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Developing multiple literacies for BSc Information Management students

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Abstract:

This study examines the development of information, computer software, and Web 2.0 literacies among undergraduate students at the University of Hong Kong. A survey was administered to students undertaking the Bachelor of Science in Information Management three times: on entry, in the middle, and towards the completion of the program. It assessed their self-reported literacy levels and their perceptions of familiarity with and the importance of the three literacies. Preliminary findings indicated that students had improved in all three forms of literacy at the end of the two academic years. Moreover, positive associations were found between their familiarity with each literacy, and their perceptions of its importance. Mastering multiple literacies fosters life-long learning by enabling students to search for information effectively and use applications such as Web 2.0 tools and computer software to present their ideas in academic activities and ultimately in the workplace. Accordingly, the study has implications for educators and librarians working to develop multiple literacies among Hong Kong university students.

Keyword: multiple literacies, information literacy, Web 2.0, computer software

1. Introduction

In the 21st century, the literacy landscape has changed from a print-saturated to a multimodal semiotic system (Luke, 1996; Kress, 2003; Iyer & Luke 2010). Accordingly, multiple literacies have been advocated as a new pedagogical approach by both educators and researchers. Numerous studies have been conducted on these multiple literacies and the use of technology to enhance teaching and learning (see for example Tynes, 1998; Baguley, Pullen, & Short, 2010; Westby, 2010; Hilton, Nicholas, & Gitsaki, 2010). The focus is on developing students' skills and knowledge in the face of globalization and the technological advances of the 21st century as well as promoting lifelong learning as a way of coping with rapid change. Building on earlier work funded by a Teaching Development Grant, this study investigates the development of information, computer software, and Web 2.0 literacies among a cohort of 21 undergraduates on the Bachelor of Science in Information Management (BScIM) program at the University of Hong Kong.

2. Literature Review

In this section, the constructs of multiple literacies (information, computer software, and Web 2.0 literacy) are defined and the ways in which students use software and Web 2.0 applications for educational purposes discussed.

2.1 Multiple literacies

The New London Group, a group of educators including Cazden, Cope, Fairclough, and Gee (Cazden et al., 1996), point out that traditional language-based approaches should be replaced by a pedagogy of multiple literacies in order to meet the rapid changes brought about by globalization, technological advancement, and social diversity. There are various definitions of multiple literacies. For example, Tynes (1998) suggests that the concept consists of computer, networking, technology, information, media, and visual literacy while Westby (2010) believes that its scope needs to be extended beyond the conventional areas of reading and writing to include computer, media or technology, and cultural literacies. It can be seen that Tynes (1998) and Westby (2010) offer a broad range of examples. Others, however, view multiple literacies as a function of the impact of technology. Baguley, Pullen, and Short (2010), for example, point out that technological advancement leads to a multiplicity of communication platforms and an increase in awareness of, and exposure to, linguistic and cultural diversity.

2.2 Information literacy

Various definitions of this have been proposed. Sawetrattanasatian (2008) compares three standard models of information literacy used in academic libraries in Australia, USA, and the UK. She concludes that their common features include searching for information effectively and efficiently, evaluating information sources critically, organizing and using

information properly and ethically, and proactively contributing new ideas and knowledge. In view of her comprehensive analysis, this study adopts this definition.

2.3 Computer software and Web 2.0 applications

In 2004, O'Reilly coined the term Web 2.0. Chiang, Huang, and Huang (2009) demonstrate that it is an umbrella term used to explain various Web developments. Its key benefits include improved collaboration, active user participation and social networking, convenient file sharing, and a rich user experience. Alexander (2008) suggests that educators consider the demand for new literacies in a Web 2.0 world and help students to develop multiple skill sets and maximize their experience with Web 2.0 tools for the benefit of students. In addition, Godwin (2009) shows that librarians use Web 2.0 applications to supplement their information literacy interventions and keep up with trends. In line with Godwin's findings (2009), Chu et al. (2010) show that social networking tools are a useful way for academic librarians to facilitate information and knowledge sharing and to enhance their reference service. While Chu and Du (2010) acknowledge the benefits of social networking tools, they also show that such tools allow "interaction with student library users" (Chu & Du, n.d., p.16) for minimal cost and help students in learning such as making it easy to share ideas with each other.

2.4 University students' use of software and Web 2.0 applications

Various software and Web 2.0 applications are widely used by university students. Web 2.0 tools such as Blackboard, blogs, wikis, and Moodle are used for web-based learning (Hazari & North, 2009); MySpace and Facebook for social networking; and Second Life for social gaming (Kearns & Frey, 2010). A number of studies demonstrate how such tools can benefit students (Aharony, 2009; Chan & Cmor, 2009; Chu, 2008; Dang & Robertson, 2010). Dang and Robertson (2010) point out that they create opportunities for expressing ideas, strengthening confidence, and increasing engagement with learning through virtual interaction. Chu (2008) shows that undergraduates agree that the Wiki is useful for collaboration, knowledge sharing, and keeping track of the work contributed by each member; it may also result in the production of better-quality work. Moreover, Chan and Cmor (2009) note that students regard blogs as a useful learning tool since they can share their learning process with peers and subsequently improve their academic performance. Likewise, Chu, Chan, and Tiwari (2011) point out that blogging is rated positively by students in terms of information sharing, problem solving, knowledge construction, and learning from internship experiences. In addition, Aharony (2009) reveals that deep learners use Web 2.0 tools more than their compatriots and consider them to be more important; they also demonstrate more motivation to learn. Furthermore, Chu and Law (2005) and Chu, Fong, and Tan (2010) find that students regard databases and resources as more important to learning when they are more familiar with them, while Chu, Chan, and Tiwari (2011) shows that frequent blog users rate blogging as more effective for learning than do less frequent users.

The above review shows the relationship which students have with multiple literacies in the 21st century. Most of these studies have looked at the efforts of educators, teachers, and librarians to help students develop multiple literacies. However, there is a lack of longitudinal research examining such development. This is the gap this study attempts to address.

3. Research Methodology

The paper reports on a two-year longitudinal study carried out with a single cohort of BScIM students at the University of Hong Kong. This project investigated the development of the students' information, computer software, and Web 2.0 literacies in the context of their academic studies.

3.1 Research questions

To understand how BScIM students develop their information literacy, computer software literacy and Web 2.0 literacy during a period of two years, five research questions were formulated as follows:

- 1.1 What is BScIM students' development in Information Literacy?
 - 1.1.1 What are the information needs for BScIM students and do these needs change over time?
 - 1.1.2 What do BScIM students need in terms of search knowledge and skills and do these needs change over time?
- 1.2 What is BScIM students' development in Computer software literacy?
- 1.3 What is BScIM students' development in Web 2.0 literacy?

3.2 Instruments

Twenty-one students joined the BScIM program in September 2009 and responded to a paper-based survey of self-reported perceptions, developed specifically for this study by the research team at the Faculty of Education of the University of Hong Kong. Three surveys looking at the perceived importance of, and familiarity with, information, computer software, and Web

2.0 literacy among the group were administered over the following two academic years, in September 2009-the start of students' degree program, April 2010-the middle of the students' degree program, (at the end of the first academic year) and April 2011-the time the students had almost finished their degree program.

4. Findings and Discussion

This section discusses the development of the three areas of literacy as the students pursued their courses. The data were analyzed using a paired-sample t-test and Friedman's analysis of variance (ANOVA). Items to which the respondents answered "don't know" were not included in the analysis.

Results

Research question 1.1: The development of BScIM students in information literacy

i) Students' perceived familiarity with various electronic databases / internet resources / search engines¹ (see Footnote 1)

In this section, respondents were asked to self-report their familiarity with various resources and databases. The results of the ANOVA comparison of the mean ratings across the three surveys is $X^2(2) = 10.58$, $p = 0.0050$, suggesting that the overall familiarity of students with various resources and databases changed significantly over the study period. As shown in Table 1, The mean of the total ratings in the third survey is 3.19, showing that students are "somewhat familiar" with the listed resources and databases. For each individual resource and database, the changes in perceived familiarity between the first and second surveys are not obvious. However, when comparing the second and third surveys (that is, at the end of the first and second years of the program) the familiarity ratings for CSA, ERIC, and Google Scholar increase significantly, implying that students have become more familiar with these databases in the interim. In addition, if the first and third surveys are compared, the ratings for 7 out of the 16 items increase. These seven items (EBSCOhost, ERIC, Google Scholar, Lexis-Nexis, Scopus, Web of Science, and Wise News) are commonly used study tools.

Table 1: Students' perceived familiarity with various electronic databases/internet resources/ search engines

Perceived familiarity Item	Total ratings at the beginning of the program (First survey)	Total ratings in the middle of the program (second survey)	Total ratings in the time towards the end of the program (Third survey)	Comparing of the 1 st and 2 nd surveys		Comparing of the 2 nd and 3 rd surveys		Comparing of the 1 st and 3 rd surveys	
	Mean (SD)	Mean (SD)	Mean (SD)	t statistic	p value	t statistic	p value	t statistic	p value
CSA	2.45 (1.37)	2.20 (1.42)	2.94 (1.34)	1.922	0.103	-3.000	*0.012	-1.871	0.104
EBSCOhost	2.83 (1.19)	3.24 (1.26)	3.86 (0.96)	-0.361	0.726	-1.928	0.069	-3.674	*0.005
ERIC	2.42 (1.16)	2.81 (1.21)	3.52 (1.21)	-0.800	0.447	-3.145	*0.006	-4.914	*0.001
Google Scholar	2.95 (1.16)	3.81 (0.98)	4.19 (0.87)	-1.862	0.077	-2.447	*0.024	-4.690	*0.000
HKALL	3.41 (1.23)	3.95 (0.97)	4.00(0.84)	-0.382	0.707	-0.237	0.815	-0.746	0.466
HKU Library Catalog	3.57 (1.25)	3.95 (0.80)	4.10 (0.83)	-0.679	0.505	-0.462	0.649	-0.326	0.748
Lexis-Nexis	2.23 (0.93)	2.90 (1.07)	2.75 (0.97)	-1.166	0.271	-1.505	0.150	-2.846	*0.017
LISA	2.64 (1.75)	2.29 (1.53)	2.75 (1.45)	1.508	0.182	-0.692	0.504	-0.935	0.381
ProQuest	3.59 (1.18)	3.24 (1.09)	4.00 (0.77)	0.000	1.000	-2.041	0.056	-2.072	0.055
Scopus	1.33 (0.78)	2.07 (1.21)	2.37 (1.34)	-0.264	0.809	-0.261	0.802	-3.361	*0.015
PsychInfo	1.33 (0.65)	1.54 (0.97)	1.76 (1.09)	0.293	0.789	-0.277	0.793	-1.348	0.235
Web of Science	1.83 (0.94)	2.13 (1.15)	3.00(1.21)	0.000	1.000	-2.144	0.053	-4.320	*0.003
WorldCat	2.54 (1.27)	2.19 (1.38)	2.58 (1.43)	2.291	0.062	-1.265	0.242	-1.305	0.221
Research Pro	1.93 (1.21)	2.13 (1.41)	2.83 (1.47)	-0.798	0.451	-0.521	0.614	-0.936	0.377
Wise News	3.41 (1.12)	3.24 (1.26)	3.48 (1.12)	-0.211	0.836	-1.129	0.273	-2.711	*0.016
China Info Bank	1.92 (1.38)	1.80 (1.08)	2.56 (1.20)	1.206	0.294	-0.403	0.699	-1.673	0.133
Overall	2.68 (0.85)	2.87 (0.83)	3.19 (0.78)	-0.996	0.331	-2.211	*0.039	-2.837	*0.010

Notes: * indicates $p < .05$

0=Don't know, 1=Not Familiar, 2=A Little familiar, 3=Somewhat familiar, 4=Familiar, 5=Very familiar

¹ Electronic databases, resources, and search engines are referred as "various resources and databases" throughout the tables in this paper.

ii) Students' perceived familiarity with various information search knowledge & skills

In this section, respondents were asked to self-report their familiarity with commonly used search terms such as Keyword and Boolean operators AND/OR/NOT. The results of the ANOVA comparison of the mean ratings given to these items across the three surveys is $X^2(2) = 3.63, p=0.1629$, suggesting that the overall familiarity of students with elements of information search knowledge and skills did not change significantly during the study period. But, as shown in Table 2, overall, there are significant changes in students' perceived familiarity with various information search knowledge and skills when comparing the second and third surveys as well as the first and third surveys. In the third survey, the mean ratings of all items are > 3 , demonstrating that students becoming "somewhat familiar" with search skills and knowledge by the time they have almost completed the program. In addition, the ratings of the six items (AND, OR, Parentheses, Wildcard, Proximity and step 4: conduct a search statement) have increased significantly, indicating an increase in students' familiarity when compared the first survey with the third survey. Moreover, the first five items are related to advanced search skills and knowledge, implying that students have become more familiar with advanced search skills and knowledge as they approach the later stage of the program.

Table 2: Students' perceived familiarity with various information search knowledge & skills

Perceived familiarity Item	Total ratings at the beginning of the program (First survey)	Total ratings in the middle of the program (second survey)	Total ratings towards the end of the program (Third survey)	Comparing of the 1st and 2 nd surveys		Comparing of the 2 nd and 3 rd surveys		Comparing of the 1 st and 3 rd surveys	
	Mean (SD)	Mean (SD)	Mean (SD)	t statistic	p value	t statistic	p value	t statistic	p value
Keyword	4.10 (0.77)	4.10 (0.77)	4.19 (0.60)	0.000	1.000	-0.525	0.605	-0.525	0.605
Subject	3.90 (0.94)	3.81 (0.93)	4.10 (0.77)	0.491	0.629	-1.826	0.083	-1.164	0.258
Field (author)	4.10 (0.89)	4.00 (0.86)	3.81 (1.12)	0.252	0.804	0.645	0.527	1.188	0.249
Field (title)	4.10(0.89)	4.10 (0.77)	4.19 (0.75)	0.000	1.000	-0.491	0.629	-0.491	0.629
Date/ year/ time period	3.71 (0.90)	3.81 (0.87)	3.95 (0.86)	-0.462	0.649	-0.591	0.561	-1.227	0.234
Material type	3.86 (0.96)	3.90 (0.83)	4.24 (0.54)	-0.271	0.789	-1.919	0.069	-1.793	0.088
Thesaurus	3.28 (1.02)	3.32 (0.95)	3.43 (0.93)	-0.899	0.382	-0.776	0.448	-0.697	0.495
Step 1; identify key concepts	3.67 (0.91)	3.71 (0.85)	3.86 (0.73)	-0.295	0.771	-0.900	0.379	-0.940	0.358
Step 2: choose search items	3.76 (0.77)	3.76 (0.89)	3.76 (0.77)	0.000	1.000	0.000	1.000	0.000	1.000
Step 3: Decide on appropriate databases search	3.20 (1.11)	3.48 (0.98)	3.67 (1.02)	-1.228	0.234	-0.940	0.358	-1.406	0.176
AND	3.62 (1.16)	3.90 (1.04)	4.24 (0.62)	-1.240	0.229	-1.323	0.201	-2.444	*0.024
OR	3.57 (1.16)	3.86 (1.01)	4.24 (0.62)	-1.240	0.229	-1.563	0.134	-2.751	*0.012
NOT	3.43 (1.16)	3.57 (1.03)	4.00 (0.95)	-0.616	0.545	-1.686	0.107	-1.743	0.097
Parentheses	2.25 (1.16)	3.25 (1.16)	3.86 (0.79)	-3.720	*0.002	-2.668	*0.015	-7.193	*0.000
Wildcard	2.69 (1.40)	2.95 (1.28)	3.62 (0.80)	-1.369	0.191	-2.390	*0.027	-2.267	*0.039
Truncation	3.24 (1.39)	3.38 (1.12)	3.86 (0.79)	-1.000	0.332	-1.870	0.076	-1.661	0.116
Proximity	2.24 (1.39)	2.71 (1.15)	3.43 (0.87)	-1.251	0.229	-2.752	*0.012	-3.035	*0.008
Step 4: Conduct a search statement	2.30 (1.26)	3.29 (0.96)	3.67 (0.80)	-3.249	*0.004	-1.504	0.148	-4.925	*0.000
Overall	3.42 (0.80)	3.61 (0.70)	3.89 (0.54)	-1.528	0.142	-2.297	*0.033	-3.002	*0.007

Notes: * indicates $p < .05$

0=Don't know, 1=Not familiar, 2=A Little familiar, 3=Somewhat familiar, 4=Familiar, 5=Very familiar

Research question: 1.1.1 Information needs for BScIM students and how these needs change over time

The self-reported ratings of the perceived importance of various skills, higher ratings suggest a greater need of the students for such skills. The analysis of information needs in this study is therefore based on students' ratings of the perceived importance of various resources and databases.

i) Students' perceived importance of various source types

Students were asked to rate a number of different potential sources of information in terms of their importance. The results of the ANOVA comparison of their mean ratings across the three surveys is $X^2(2) = 3.45$, $p = 0.1778$ imply that there is no significant change over time. For individual items, as shown in Table 3, the ratings given to journals, conference papers, encyclopedias, statistical sources, and consultations with lecturers changed significantly between the first and third surveys. For example, the rating given to lecturers as a source decreased from 4.05 to 3.67 with $p < 0.05$, suggesting that students seem to progress through their courses and come to rely less on lecturers' assistance. Looking at the other items, such as journals and statistical sources, the ratings increased (with a significance of $p < 0.05$) between the first and both the second and third surveys. This indicates that students came to regard conference papers and encyclopedias as more important in the later stages of the program.

Table 3: Students' perceived importance of various source types

Item	Total ratings at the beginning of the program (First survey)	Total ratings in the middle of the program (second survey)	Total ratings in the time towards the end of the program (Third survey)	Comparing the 1st and 2 nd surveys		Comparing the 2 nd and 3 rd surveys		Comparing the 1 st and 3 rd surveys	
	Mean (SD)	Mean (SD)	Mean (SD)	t statistic	p value	t statistic	p value	t statistic	p value
Books	4.00 (0.77)	4.00 (1.00)	4.29 (0.72)	0.000	1.000	-1.188	0.249	-1.451	0.162
Journals	3.67 (0.80)	4.33 (0.66)	4.57 (0.51)	-4.183	*0.000	-1.420	0.171	-4.990	*0.000
Conference Papers	2.70 (0.92)	2.76 (1.14)	3.57 (0.75)	-0.645	0.527	-3.179	*0.005	-4.344	*0.000
Encyclopedias	3.33 (0.86)	3.38 (0.86)	3.86 (0.79)	-0.175	0.863	-2.225	*0.038	-2.329	*0.030
Magazines	2.52 (0.81)	2.55 (1.10)	2.86 (1.20)	0.195	0.847	-1.324	0.201	-1.323	0.201
Newspapers	3.00 (0.89)	2.95 (0.92)	3.43 (1.03)	0.237	0.815	-1.870	0.076	-1.627	0.119
Internet Resources	3.95 (1.20)	4.05 (0.86)	3.90 (1.04)	-0.346	0.733	0.616	0.545	0.161	0.874
Statistics sources	3.05 (0.67)	3.62 (0.67)	3.86 (0.65)	-3.230	*0.004	-1.227	0.234	-3.302	*0.004
Guide Books	3.62 (1.12)	3.43 (1.03)	3.76 (0.94)	0.777	0.446	-1.375	0.184	-0.471	0.642
Consult Lecturers	4.25 (0.55)	4.43 (0.60)	3.67 (1.15)	-0.900	0.379	2.860	*0.010	2.459	*0.024
Consult Librarian	2.94 (1.11)	2.22 (0.73)	2.90 (1.22)	2.703	*0.017	-2.650	*0.017	0.000	1.000
Other Students	3.57 (0.75)	3.53 (0.84)	3.38 (1.16)	0.718	0.482	0.156	0.878	0.722	0.479
Discussion Group	3.19 (0.93)	3.15 (0.88)	3.33 (1.02)	0.252	0.804	-0.567	0.577	-0.460	0.651
Overall	3.37 (0.42)	3.42 (0.48)	3.64 (0.55)	-0.563	0.580	-1.601	0.125	-1.837	0.081

Notes: * indicates $p < 0.05$

0=Don't know, 1=Not important, 2=A Little important, 3=Somewhat important, 4=Important, 5=Very important

ii) Students' perceived importance of various electronic databases / internet resources / search engines

Students were asked to rate the importance of various databases and other resources as well as assessing their familiarity with them. The results of the ANOVA comparison across the three surveys for overall is $X^2(2) = 2.19, p = 0.3341$. This indicates no significant change in ratings overall over the research period. However, the scores assigned to most items shown in Table 4 below increased between the first and each of the second and third surveys. The perceived importance of EBSCOhost and ERIC, the two most popular multiple-disciplinary databases, increased significantly over all three surveys with $p < 0.05$, indicating that students found them useful in their studies. In general, the ratings given to the electronic databases and resources studied here, except for Scopus, PsychInfo, WorldCat, and Wise News, increased significantly over the study period, albeit less so than for EBSCOhost and ERIC.

Table 4: Students' perceived importance of various electronic databases / internet resources / search engines

Perceived familiarity	Total ratings at the beginning of the program (First survey)	Total ratings in the middle of the program (second survey)	Total ratings in the time towards the end of the program (Third survey)	Comparing of the 1st and 2 nd surveys		Comparing of the 2 nd and 3 rd surveys		Comparing of the 1 st and 3 rd surveys	
				t statistic	p value	t statistic	p value	t statistic	p value
Item	Mean (SD)	Mean (SD)	Mean (SD)						
CSA	3.00 (1.41)	2.50 (1.34)	3.29 (1.26)	-0.426	0.681	-3.395	*0.005	-0.885	0.399
EBSCOhost	3.30 (1.42)	3.45 (1.15)	4.05 (1.12)	-2.548	*0.027	-2.648	*0.015	-5.451	*0.000
ERIC	3.00 (1.12)	3.00 (1.17)	3.80 (1.01)	-2.602	*0.025	-2.855	*0.010	-4.780	*0.001
Google Scholar	3.48 (0.87)	4.00 (0.95)	4.52 (0.60)	-2.828	*0.010	-1.504	0.148	-4.812	*0.000
HKALL	3.88 (1.11)	4.05 (0.92)	4.10 (0.89)	-1.646	0.119	-0.195	0.847	-2.864	*0.011
HKU Library Catalog	4.10 (1.04)	4.20 (0.77)	4.19 (0.87)	-1.706	0.104	-0.591	0.561	-1.759	*0.094
Lexis-Nexis	2.27 (0.90)	2.95 (1.36)	3.58 (1.17)	-2.889	*0.014	0.590	0.563	-2.112	*0.056
LISA	3.63 (1.30)	3.00 (1.15)	3.39 (1.33)	-0.480	0.642	-1.936	*0.072	-1.437	0.181
ProQuest	3.71 (1.36)	3.79 (1.03)	4.33 (0.58)	1.000	0.332	-3.200	*0.004	-2.163	*0.046
Scopus	2.13 (0.83)	2.80 (1.32)	3.24 (1.03)	-2.121	0.078	0.000	1.000	-1.992	0.074
PsychInfo	2.29 (1.25)	2.50 (1.31)	3.25 (1.18)	-0.311	0.766	-0.247	0.810	-1.295	0.224
Web of Science	2.33 (1.22)	2.69 (1.11)	3.65 (1.09)	-0.667	0.524	-1.741	0.102	-5.164	*0.000
WorldCat	3.27 (1.56)	2.70 (1.06)	3.61 (1.14)	0.000	1.000	-1.417	0.178	-1.105	0.291
Research Pro	3.10 (1.52)	3.08 (1.38)	3.44 (1.34)	-1.047	0.318	-3.287	*0.005	-2.560	*0.025
Wise News	3.44 (0.89)	3.40 (0.99)	3.81 (0.98)	0.511	0.616	-1.156	0.261	-0.545	0.593
China Info Bank	2.56 (1.42)	2.56 (1.24)	3.17 (1.25)	1.474	0.179	-1.865	0.089	-2.449	*0.032
Overall	3.34 (0.88)	3.28 (0.76)	3.71 (0.77)	0.287	0.777	-2.088	*0.050	-1.651	0.114

Notes: * indicates $p < 0.05$

0=Don't know, 1=Not important, 2=A Little important, 3=Somewhat important, 4=Important, 5=Very important

Research questions:1.1.2 BScIM students' needs in terms of search knowledge and skills and how these needs change over time

i) Students' perceived importance of various information search knowledge and skills

The result of the ANOVA comparison of the mean ratings of the three surveys is $X^2(2) = 9.77, p=0.0076$. This indicates a significant change over time. The overall mean rating increased from the first survey "Somewhat important" to the third survey "Important". As shown in Table 5, the comparison between the first and third surveys is significant at $p<0.05$, and the overall mean score in the third survey is >4 (4 signifying a rating of "important"). By the time of the third survey, students regarded most of the items as at least "Important," except for the use of thesaurus, wildcard, truncation, and proximity which were considered "somewhat important". The perceived importance of individual items such as Date/Year/Time period, AND, OR, and NOT have positive changed between the first and third surveys. Ratings for parentheses, truncation, proximity, and Step 4: conducting a search statement also changed significantly between the first and each of the second/third surveys, suggesting that there is a greater need for advanced search skills and knowledge as students approach the later stages of their course.

Table 5: Students' perceived importance of various information search knowledge & skills

Perceived familiarity Item	Total ratings at the beginning of the program (First survey)	Total ratings in the middle of the program (second survey)	Total ratings in the time towards the end of the program (Third survey)	Comparing the 1st and 2nd surveys		Comparing the 2nd and 3rd surveys		Comparing the 1st and 3rd surveys	
	Mean (SD)	Mean (SD)	Mean (SD)	t statistic	p value	t statistic	p value	t statistic	p value
Keyword	4.43 (0.51)	4.38 (0.50)	4.43 (0.60)	0.439	0.666	-0.295	0.771	0.000	1.000
Subject	4.38 (0.59)	4.10 (0.70)	4.19 (0.75)	1.369	0.186	-0.568	0.576	1.000	0.329
Field (author)	4.19 (0.75)	4.10 (0.64)	4.38 (0.74)	0.418	0.681	-1.157	0.262	-1.000	0.329
Field (title)	4.33 (0.73)	4.33 (0.48)	4.48 (0.51)	0.000	1.000	-1.142	0.267	-1.142	0.267
Date/ year/ time period	3.52 (0.98)	3.71 (1.01)	4.19 (0.81)	-0.777	0.446	-1.805	0.086	-2.646	*0.016
Material type	3.76 (0.94)	4.00 (0.95)	4.19 (0.68)	-0.839	0.411	-0.777	0.446	-1.752	0.095
Thesaurus	3.47 (1.12)	3.79 (0.79)	3.86 (1.06)	-1.374	0.187	-0.399	0.695	-1.509	0.149
Step 1; identify key concepts	4.14 (0.73)	4.19 (0.93)	4.38 (0.67)	-0.204	0.841	-0.748	0.463	-2.024	0.056
Step 2: choose search items	4.00 (1.05)	4.14 (0.96)	4.43 (0.68)	-0.498	0.624	-1.101	0.284	-2.007	0.058
Step 3: Decide on appropriate databases search	4.00 (0.97)	4.00 (1.05)	4.38 (0.59)	-0.271	0.789	-1.403	0.176	-1.798	0.088
AND	3.71 (1.19)	4.00 (1.14)	4.38 (0.67)	-1.240	0.229	-1.251	0.225	-2.197	*0.040
OR	3.67 (1.20)	4.05 (1.16)	4.33 (0.73)	-1.563	0.134	-0.900	0.379	-2.197	*0.040
NOT	3.43 (1.21)	3.86 (1.20)	4.19 (0.81)	-1.686	0.107	-1.022	0.319	-2.212	*0.039
Parentheses	3.10 (1.12)	3.76 (1.04)	4.30 (0.73)	-3.036	*0.007	-1.697	0.106	-4.060	*0.001
Wildcard	3.39 (0.92)	3.75 (0.97)	3.86 (0.79)	-2.263	*0.037	-0.590	0.562	-2.051	0.056
Truncation	3.37 (1.01)	3.90 (0.97)	3.95 (0.80)	-2.974	*0.008	-0.384	0.705	-2.721	*0.014
Proximity	3.06 (0.73)	3.75 (1.02)	3.80 (0.83)	-3.273	*0.005	-0.170	0.867	-3.429	*0.003
Step 4: conduct a search statement	3.30 (1.17)	3.81 (1.03)	4.05 (0.67)	-2.146	*0.045	-0.894	0.382	-3.000	*0.007
Overall	3.72 (0.67)	3.97 (0.68)	4.21 (0.55)	-1.762	0.093	-1.332	0.198	-3.327	*0.003

Notes: * indicates $p<0.05$

0=Don't know, 1=Not important, 2=A Little important, 3=Somewhat important, 4=Important, 5=Very important

Research question: 1.2 The development of BScIM students in computer software literacy

While the preceding sections have focused on aspects of information literacy, the study also explored students' perceptions of their own familiarity with, and the importance of, computer software literacy.

i) Students' perceived familiarity with computer software

The results of the ANOVA comparison of the mean ratings across the three surveys is $X^2(2) = 26.05, p=0.0000$, indicating that self-rated familiarity with computer software changed significantly over time. As shown in Table 6, most items have changed in familiarity over time. The rating has increased over the three surveys even the overall mean rating in the third survey is "a Little familiar". This suggests that although students have room to improve their familiar with computer software, they have progressed in familiarity with the computer software.

Table 6: Students' perceived familiarity with computer software

Item	Total ratings at the beginning of the program (First survey)	Total ratings in the middle of the program (Second survey)	Total ratings in the time towards the end of the program (Third survey)	Comparing of the 1st and 2 nd surveys		Comparing of the 2 nd and 3 rd surveys		Comparing of the 1 st and 3 rd surveys	
	Mean (SD)	Mean (SD)	Mean (SD)	t statistic	p value	t statistic	p value	t statistic	p value
Statistical Software (SPSS)	1.08 (0.29)	1.62 (1.12)	2.05 (1.13)	-1.793	0.111	-1.301	0.220	-2.212	0.054
Bibliographic software (EndNote)	2.00 (0.77)	3.20 (1.01)	3.62 (1.16)	-3.922	*0.001	-1.577	0.131	-4.777	*0.000
Project management software	2.12 (0.70)	2.68 (0.95)	2.95 (1.32)	-1.581	0.135	-1.102	0.285	-3.234	*0.005
Database management software	2.60 (0.75)	3.10 (0.94)	2.76 (1.04)	-2.364	*0.029	1.435	0.167	-0.547	0.591
Data Mining Software	1.50 (0.65)	1.82 (0.95)	2.37 (0.96)	-1.166	0.271	-1.817	0.088	-2.561	*0.026
Web Page Authoring Tools	2.32 (0.95)	2.95 (0.94)	2.81 (0.98)	-2.557	*0.020	0.490	0.629	-1.569	0.134
Record Management Tools	1.33 (0.49)	1.71 (1.21)	2.06 (0.80)	0.000	1.000	-1.046	0.312	-3.000	*0.015
Online Survey Tools	1.77 (0.73)	2.57 (1.50)	2.89 (1.20)	-1.000	0.341	-1.395	0.188	-3.045	0.011
Digital Library Software	1.54 (0.66)	2.45 (1.28)	2.52 (0.93)	-3.323	*0.006	-0.513	0.614	-3.338	*0.006
Digital Document Publishing Tools	3.10 (0.79)	3.55 (0.94)	3.76 (1.26)	-1.455	0.163	-1.377	0.185	-1.878	0.076
Digital Storytelling Software	2.42 (0.96)	3.19 (1.21)	2.85 (1.23)	-2.333	*0.031	1.630	0.119	-1.095	0.289
Video Editing Software	2.95 (1.00)	3.71 (0.85)	3.62 (0.97)	-3.036	*0.007	0.439	0.666	-2.042	0.055
Animations on Web	1.62 (0.77)	2.47 (1.35)	2.30 (0.98)	-3.458	*0.005	-0.212	0.834	-3.000	*0.012
Advanced Spreadsheet Software	2.27 (1.10)	2.89 (1.33)	2.50 (1.15)	-2.323	*0.036	0.776	0.449	-1.325	0.208
Overall	2.20 (0.56)	2.76 (0.63)	2.81 (0.61)	-3.265	*0.004	-0.449	0.658	-3.591	*0.002

Notes: * indicates $p < .05$

0=Don't know, 1=Not familiar, 2=A Little familiar, 3=Somewhat familiar, 4=Familiar, 5=Very familiar

ii) Students' perceived importance of computer software

The result of the ANOVA comparison of the mean ratings across the three surveys is $X^2(2) = 5.70$, $p = 0.0580$, indicating no significant change over time. As shown in Table 7, the overall mean item rating is "somewhat important." There was no significant change in perceived importance over the three surveys for most of the items, except Web page authoring tools and digital library software. The ratings for Web page authoring tools have significantly increased when comparing the first and the second surveys. On the other hand, the ratings for digital library software have significantly decreased when comparing the second/third survey and first/third surveys. This suggests that students regard the digital library software as less important in the later stage of the study.

Table 7: Students' perceived importance of computer software

Item	Total ratings at the beginning of the program (First survey)	Total ratings in the middle of the program (second survey)	Total ratings in the time towards the end of the program (Third survey)	Comparing of the 1st and 2 nd surveys		Comparing of the 2 nd and 3 rd surveys		Comparing of the 1 st and 3 rd surveys	
	Mean (SD)	Mean (SD)	Mean (SD)	t statistic	p value	t statistic	p value	t statistic	p value
Statistical Software (SPSS)	3.08 (0.79)	2.91 (1.14)	3.15 (1.14)	0.359	0.729	-0.612	0.555	0.000	1.000
Bibliographic software (EndNote)	3.84 (0.69)	3.67 (1.06)	3.86 (0.91)	0.697	0.494	-0.940	0.358	-0.170	0.867
Project management software	3.29 (1.05)	3.50 (1.04)	3.67 (1.06)	-0.487	0.634	-1.000	0.331	-1.237	0.234
Database management software	3.85 (0.88)	3.71 (0.90)	3.52 (1.17)	0.438	0.666	1.000	0.329	1.277	0.217
Data Mining Software	3.00 (0.58)	3.17 (1.15)	3.10 (1.22)	-0.249	0.808	0.747	0.466	0.000	1.000
Web Page Authoring Tools	3.05 (1.00)	3.81 (0.87)	3.67 (1.06)	-3.000	*0.007	0.679	0.505	-2.065	0.053
Record Management Tools	3.25 (0.62)	3.73 (1.19)	2.95 (1.15)	-1.000	0.351	1.491	0.167	1.242	0.242
Online Survey Tools	3.07(0.88)	3.79 (1.19)	3.38 (1.20)	-1.876	0.087	0.234	0.818	-0.544	0.595
Digital Library Software	3.57 (0.85)	3.58 (1.02)	2.43 (1.40)	-0.201	0.844	4.135	*0.001	2.738	*0.017
Digital Document Publishing Tools	3.65 (0.67)	4.00 (0.89)	4.10 (0.94)	-1.064	0.301	-0.525	0.605	-1.453	0.163
Digital Storytelling Software	3.30 (0.86)	3.50 (1.10)	3.05 (1.20)	-0.334	0.743	1.719	0.104	1.022	0.320
Video Editing Software	3.35 (0.81)	3.62 (0.92)	3.38 (1.16)	-0.698	0.494	0.925	0.366	0.152	0.881
Animations on Web	2.69 (0.75)	3.17 (1.34)	2.43 (1.16)	-1.732	0.111	3.010	0.008	0.249	0.808
Advanced Spreadsheet Software	3.18 (0.88)	3.71 (1.05)	3.62 (1.07)	-1.000	0.334	-0.169	0.868	-1.098	0.289
Overall	3.31 (0.48)	3.52 (0.64)	3.30 (0.74)	-1.248	0.227	1.697	0.105	0.290	0.775

Notes: * indicates $p < .05$

0=Don't know, 1=Not important, 2=A Little important, 3=Somewhat important, 4=Important, 5=Very important

i) Students' perceived familiarity with Web 2.0 applications

The result of the ANOVA comparison of the mean ratings across the three surveys is $X^2(2) = 5.92$, $p = 0.0518$ implies that there is no significant change. The overall mean ratings for the three surveys are "Somewhat important". For individual items, as shown in Table 8, there is significant change for Google Docs and RSS (Really Simple Syndication) between the second and third surveys. The other differences are not significant. Although there is no significant change for most items, the ratings for applications including Blogs, Wiki, Google Docs, Podcasting and Social networking are "Familiar". This suggests that the students are familiar with the commonly used Web 2.0 applications.

Table 8: Students' perceived familiarity with Web 2.0 applications

Item	Total ratings at the beginning of the program (First survey)	Total ratings in the middle of the program (Second survey)	Total ratings in the time towards the end of the program (Third survey)	Comparing the 1st and 2nd surveys		Comparing the 2nd and 3rd surveys		Comparing the 1st and 3rd surveys	
	Mean (SD)	Mean (SD)	Mean (SD)	t statistic	p value	t statistic	p value	t statistic	p value
Blogs	3.55 (0.94)	3.80 (0.89)	4.10 (0.89)	-0.528	0.604	-1.097	0.287	-1.602	0.126
Wikis	3.70 (1.17)	3.81 (0.81)	4.00 (0.84)	-0.170	0.867	-0.890	0.384	-0.839	0.412
Google Docs	3.47 (0.90)	3.90 (0.89)	4.38 (0.74)	-1.509	0.149	-2.500	*0.021	-3.923	*0.001
Podcasting	3.95 (0.89)	4.05 (0.80)	4.24 (0.70)	-0.213	0.834	-1.164	0.258	-1.314	0.204
RSS	2.08 (0.95)	2.13 (1.19)	3.00 (1.38)	0.244	0.813	-4.036	0.001	-1.939	0.076
Media Sharing	2.85 (1.04)	3.00 (1.22)	3.48 (1.12)	-0.203	0.841	-1.599	0.125	-1.868	0.077
Social Bookmarking	2.24 (1.03)	2.87 (1.36)	2.86 (1.11)	-1.723	0.110	0.000	1.000	-1.237	0.234
Social Networking	3.90 (1.12)	4.00 (1.21)	4.33 (0.80)	-0.309	0.761	-1.143	0.267	-1.165	0.258
Overall	3.31 (0.76)	3.48 (0.73)	3.80 (0.69)	-0.549	0.589	-1.907	0.071	-1.936	0.068

Notes: * indicates $p < .05$

0=Don't know, 1=Not familiar, 2=A Little familiar, 3=Somewhat familiar, 4=Familiar, 5=Very familiar

ii) Students' perceived importance of Web 2.0 applications

The result of the ANOVA comparison of the mean ratings across the three surveys is $X^2(2) = 1.97$, $p = 0.3729$ implies that there is no significant change. As shown in Table 9, the overall rating for each item is "somewhat important." When viewing individual items between the first and second surveys, it can be seen that the ratings for the perceived importance of Wikis and RSS increased significantly. Google docs and social networking also showed a significant increase between the first and third surveys. Also, same as with Table 8: students' perceived familiar with Web 2.0 applications, the ratings of perceived importance of Google Docs, Podcasting and Social networking are also "Important". This suggests that there is correlation between their perceived familiarity with and perceived importance to students.

Table 9: Students' perceived importance of Web 2.0 applications

Item	Total ratings at the beginning of the program (First survey)	Total ratings in the middle of the program (Second survey)	Total ratings in the time towards the end of the program (Third survey)	Comparing the 1st and 2nd surveys		Comparing the 2nd and 3rd surveys		Comparing the 1st and 3rd surveys	
	Mean (SD)	Mean (SD)	Mean (SD)	t statistic	p value	t statistic	p value	t statistic	p value
Blogs	2.84 (1.26)	3.60 (1.31)	3.38 (1.16)	-1.822	0.086	0.448	0.659	-1.235	0.233
Wikis	3.65 (0.67)	4.15 (0.75)	3.95 (0.92)	-4.025	*0.001	1.045	0.309	-1.000	0.330
Google Docs	3.50 (1.19)	4.10 (0.85)	4.43 (0.60)	-1.637	0.119	-1.371	0.186	-3.758	*0.001
Podcasting	3.70 (0.86)	3.71 (1.01)	4.05 (0.67)	0.170	0.867	-1.435	0.167	-1.143	0.267
RSS	2.87 (1.06)	3.50 (1.03)	3.10 (1.04)	-2.511	*0.026	1.046	0.312	-1.099	0.290
Media Sharing	3.15 (1.04)	3.78 (0.65)	3.24 (1.09)	-1.329	0.203	1.304	0.210	-0.188	0.853
Social Bookmarking	2.84 (1.12)	3.41 (1.06)	3.19 (0.93)	-1.519	0.150	0.398	0.696	-1.302	0.209
Social Networking	3.45 (1.19)	3.81 (1.21)	4.29 (0.85)	-1.101	0.285	-2.351	0.029	-2.792	*0.012
Overall	3.25 (0.64)	3.68 (0.81)	3.70 (0.58)	-2.121	*0.047	-0.130	0.898	-2.757	*0.013

Notes: * indicates $p < .05$

0=Don't know, 1=Not important, 2=A Little important, 3=Somewhat important, 4=Important, 5=Very important

5. Findings and conclusion

These findings demonstrate what kinds of databases, resources, search skills and knowledge, software, and Web 2.0 applications are familiar and important to undergraduates and for which there is demand. It also identifies areas of weakness, primarily the use of certain software packages and applications. These results can inform librarians and faculty members

seeking to enhance the curriculum and design tailor-made workshops to help students develop multiple literacies. In addition, this work can also help librarians to understand the kinds of databases, software packages, and Web 2.0 applications students want to use, enabling them to enhance the management of their collections. As well as librarians and university administrators, undergraduates themselves can also benefit from the study as they can use it to identify the skills and knowledge necessary to develop their own information, computer software, and Web 2.0 literacies.

Although the study presents a longitudinal analysis and hence can identify changes in the participants' perceptions of what is important and familiar across the three literacies, further investigation is suggested to identify what kinds of interventions will affect their development, and the mechanism of such influence. For example, students rated their perceived familiarity with, and importance of, Web 2.0 applications as "somewhat important/familiar" across the three surveys. This may be due to the usability of such applications, as discussed by Chu and Kennedy (2011) and Chu (2008). In their work, students pointed out the disadvantages of MediaWiki and TwiKi, including the low user-friendliness of the interface and technical problems such as difficulties with formatting text. These factors could have a significant effect on the choice of applications used by students. This may also affect the perceived importance and perceived familiarity with the tools by students as well as motivation for students to develop skills and knowledge of these tools. Therefore, further research should be conducted to find out what interventions may influence the development of multiple literacies.

To conclude, this research shows that undergraduates' familiarity with, and their perceptions of the importance of, information, computer software, and Web 2.0 literacy changed across the two academic years studied. In general, their overall ratings increased over time, suggesting that students both enhance familiarity with all three forms of literacy and also come to consider them as more important. Moreover, the study also identifies a positive correlation between familiarity and perceived importance across all three literacy types. When students become more familiar with a particular literacy, they tend to regard it as more important than the others.

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