Using Mobile Technology to Enhance Undergraduate Student Digital Information Literacy Skills: A Canadian Case Study

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Abstract

Learning essential information literacy skills through the use of mobile phones is an innovative m-learning pilot project that was collaboratively undertaken in a Canadian university college over the course of two academic terms by faculty and the library staff. The research pilot project involved ninety one undergraduate students in five different classes majoring in psychology, social work, education or social development studies in an attempt to determine the effectiveness of using mobile technology to enhance students' information literacy skills and learning experiences. Pre and post-test measures, and survey questionnaires generated quantitative and qualitative data that was analyzed to determine the degree of changes in frequency of mobile device information literacy access and fluency in digital literacy skills. The article highlights the Mobile Information Literacy innovation and includes the development and design of the mobile lessons, interactive exercises, and its applications. The study's main results and conclusions are also discussed. Additionally, the successes and challenges of the pilot to support anytime, anywhere student mobile information literacy eLearning training that engages mobile learners and enhances their learning experience are identified and critically reflected upon to improve the innovation for stage two of the project.

Keywords: Mobile learning; information literacy; e-Learning; digital literacy; post-secondary education.

Introduction

University students frequently use academic material both on and off campus, there is demonstrated need to provide easily accessible tools to assist them (Baggaley, 2004; Brown, 2004; Perry, 2000). Academic literature has emphasized the value of teaching information literacy skills, clearly linked with academic and critical thinking skills, as part of a comprehensive university education (Kim & Shumaker, 2015; MacPherson, 2004; Tumbleson & Burke, 2013). 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). Despite the aspiration towards pedagogical innovation in higher education, the inclusion of information literacy in undergraduate education often remains an objective rather than a fully realized ideal/accomplishment

This project supported the development and administration of the mobile information literacy (MIL) tool, being a web search application for use by undergraduate arts and humanities students at Renison University College, affiliated with the University of Waterloo, Waterloo, Ontario, Canada. Participants had the opportunity to utilize this tool and reported on their level of satisfaction with the tool. Project objectives were to develop best strategies, from a user perspective, for delivering and accessing information that enhances student information literacy skills through mobile technology. With the MIL tool, the research team hypothesized that students would improve their literacy skills and would increase their access, retrieval and evaluation skills, to ascertain and understand reliable and credible academic information. The research team also felt that other school communities would benefit from the MIL tool to assist them to complete academic assignments and research projects. Our research aims to contribute to the understanding of the innovative practice for mobile technology academic learning (m-learning).

The pilot study was a mixed-method (quantitative and qualitative) non-experimental approach that included both pre- and post- digital literacy tests and student questionnaires. All study participants completed a digital literacy pre-test and a digital literacy post-test. Undergraduates in three participant groups completed thirteen mobile information literacy lessons (online) before completing the post-test and questionnaire. Students in the comparison group received a one hour research skills library workshop and completed the pre and post digital literacy test. The comparison group participants did not participate in the thirteen online literacy lessons.

Literature Review

M-learning involves the use of mobile devices to deliver electronic learning materials with built-in learning strategies to allow access to knowledge from anywhere and at any time (Ally, 2004). M-learning or “education on the go” utilizing mobile devices such as mobile phones and tablets, expands the boundaries of anytime, anywhere learning and will play an important role in the future of learning (Keegan, 2002; Wu et al., 2012). As this type of learning is an emerging field, the full potential of m-learning is still untapped and best-practice guidelines for m-learning are still unknown. Although using mobile technology for information literacy training is limited, there are a few programs in universities and colleges in the United States, England and Australia that include infusing information literacy and technology into the educational experience in for-credit courses and a certificate provided upon graduation for completion of the lessons (DaCosta, 2010; Kraemer et al., 2007; Salisbury& Ellis, 2003; Warnken, 2004).

Research on m- learning is a recent development and there has been limited research conducted in this area (Attewell, 2005; British Educational Communications Technology Agency, 2004; Keegan, 2002; Savill-Smith & Kent, 2003). A study conducted by DaCosta (2010) on the integration of

information literacy skills in selected post-secondary higher education curricula in England and the United States found limited integration of information literacy in the curriculum across a variety of academic disciplines, including arts, education, sciences and engineering. Although information literacy skills were deemed to be important tools by faculty and librarians for students, opportunities for integration were limited. There appears to be no consensus among faculty on when students should learn the skills or if they need to be taught information literacy in the curriculum (DaCosta, 2010). This highlights the gap between understanding the level of importance of the information literacy 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, but rather pedagogical collaborations between faculty and librarians can be encouraged and established to assist in incorporating information literacy into higher education curriculums.

Typically, information literacy competencies are highly valued by faculty in various disciplines at colleges and universities, however little has been written on information literacy outside of the library literature. The transformation of information literacy from a library-centered issue to a mainstream educational issue is just beginning (DaCosta, 2010; McGuinness, 2006; Owusu-Ansah, 2004). Often, there is limited interaction between faculty and librarians 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 (Saunders, 2012). The pilot study described in this paper aimed to enhance the collaborative efforts between these two roles in order to allow them to share responsibility for teaching students information literacy skills in an innovative way.

More research, from a user perspective, is needed to discover the best strategies for maximizing m-learning, including discovering what is the best mobile device for accessing digital information tools such as the MIL, and what form the content needs to take to contribute to effective m-learning to engage mobile learners. The passion to help student learners improve their information skills using mobile devices shaped the research framework for this project. Overall, the research on the educational use of mobile devices is in the early stages and limited research includes case studies of different implementations. Cross-faculty and library collaborations are still needed.

Outcomes of this project will have several meaningful and significant contributions to the emerging knowledge in the field of m-learning. To be successful and independent learners for life, students must graduate with the ability to successfully navigate electronic environments. Understanding and using both the information and technology related to their fields of study is deemed critical. With emergence of new technology, ways to develop information and digital literacy skills in the curriculum that interact with mobile technology offers exciting possibilities (Sandars, 2012; Saunders, 2012).

We ask the question, "Is m-learning the next evolutionary step of e-learning?" To fill the gap in the research, this innovative project was designed and implemented to support and enhance m-learning pedagogy at Renison University College. Students enrolled in both the Bachelor of Social Work and the Bachelor of Social Development Studies degree programs are required to write numerous academic papers over the course of their programs. Many students struggle with information literacy in searching for appropriate information and evaluating the validity of sources. It is especially critical that students understand how to conduct research and be self-reliant in the electronic information environment at a time when there is less need to consult with a librarian or to access a library.

It is anticipated that m-learning will grow quickly in the next few years. With the development of a variety of mobile devices that are more powerful, portable and have increased Wi-Fi access, this research will serve as a foundation for developing and promoting segments of mobile learning among students, the community and beyond. There is an apparent gap between the information literacy skills that faculty want their students to have and those that they actively support and develop. It is a gap that faculty and librarians from various faculties are best placed to fill as collaborators and bridge builders. This project begins this collaborative, bridge-building process.

Methodology and methods

Our study used a mixed-method (quantitative and qualitative) non-experimental approach, including both pre- and post- literacy tests and student questionnaires. This project and the survey instruments were approved by the Research Ethics Board at the University of Waterloo. Ninety-one university undergraduate students participated in the project during the fall 2014 and winter 2015 school semesters as part of their course activities from five Social Development Studies (SDS) and Social Work classes at Renison University College. University participants ranged in year of study from their second year to their fourth year. Undergraduates in four of the five participant groups completed a pre-test, thirteen mobile information literacy 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. riding a bus). Students in the comparison group (n=32) received a one hour research skills library workshop and completed the pre and post digital literacy test, but they did not participate in the thirteen online literacy lessons.

A short training session on the use of the MIL tool was provided by the librarian to students before completing the on-line lessons. At the start of the session, participants completed paper and pencil pre-tests to determine a baseline understanding of information literacy. On-line student participants completed pre-test/post-test surveys through a web link accessed using their course newsfeed in the university's 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 respectively. Additionally, students provided an assessment of their use of the MIL tool at the end of the semester. All study participants received a 1% bonus mark in their course at the end of the completion of the study.

Both quantitative and qualitative data was collected and coded. Statistical analysis of the completed surveys and questionnaires was done using Survey Monkey`s Analyze tool and by reviewing the raw data through the program Wordpress (https://wordpress.org). Opened ended questions were coded and thematically analyzed while usage of the MIL web app tool was explored through Google Analytics. The data was analyzed for program improvement, MIL tool enhancement and expansion, and as basic research in the emerging field of information literacy instruction.

Findings

Data collected through a Survey Monkey link, an online cloud-based survey tool, retained participant demographic information and survey results. Almost 60% of students were in a post-degree Bachelor of Social Work program, while 25% of students were in an undergraduate SDS program and the remaining students (about 15%) identified their programs as other arts faculty or humanities programs (psychology, sociology, French or fine arts). The comparison group demographics closely matched with other participant groups and consisted of thirty two Bachelor of Social Work students. Most study participants were female (90%) and 77% of the participants were between the ages of eighteen and twenty-five, while 3.5% of participants indicated they were

over fifty years of age. Prior to participating in this MIL pilot study, almost 87% of students had not received any type of literacy skills training.

Close to ninety-eight percent of participants owned a smartphone and 58% of these participants were Apple iPhone users. This group reported using their phone and other mobile devices (i.e. tablets) on a daily basis. Only twenty-eight percent of this group used a mobile device to search for academic related information despite daily usage, while thirty-six percent of them made phone calls with their device. Texting was their main use (86%), while 35% browsed the internet and less than 10% of students played games on their smartphones.

Students who accessed academic information or conducted research on their phones significantly preferred using a Google search engine (69%)over other search tools, such as the University of Waterloo's research and discovery tool, Primo (29%), other research databases, including Google Scholar (30%), or RefWorks (3%), a web-based citation and bibliography tool.

Variations in accessing the mobile lessons by study participants were noted (see Table 1) as some lessons proved to be more frequently accessed than others.

Table 1. Access to the mobile lessons by study participants

Lessons	Response Percent
Locate: Lesson 1: An Introduction to Primo Central	60.2%
Locate: Lesson 2: The Basics: How to Search	44%
Locate: Lesson 3: Finding Articles	78.3% (3)
Locate: Lesson 4: Finding Peer Reviewed Journals	82.3% (1)
Evaluate: Lesson 5: Evaluating Information Sources	73.3% (4)
Evaluate: Lesson 6: Peer Review Process	60%
Evaluate: Lesson 7: Popular Vs. Scholarly Resources	73.2% (5)
Use: 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	64.1%
Use: Lesson 12: How to Approach Assignments	68.2%
Use: Lesson 13: What is a Paragraph?	56.8%

Seventy-nine participants completed the pre and post-tests, the MIL questionnaire, and all thirteen information lessons. A majority of those participants (77.2%) gained or maintained their MIL knowledge as evidenced by the test results. Of those, 50.63% improved their information literacy knowledge while 26.58% maintained their knowledge from beginning to end of the semester. There was a decrease in test scores noted in 23% of participants.

Study Findings: Information Literacy Knowledge

Several key findings emerged during the review of the information literacy knowledge pre and post-test scores for participant and comparison group scores (see Table 2). These included: 1) three of the four participant group score averages (participant groups A,B, and D) increased substantially (about 50%), 2) Group B, who had the least number of participants (n=4), varied significantly in final scores in relation to all other groups and increases in knowledge were not reported, 3) many of the online participants (75%) had significant improvements in their post test scores, 4) over one-quarter (28%) of the study participant's information literacy knowledge decreased from beginning to the end of the semester while about half that number (12.5%) of comparison participants information literacy knowledge declined, and 5) comparison group participant post-test scores were surprisingly strong and actually surpassed the post test scores of the participant students that completed the MIL lessons via smartphones.

Table 2. Information Literacy Knowledge Pre-Post Test Score Results

	Number of participants	Increase		Decrease		Maintain		Total
		N	%	N	%	N	%	%
TOTAL participants 99								
On-campus participants								
A. SDS-01	27	16	59.3%	7	25.9%	4	14.8%	100%
B. SDS-02	4	0	0%	3	75%	1	25%	100%
C. Social Work	16	8	50%	4	25%	4	25%	100%
Online participants								
D. Social Work online	20	13	65%	5	25%	2	10%	100%
Participants (A+B+C+D)	67	37	55.2%	19	28.4%	11	16.4%	100%
Comparison group								
E. Comparison Group (SW)	32	16	50%	4	12.5%	12	37.5%	100%

Notable enhancements (55%) in information literacy knowledge occurred for three of the four participant groups from the beginning to the end of the semester, whether they completed the mobile lessons online or through their smartphones (see Table 3). For participant group A (n=27), a class in SDS, almost 60% (16 of 27) of the students demonstrated an increase in information literacy knowledge from the start of classes to the end of the semester. Almost 38% maintained the information literacy knowledge throughout the semester. These students were required to write research paper proposals, which were then used as the starting point for their course research papers. Perhaps group A students were able to apply what they learned from the MIL tool directly to their course assignments.

The smallest participant group B (n=4) varied significantly from the other groups. This small group did not improve their information literacy scores by the end of the semester (0%), rather the scores decreased for three of the four students while the fourth student retained the information literacy knowledge from the beginning to the end of the semester. As voluntary participation in this project was offered to students and only four volunteered from this class, perhaps the results may not be representative due to small numbers.

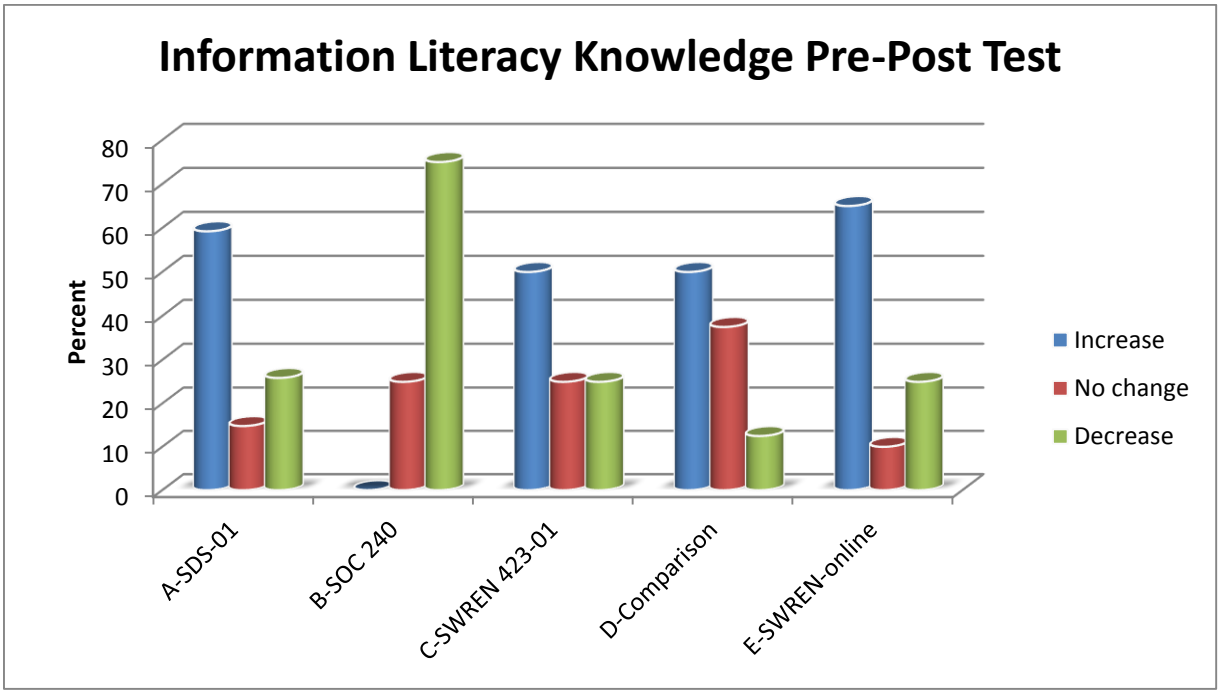
Seventy-five percent (12 of 16 students) in the social work Group C (n= 16) participant group retained or increased their information literacy knowledge over the course of the semester. Online

learners, Group D (n=20) demonstrated the greatest increases (65%) in information literacy of the study participants. Seventy-five percent of those online students who increased their post test scores recorded gains of thirty to forty percent. Could this be a reflection of a student's familiarity and comfort with online learning where they easily gravitated to the online modules?

Scores between the pre and post-tests decreased for some students in all participant groups indicating a loss of information literacy knowledge. The loss of information literacy knowledge was greater for those students in the online class (about 25%) than the participants in the comparison group (12.5%). The 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.

Comparison group E members that received the in-class information literacy tutorial demonstrated significant gains during the semester. Twelve comparison group students (40%) maintained their information literacy knowledge at the same level, as compared to twenty (65%) of the online Social Work class. It is interesting to note that over eighty-seven percent of the students who received their information literacy lesson in person retained or increased their information literacy knowledge as compared to forty-eight (71.6%) of the students who received the information via their smartphones. Not all students in the participant groups completed all the thirteen lessons which may explain the decline in their follow up test scores. The research team also recognizes this is a pilot study and future development, enhancement and refinement of the MIL tool, pre and post tests and the questionnaire are necessary which may impact outcomes and may address the variance in scores.

Table 3. Information Literacy knowledge Pre-Post Test



The authors of this paper present the study findings in Table 3 as preliminary results and a reflection on lessons learned from our pilot study. These results will inform Stage 2 of the MIL project e.g. testing the revised MIL tool, revised pre/post-test surveys and questionnaires, and a larger sample size.

Description of the MIL Tool

The MIL web app contains 13 lessons, focusing on how to locate, evaluate and use information (Figure 1) and is accessible at URL: http://beam.to/renmil. The learning contents are designed for use with the University of Waterloo's library resources and services. The lessons contain multiple instructional videos about topics such as Boolean operators, database functions, writing search strategies using keywords, and bibliographic management tools such as Refworks.

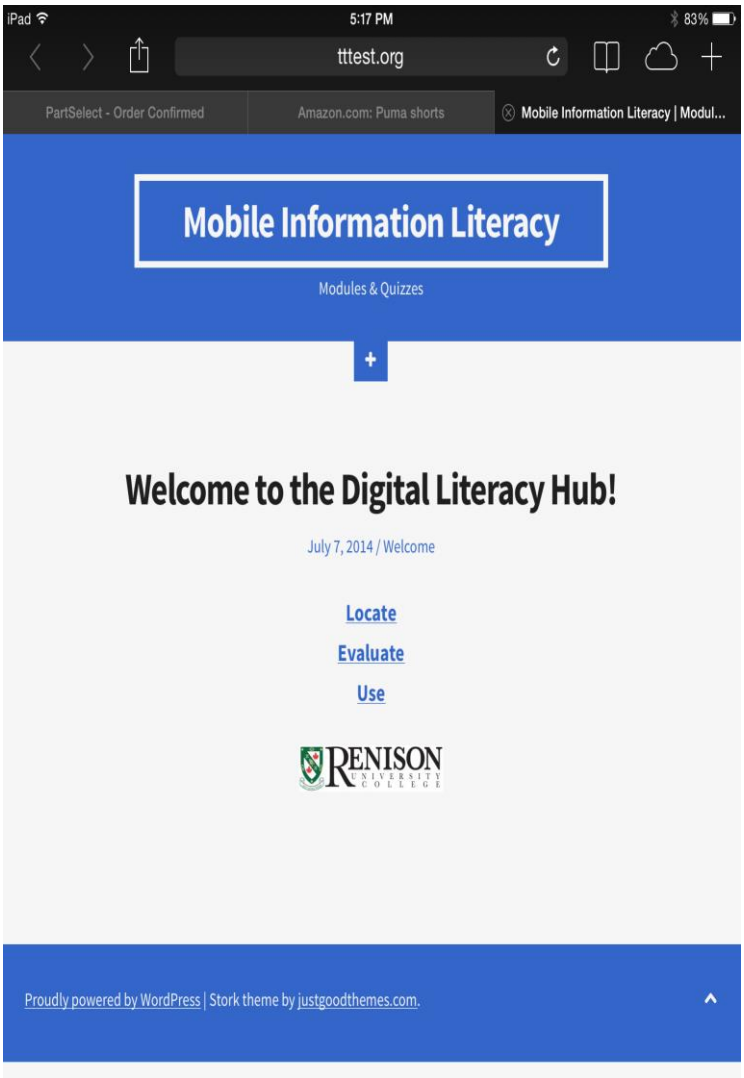
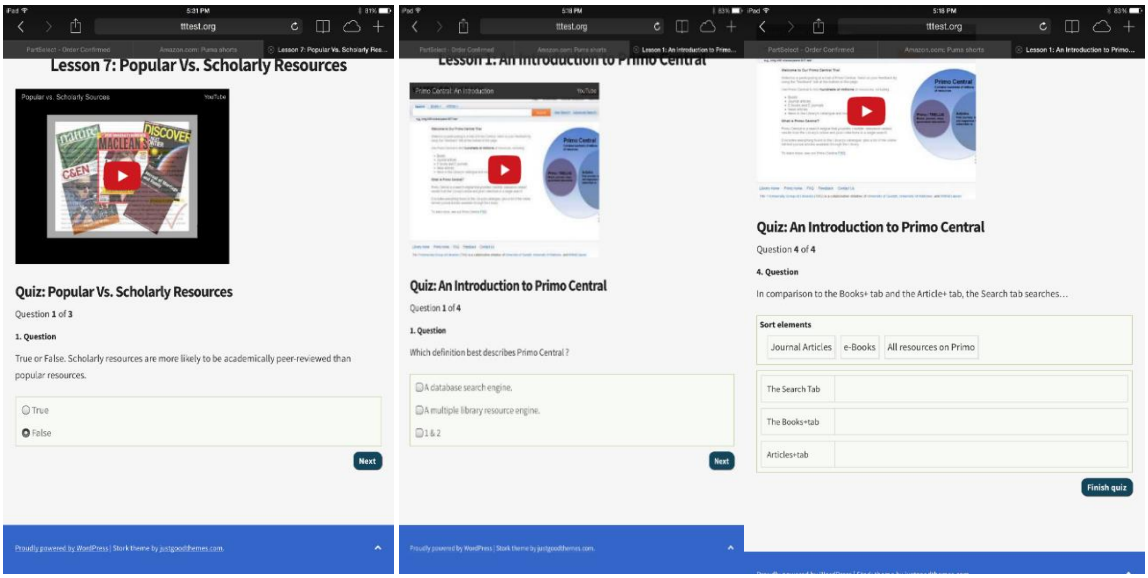
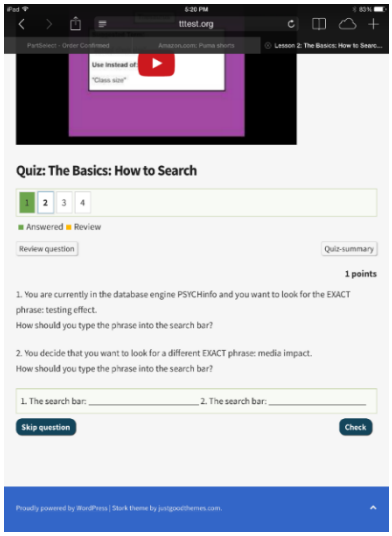


Figure 1. Web App

Many information literacy 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/False, Multiple Choice, Text Impute, and Drag and Drop as demonstrated in Figure 2.



True/False Multiple Choice Text input



Drag and Drop

Figure 2. Different types of interactive exercises

The web app also provides two types of assessment tools to evaluate students' progress as shown in Figure 3. The formative assessment allows students to complete one question and then view their results before moving on to subsequent questions. The summative evaluation permits student to view their results at the end of the lesson exercise and to compare their results with peers.

The web app also 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.

Formative Evaluation Summative Evaluation

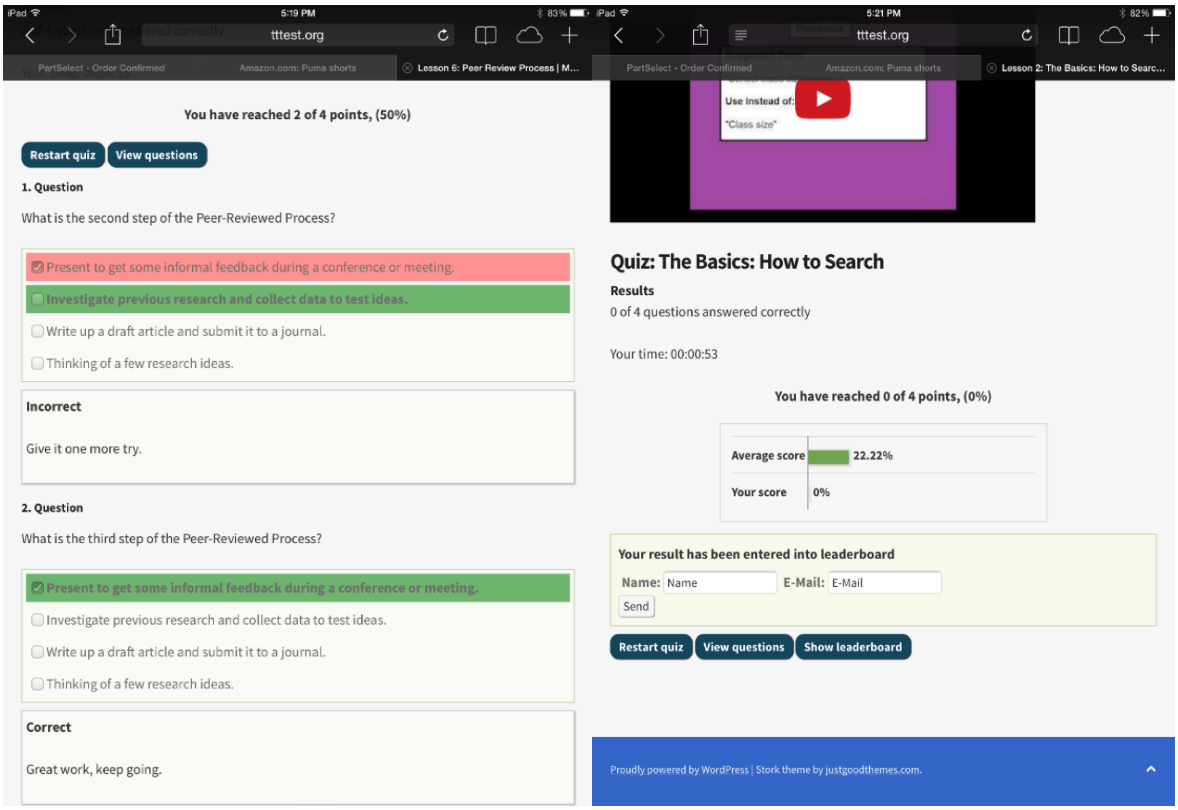


Figure 3. Summative and formative response

The MIL web app runs on WordPress (https://wordpress.org), an open source content management system based on MYSQL and PHP. It generates content on the fly without any html programming involved. MIL utilizes a mobile plugin to auto-detect the mobile browser and load the mobile version of the MIL site. For assessment, a plug-in program called Wp-Pro-Quiz generates different types of quizzes and the web app also tracks users' scores and generates statistical reports. Google Analytics was used to analyze student use and engagement, especially time spent on the MIL site and detects the content students interacted with the most.

Discussion

MIL training for students, especially mobile learners will enhance mobility and flexibility in learning, as well as enable students to be "spontaneous, personal, informal, contextual, portable, ubiquitous, and pervasive" (Kukulska-Hume, 2005, p.5). Most participants in the pilot study expressed a positive experience using the mobile web app technology to learn information literacy skills, and appreciated the flexibility of "anytime" availability of the MIL materials. Study participants identified positive experiences with m-learning. They felt that this project gave them a new opportunity to learn: about information literacy; an appreciation for the visual aspects of the MIL tool; a better understanding of how mobile phones can be used as tools for efficiency; accessibility to the vast quantity of information available on the internet (especially Wi-Fi access), and the speed with which the lessons could be completed using the tool.

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 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 keyboard or the phone lacked a keyboard altogether; need to use more multimedia, including videos and interactive exercises; MIL web app is only optimized for IOS use, thus causing some

viewing issues on Android devices (e.g. Drag and Drop exercises work with touch screen devices); and slow Internet connectivity may impact access to videos in MIL lessons.

Some concerns raised by participants can be addressed by incorporating more sophisticated instructional design and by improving the accessibility and functionality of the mobile friendly website, while others such as the size of the screen and the limitations on band width are inherent limitations of the current technology. Shurtz and von Isenburg (2011) contend that increased screen size and touch features on contemporary mobile devices are expected to increase the use of mobile technology in education.

The MIL tool has the potential to be an important aid for m-learning, however to make it more effective some enhancements and upgrading of features in the tool and in the lessons will be required. Not all MIL contents are fully interactive. Phase 2 of this study/tool will aim to enhance student learning and will do further testing of learning analytics. With these enhancements, students will be better able to access MIL training resources with interactive module formats on demand with multimedia-rich content (such as text, audio, and video),with the aim of increasing learner motivation and interest while facilitating more self-directed study. Future implementation of HTML5 will allow better animation, smooth video playback, and the capability to run the app and store content on the local device even when disconnected from the Internet. We suggest that information literacy training could be delivered more effectively if MIL was embedded in the curriculum.

Analysis of the data gathered in the pilot and sharing of the lessons learned from the process will benefit future research. Phase 2 will begin in September 2015 with the goal of increasing the number and scope of student participants.

Conclusions

Notwithstanding the general increase in mobile applications, our research indicates that there is a need to collect more information to develop a strong underlying evidence base to support the benefits to students of m-learning and information literacy training. Information literacy is not a standard part of classroom content, but appears to be provided only to those students who actively seek out the information. Based on our early findings, it appears that students' information literacy knowledge may be linked to specific training. This leads the authors to advocate that information literacy be embedded as part of the classroom curriculum. This project has reinforced our belief that both learners and educators need to develop a range of information literacy skills and that they be provided supportive materials to take full advantage of and make the best use of the emerging technologies.

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