search strategies in keywords. However, the literature emphasizes that interactivity and assessment help to reinforce concepts learned (MSCHE, 2003), so the project enhancements will focus on creating activities to complement the videos. These activities would be made accessible on a mobile-friendly website. The goal is to make the activities entertaining enough for students to engage with the content while they are waiting in line, sitting on the bus, or before classes. The goal is to make a true point-of-need library service that benefits students and makes their library experience fun.

## 4. Study Findings

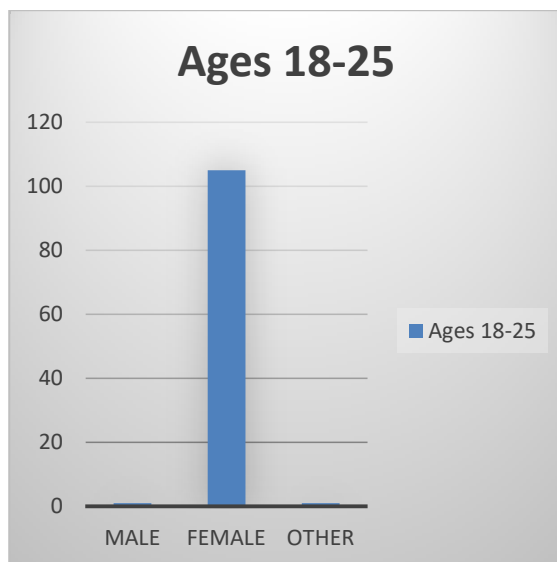
Demographic data collection through the survey tools gathered participant information and preliminary data analysis indicated some trends about their mobile phone use. Data collected through a Survey Monkey link, an online cloud-based survey tool, retained participant demographic information and survey results. Almost 50% of students were in a post-degree Bachelor of Social Work program, while 23% of students were in an undergraduate Social Development Studies program and the remaining students (about 27%) identified their programs as other arts faculty or humanities programs (psychology, sociology, speech communication, French or fine arts). The comparison group (N=18) demographics closely matched with other participant groups and



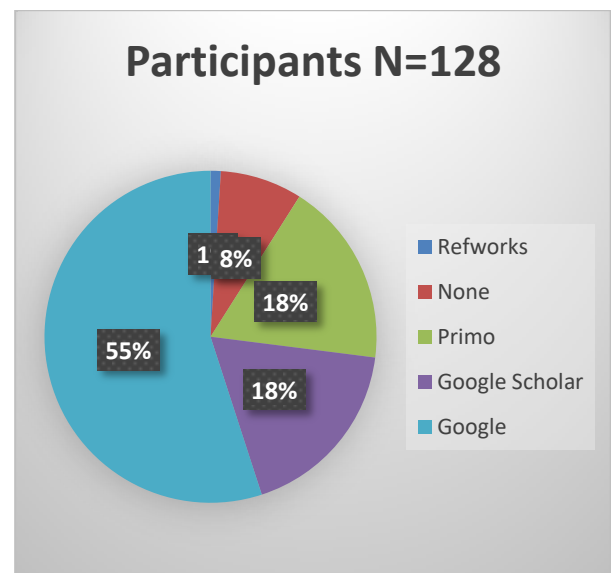
consisted of eighteen part time Bachelor of Social Work students. Most study participants were female (82%) and 83.5% of the participants were between the ages of eighteen and twenty-five (Figure 3. Gender & age), while only two (0.01%) participants indicated they were over fifty years of age. Prior to participating in this MIL pilot study, almost 84% of students had not received any type of literacy skills training.

Several key findings emerged during the review of the IL knowledge pre and post-test scores for participant and comparison group scores. Of the students who used Google to explore research on their phones, almost three-quarters were able to maintain or increase their IL skills over the semester. Students who accessed academic information or conducted research on their phones (see Figure 4, Research accessed on phone) significantly preferred using a Google search engine (55%) over other search tools such as the University of Waterloo’s research and discovery tool, Primo (18%), other research databases including Google Scholar (18%), or RefWorks (1%), a web-based citation and bibliography tool.

**Figure 3: Gender and Age**



**Figure 4: Research Accessed on Phone**



Over ninety nine percent of participants owned a smartphone and 59.3% of these participants were Apple iPhone users. The students reported using their phone and other mobile devices (i.e. tablets) on a daily basis. Almost sixty-two percent (61.7%) of the participants in the study used a mobile device to search for academic related information and one student commented that, *‘learning by mobile is useful as online learning is the future.’* Seventy-two percent of iPhone users were able to maintain or increase their IL skills from the beginning to the end of the study. The Android phone users included 34.3% of the student participants. Eighty-one percent of Android users either maintained or improved their IL skills during the course of the semester.

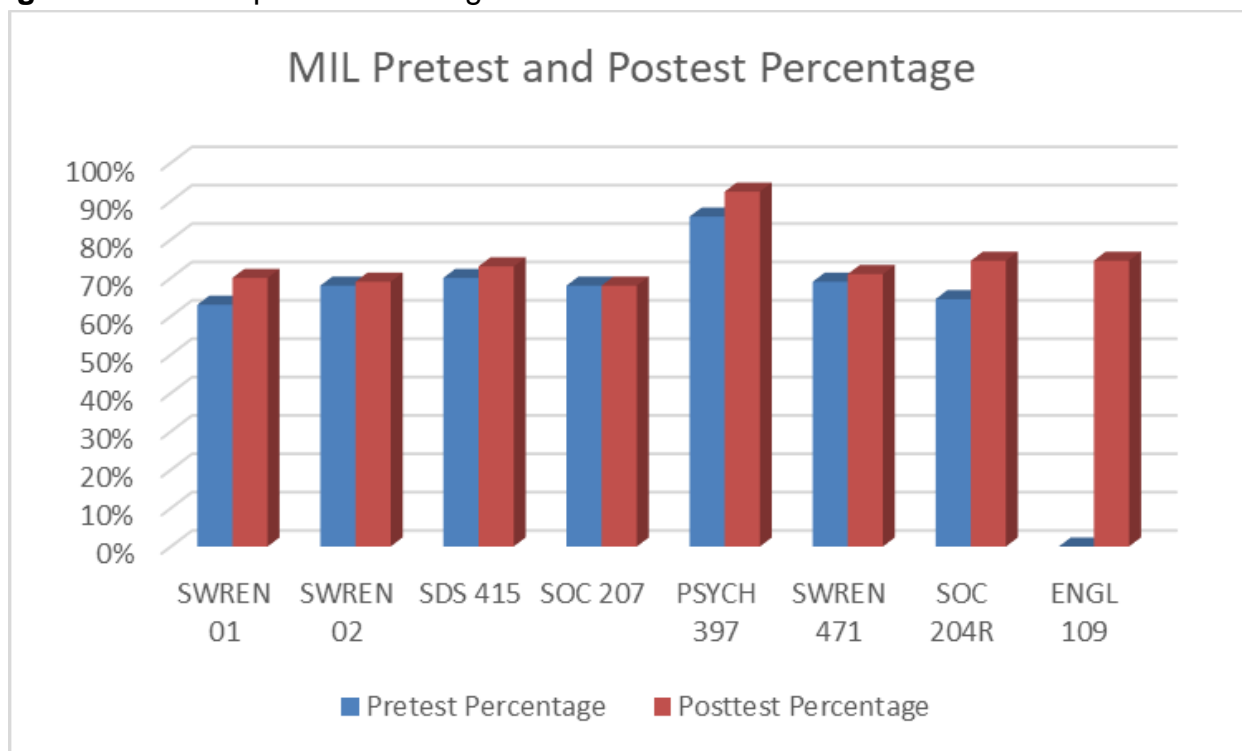
Overall, students did quite well in learning and maintaining their IL skills in this project. One Hundred twenty eight participants completed the pre and post-tests, the MIL questionnaire, and all thirteen information lessons (see Figure 5: Pre and post-test averages). A majority of those participants (72%) increased or maintained their MIL knowledge as evidenced by the test results. Of those, 54% improved their IL knowledge while 18% maintained their knowledge from beginning to end of the semester. There was a decrease in test scores noted in 28% of participants. This loss

of recall about IL for some participants may be correlated from the lapse in time between the completion of lessons early in the semester and the post-test many weeks later.

It was determined that the class that demonstrated the greatest gains in their IL skill was composed of a large number of first year university students who increased their pre to post scores over 17% from beginning to the end of the semester. This may be representative of steep learning that students accomplish during their first year of higher education. Only one student participated in the study from the class PSYCH 397 and this student was very successful in the study results, however, this student may not be representative of the class. When comparing the gains in IL skills among students corresponding to the university year that students are registered in, students who indicated they were in their first year overwhelmingly enhanced their IL skill by 86%. This finding is similar to students in their second year of university who either maintained (14%) or enhanced their IL skills (56%). Conversely, students in their fourth year of university either maintained (33%) or improved their IL skills by thirty-nine percent (39%). Students in their fifth year completing a post-BA degree in social work maintained or improved their IL skills by 80%.

When reviewing the pre and post-test class averages (see Figure 5), the first year English class gained the most IL skill (with the exception of the one student from PSYCH 397), with student scores moving from 58% correct answers on the pretest to 75.3% correct answers at post-test. Gains were comparable across other classes, with the exception of limited gains for SOC 207.

**Figure 5:** Pre and post-test averages



#### 4.1 Gender and Age

The research team was specifically interested to understand whether gender and age differences were present in use of the mobile phone usage (such as sending photos and reading novels) as reported in a previous study by Lui (2015). In this study, 75% of the male participants reported 'Browsing the Internet' as their main use of their mobile device, while 25% reported texting as their

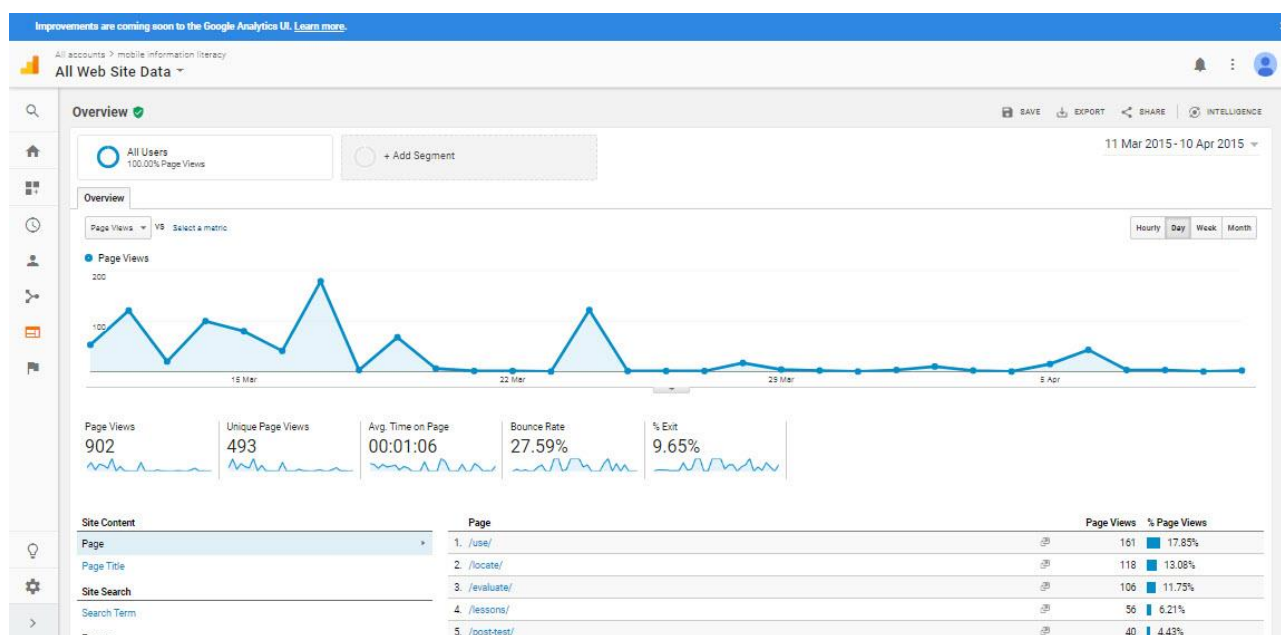
main use. Seventy-one percent (71%) of the female participants identified 'Texting' as one of their main uses of their mobile devices, while only 24% indicated that they used their devices for 'Browsing the Internet'.

Generally, it was found that over half of the females (52%) improved their IL scores from beginning to end of the study while 18% were able to maintain their knowledge throughout the semester in school. Thirty percent (30%) of females' scores decreased from pretest to post-test while all males (N=4) improved their IL scores during the semester. Having only 4 males in the sample group limits the potential to speculate as to the reasons for this gender difference.

Seventy-one percent (71%) of students between the ages of 18 and 25 maintained or improved their IL skills while 66.3% of those between the ages of 26 and 49 improved their skills and 22% maintained their skill level. Of those students over the age of 50, half of them improved their skills and the other half (50%) lost some skills during the semester. It would appear that the younger students, aged 18-25, may be better able to retain the IL skills they learned during the research study. Perhaps this group is accustomed to learning academic material with technology.

Google Analytics (Figure 6) was used to analyse student use and engagement, especially time spent on the MIL site and detection of the content students interacted with the most. Statistics were noted for time spent in each lesson and individual participant log in time.

**Figure 6:** Google Analytics



While the analysed data suggests that the year of program that participants are in does not have a strong influence on improvement of IL skills, it does indicate that the type of program disciplines and courses that students are enrolled in may positively impact the significance of their IL learning. Findings in the data indicate that of a second year sociology class who completed the MIL study, 15 of the 36 (41.7%) study participants improved their IL skills from the beginning of the semester to the end. In a fourth year seminar class in social development studies, 14 of the 22 (63.7%) study participants improved their pre-post test scores, and enhanced their IL skills.

## 4.2 MIL Tool Lessons

Students enrolled in the second year class scored ease of navigation of the mobile lessons within the tool at a 75% rating. Students in both classes completed a major research paper as part of the course that incorporated IL skills. Thus, what they were learning in the lessons could be directly applied to their coursework. This finding suggests that it is important to use the m-learning resource in a course that has a research based assignment in it so that there is a connection between the technology and the coursework.

IL lessons that students found most helpful (Table 1.) are identified in the table below. From our data analysis, the researchers determined that the most sought after online lesson for students was aimed at helping them to find peer reviewed journals (Lesson 4). The next most sought after lesson was that students wanted to learn when to cite their research to avoid plagiarism (Lesson 10). Finally, students also searched for guidance in locating journal articles (Lesson 3) and differentiating between popular and scholarly resources (Lesson 7). Once students submitted each answer to a quiz question, an indicator noted whether student responses were correct or not, along with an explanation (Figure 8. Quiz Answers).


**Table 1:** MIL lesson use

Lessons	Response Percent
<b>Locate:</b> Lesson 1: An Introduction to Primo Central	60.0%
Locate: Lesson 2: The Basics: How to Search	44.0%
Locate: Lesson 3: Finding Articles	78.3% (3)
Locate: Lesson 4: Finding Peer Reviewed Journals	82.3% (1)
<b>Evaluate:</b> Lesson 5: Evaluating Information Sources	73.3%
Evaluate: Lesson 6: Peer Review Process	60.0%
Evaluate: Lesson 7: Popular vs. Scholarly Resources	73.2%
<b>Use:</b> Lesson 8: Using the Web for Resources	67.9%
Use: Lesson 9: RefWorks	61.3%
Use: Lesson 10: When to Cite Your Articles	79.3% (2)
Use: Lesson 11: Types of Written Articles	64.19%
Use: Lesson 12: How to Approach Assignments	68.3%
Use: Lesson 13: What is a Paragraph?	56.8%

**Figure 8: Quiz Answers**

### Your Answers

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 [Print Report](#)

✓ **Correct**

1) You can use  library catalogue to find:

- A. books.
- B. journal articles.
- C. resources in  libraries.
- D. books, journal articles and other resources in  libraries. ✓ (Your Answer)

**Explanation**  
 The library catalogue serves as a single search interface for everything found in the Library (including monographs at all  libraries), plus hundreds of millions of online full-text journal articles. Access is provided on the  Library website.

A comparison of the findings from the first pilot study and the second phase of data collection demonstrated a consistent pattern to the results (Table 2: Study Comparison). A total of 74.6% of study participants were able to maintain or increase their IL skill knowledge from beginning to end of the study. There was a decrease noted in twenty five percent (25.5%) of student test scores. Although this result is puzzling, this decline could reflect the negative impact on study participant memory recall arising from the lapse in time between the completion of lessons early in the semester and the post-test many weeks later.

**Table 2: Study Comparison**

Study	Improve IL Skills	Maintain IL Skills	Decline IL Skills
MIL 2015 Pilot Study A (N=99)	50.63%	26.58%	23%
MIL 2016 Study B (N=128)	54%	18%	28%
Total N= 227	52.3% average	22.3% average	25.5% average

One of the study's goals was to determine the usability, strengths and challenges for participants in completing the MIL lessons. The research team was looking for constructive feedback to enhance the MIL tool. From the feedback provided by the phase two participants, a number of changes will be made in order to improve the online tool. Some of the MIL tool changes are detailed below.

*Schmidt Hanbidge, Sanderson & Tin. 2018. Journal of Information Literacy 12(1)  
<http://dx.doi.org/10.11645/12.1.2322>*

### 4.3 Challenges

Several challenges impacted the results of the study, including limited visual cues in the MIL tool and difficulty opening some MIL lesson video links. Multiple technology challenges were indicated by students such as small viewing screens on the smartphones and limited data coverage to access the MIL lessons. Some students suggested that the MIL tool layout and features needed improvement; a 'Next Lesson' button embedded in the tool would enhance usability; a list of visual cues to know which lessons had been completed would also enhance the user's experience.

One common concern voiced by participants regarding the use of smart phones was the cost of accessing internet data. Availability of more Wi-Fi capable phones and free Wi-Fi accessible locations should address the issues of the cost of access. Additional issues raised by the participants with regards to MIL training, included: eye strain caused by small mobile screens; difficulty inputting data on small keyboards or that the phone lacked a keyboard altogether; need to use more multimedia, including visually appealing videos and interactive exercises; MIL web app is only optimised for IOS use, thus causing some viewing issues on Android devices (e.g. Drag and Drop exercises only work with touch screen devices); and slow internet connectivity limited some student's access to the MIL lessons. Improving these features could enhance usability of the MIL tool and mobile devices in learning environments. Feedback provided by study participants will positively impact the upgrading of the MIL tool for the next research study. Attewell (2005) noted similar challenges using mobile phones where small mobile phone screen size, reduced screen resolution and complicated mechanisms presented obstacles to the educational applicability of mobile phones.

### 4.4 Strengths

Study participants identified many positive experiences with the MIL tool and mLearning including; access to a new opportunity to learn about IL, an appreciation for the visual aspects of the MIL tool, support for mobile phones as superb tools for efficiency, accessibility of the tool (in hand when on-the-go) and the internet (appreciated Wi-Fi access), and the speed with which the MIL lessons could be completed. Student participants also commented that they appreciated the lessons were simple and straightforward, *'Lessons easy to understand and were very convenient'* One student indicated that, *'I learn better when my learning is applied to a certain project, for example, learning to research using real keywords, for actual papers rather than just learning how to navigate the system in general.'*

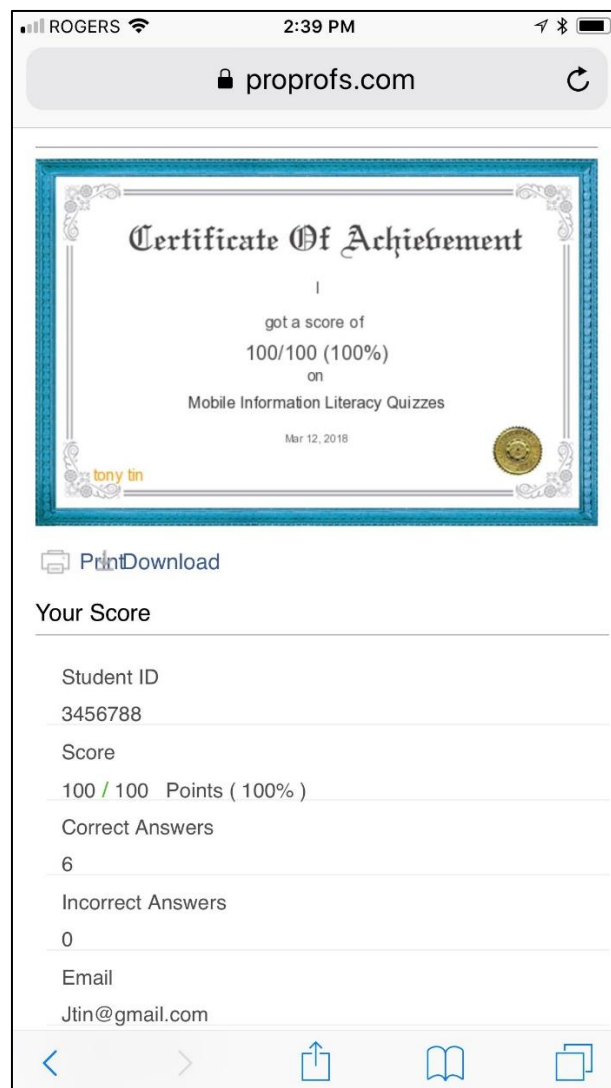
### 4.5 Technical Platform

Based on assessment of the platform of the MIL tool, its performance, and feedback about ease of navigation and usability, the research team decided to change the MIL tool platform from Wordpress (WP) to the ProProfs platform. The next iteration of the MIL tool will be hosted with the ProProfs platform. The new platform host, (ProProfs Quiz Software <http://www.proprofs.com/quiz-school/>) is a web application which allows educators and trainers to create and deliver mobile online lessons and assessments to learners. In comparing the features and usability for the purposes of delivery of the MIL tool, we determined that certain features were better suited with greater functionality in ProProfs.

- a) Rich functionality and features: It has an intuitive and interactive interface and supports more question types than WP such as checkboxes, fill-in-the-blanks, true or false, multiple choice, and essay types.
- b) Better report feature: Trainer can easily assign quizzes to learners and get advanced reports in excel and pdf format – a feature that WP is lacking.

- c) Interoperability: It can accommodate desktop and mobile access, supporting different platforms such as Linux, Mac, Windows, Android and Apple IOS. It is a web-based service that can be interoperable with the University of Waterloo's Learning Management System like LEARN.
- d) E-certificate feature (Figure 7): automatically provides the quiz-taker with a certificate of completion once someone has completed the quizzes. Certificates are created based on name entered by quiz taker, date the quiz is taken and the achieved score. Once a quiz-taker completes a quiz, results and score reports can be viewed online or via email. They will then have access to their certificate which can be shared through social media or email, printed, or embedded in a website or blog.
- e) Better user interface: a 'Next Lesson' and 'Lessons Completed' button can be embedded in the tool with visual cues to indicate which lessons have been completed.

**Figure 7: E-certificate feature**





## 4.6 Suggestions for Future Use

The MIL tool has good potential for on-the-go learning; however, some enhancements and upgrading of features in the tool and in the lessons are required as found in the pilot study and confirmed in the follow up study. Phone screens are often small; however, the new smart phones have greater potential for visual ability to view mobile learning lessons as they are larger in size. Some students prefer computer viewing or face-to-face learning over mobile technology as they prefer to have the human contact. Moving to the ProProfs platform will address much of the participant feedback. Some suggestions for future use include;

- Use of learning analytics – evidence based learning.
- Free or affordable Internet for all users.
- Mobile IL training in remote areas that would provide equal access to education e.g. remote Aboriginal communities in Canada and impoverished communities globally.
- Screen size redesign for ease of reading. Phone functionality will progress with each design iteration of new phones.
- Use of multimedia and games to improve the learning experience. Students report increased enjoyment learning course materials when gaming is introduced (Breuer & Bente, 2010; Jackson & McNamara, 2013; Soykan & Uzunboylu, 2015).
- Use of mobile device to interact with teachers and trainer (e.g. Ask a mobile librarian). By embedding links direct to a librarian within an online course learning management system (LMS), students can connect with a librarian using their mobile devices to ask questions about IL.

## 4.7 Limitations of Study

The relatively small sample size limits the generalisability of the study's findings to other settings. This case study is particularly relevant to the Canadian higher education landscape and may be unique to this particular system. Expanding the sample size to a greater number of students in multiple settings would ensure more robust results that provide substantial findings. Future MIL tool research could focus on translation of the MIL tool lessons and delivery of MIL in other countries and multiple languages (e.g. French, Chinese, Japanese and Arabic). Expanding research from mobile IL to mobile academic fluency is an expanding area that can incorporate IL skills.

## 5. Conclusion and implications

In spite of the increase in mobile educational applications, this research indicates that there is a need to collect additional information and to further evaluate the mobile IL tools to develop a strong underlying evidence base for academic mLearning. Within the MIL lessons, there is still need to further develop and enhance the content, videos and interactive tools to potentially support greater positive outcomes. Implementation of the MIL Tool in the ProProfs platform will begin in the next semester. Institutions providing tools for learning, such as computers, books, databases and classrooms is not the same as providing content nor does it necessarily translate into making information literate students. There is still work to be done to ensure that students are information literate.

The authors of this paper query: Why is learning IL not a dedicated element in the main curriculum? It has been argued elsewhere that IL skills should be a core element of the academic curriculum (ALA, 1989; Grafstein, 2002) which is supported in the findings of this research project. While there has been a tendency to isolate IL as a field in its own right (Shapiro & Hughes, 1996), incorporating research papers into specific discipline-based courses integrally links discipline-based knowledge and research. This project has reinforced the notion that IL is not a standard part of classroom content, but appears to be provided only to those students who actively seek out the

information. Both learners and educators need to develop a range of IL skills and be provided with supportive materials to take full advantage of and make the best use of the emerging technologies. As the volume of information expands and becomes more available, technology changes and improves and methods of research change, it is important to become aware of the increasing complexity of skills to use information effectively in all aspects of our lives.

Outcomes of this MIL project aim to contribute significantly to the emerging field of mLearning. Inclusion of IL in undergraduate education curricula often remains an aspiration rather than a fully realised ideal and this project addresses one way to incorporate learning IL skills into post-secondary education classes and to promote mobile learning among undergraduate students, the community and beyond.

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