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Information Literacy of First-Year Undergraduates across Disciplines - Engineering, Architecture, and Information Technology

Vathsala Wickramasinghe[1], Thushari Seneviratne[2]

Department of Management of Technology, Faculty of Business, University of Moratuwa, Sri Lanka
Correspondence author email : vathsala@uom.lk

A B S T R A C T		A R T I C L E I N F O
The literature suggests that students commence university education with limited levels of IL, and this is true for both developed and developing countries. When universities understand entry-level students' actual level of IL at the beginning of their undergraduate programmes, universities can objectively describe entry-level undergraduates' IL levels and take steps to improve the levels to match with required revels for academic success. The purpose of the study was to investigate the information literacy of first-year undergraduates of engineering, architecture, and information technology disciplines when they commence their university education, and whether socio-demographic characteristics are associated with the information literacy of first-year undergraduates. 545 first-year undergraduates covering the three study disciplines responded to the survey questionnaire. Quantitative methods were used to analyse the data. Findings revealed that although information literacy exists in undergraduates to a certain extent, these vary by the discipline of study. The findings imply the need of addressing information literacy requirements by the discipline of the study to better serve undergraduates. Overall, the results lead to understanding information skills and behaviour of entry-level undergraduates, and what kinds of library services are appropriate and necessary for undergraduates across disciplines.		

1. INTRODUCTION

Information literacy (IL) forms the basis for academic success at university as an utmost important set of generic skills required for lifelong learning. A lifelong learner has access to needed information and can make an informed judgement based on the information to which they are exposed throughout his/her lifetime in different capacities, circumstances, and contexts (Clark and Catts, 2007). We investigated information literacy (IL) in the academic context. It is widely acknowledged that IL plays an important role on university students; lack or insufficient levels of IL limits undergraduates in searching, retrieving, evaluating, and using information for academic performance (Lwehabura, 2016). Since IL has been identified as a set of generic skills that illustrate an important graduate attribute, assessment of IL of undergraduates is essential (Catts, 2005).

This paper presents findings of an empirical investigation into IL of first-year undergraduates belonging to three different disciplines- engineering, architecture, and information technology (IT). The specific objectives of the study were to investigate (i) IL of first-year undergraduates of the three disciplines when they commence their university education, and whether their skills vary by the discipline of study, (ii) whether socio-demographic characteristics predict IL of first-year undergraduates, and (iii) whether first-year undergraduates perceive formal instruction as an important mean of gaining IL.

Our study makes important contributions, which are valuable for academics, researchers, practitioners, and policymakers. First, universities are faced with the challenge to inculcate IL considering it as a lifelong learning requirement (de Arenas et al., 2014). This implies the importance of understanding the extent to which students are information literate when they enter the university. Students commence university education with limited levels of IL, and this is true for both developed and developing countries (Ellis and Salisbury 2004; Gabridge et al., 2008; Rowlands, 2008; Lwehabura, 2016). When universities understand entry-level students' actual level of IL at the beginning of their undergraduate programmes, universities can objectively describe entry-level undergraduates' IL levels and take steps to improve the levels to match with required revels for academic success. Hence, it is vital for universities to understand the extent to which first-year undergraduates are information literate to appreciate the value of quality scholarly information, develop abilities to apply sophisticated information seeking, retrieval, and use strategies, use efficiently available information resources during the undergraduate degree programme, and apply the ethical and legal use of information. Therefore, it is vital to understand the IL of students during the beginning of their university lives, i.e., in their early first year of university education. Second, the literature suggests that IL requirements could vary across study disciplines (Catts, 2005; Clark and Catts, 2007). This suggests that IL is discipline specific. If universities know the levels of IL of entry-level undergraduates (1st year) across disciplines at the beginning of their university lives, suitable strategies could be applied in the teaching and learning process to enhance their information literacy requirements. Third, knowing entry-level undergraduates' IL levels is important for librarians to have a sense on who these undergraduates are and to customize IL instructional programmes by their study disciplines to better serve them. Having all these in mind this study has been undertaken to provide useful information for informed decision-making.

Information literacy (IL) as: "a set of abilities requiring individuals to recognize when information is needed and to locate, evaluate, and use effectively the needed information" (The American Library Association (ALA), 1989). A higher education-specific definition of IL is given by the Society of College, National and University Libraries (SCONUL, 2004), where IL

encompasses library user education or formal instruction in the area of transferable skills on the use of information in the context of learning, teaching, and research in higher education. Hence, IL as a concept includes both information skills such as accessing needed information, evaluating information and its sources, managing information, applying information, and using information ethically and legally as well as information behaviour (Clark and Catts, 2007; Pinto and Sales, 2007) such as organization and planning, problem-solving, capacity for analysis and synthesis, computer literacy, information management skills, and decision-making. Therefore, IL in the higher education context denotes a wider concept than that described in general, and IL is a necessity for the successful completion of course work and research projects of an undergraduate degree programme.

The literature suggests that many undergraduate students entering the university lack IL. However, exact levels of IL in students at the time of university entrance are not known due to the lack of information available when students move from high school to tertiary education (Yager et al., 2013). Further, although universities provide IL instruction during the university degree programme, undergraduates' real level of IL at the beginning of university education has rarely been evaluated. It is also suggested that many entry-level undergraduates are poor at expressing information needs, evaluating information and information source management (Petermanec and Šebjan, 2017). Below expectations in IL in entry-level undergraduates raise the question about universities' ability to inculcate these in undergraduates during the university degree programme. However, for successful instruction, knowing the entry-level undergraduates' levels of IL is advantageous across disciplines. Our study was set to investigate entry-level undergraduates' IL across three disciplines of engineering, architecture, and IT in a developing Asian country, Sri Lanka. Based on the above reviewed literature it is hypothesised, H1: There are significant differences in IL of first-year undergraduates across disciplines.

Our review of the literature led to reveal, on the one hand, that investigating the influence of individual characteristics on IL is not much popular. On the other hand, IL research is not much popular in the non-Western context. However, some previous studies emphasised the importance of taking into account individual and family-related characteristics in IL research (Catts and Lau, 2008; Latham and Gross, 2013). We investigated six individual and family-related characteristics in the study to examine whether these are associated with the possession of IL in entry-level undergraduates. The individual characteristics were age, sex, the existence of siblings, and Z Score achieved in the university entrance examination. Information and the skills to use it are needed in every society, but the ways that a citizen may identify and express information needs are affected by family patterns, language, and religion, among other social factors" (Catts and Lau, 2008). Building on these arguments, we included two family-related characteristics. These were whether respondents had grandparents or any other relatives living with them during their school days who had an influence on them, and the role of mother, i.e., in a paid employment or housewife. Therefore, it is H2: Individual and family-related characteristics are associated with IL skills.

2. METHODS

The survey was conducted in one of the state universities in Sri Lanka. A random sample of undergraduate students of first-year across engineering, architecture and IT undergraduate degree programmes participated. Table 1 provides data on the population and sample. All three first-year cohorts were just entered the degree programme with three months of the university experience. Therefore, they were assumed to have general IL skills,

and have not yet been exposed to information sources exclusive to their respective study disciplines. All three first-year cohorts voluntarily respond to the anonymous survey questionnaire in the classroom setting. The paper-based survey was administered to each group of students on only one occasion. The survey was distributed at the end of a class and requested respondents to leave the completed survey at a designated place in the classroom. The questionnaire took approximately 15 minutes to complete. The survey was in the English language, which is one of the national languages of the country, and the only language for academic instruction at the university. Further, all forms of resources provided by the university library for the degree programme are in the English language.

Table 1. Population and sample

	Population	Sample (responses received)	% represented
Engineering	706	384	54
Architecture	291	122	42
IT	98	39	40

IL skills. We used two instruments to evaluate IL skills of undergraduates, where one instrument is called information skills while the other is called information behaviour (Clark and Catts, 2007; Pinto and Sales, 2007). Although both information skills and information behaviour scales sought responses in similar IL areas, the two scales differ based on the purpose of measurement. Specifically, the measure of information skills sought responses for the perceived level of IL possession while the measure of information behaviour sought responses for the perceived level of general competence achieved. The details of the measures are as follows.

Information skills. The 20-item scale of Clark and Catts was used. The scale assessed IL in five areas, namely, skills to access needed information, evaluate information and the information-seeking process, manage information, apply information, and use information ethically, legally and respectfully. Items were on a Likert-type scale ranging from always (4), often (3), sometimes (2), and never (1). The scale used is given in Appendix 1.

Information behaviour. The 20-item information behaviour scale of Pinto and Sales was used. The scale inquires general competence related to needs of, access to, processing of, and use of information. The scale assessed the degree of success achieved in organization and planning, capacity for analysis and synthesis, computer literacy, information management, and decision-making. Items were on a Likert-type scale ranging from very high (4), high (3), low (2), and very low (1). The scale used is given in Appendix 1.

Since our undergraduates were not exposed to IL instruction, we also inquired about their willingness to undertake such an instructional programme if provided.

Individual and family-related characteristics. We collected information on six characteristics. Data on age and number of siblings were collected on a ratio scale (years). Sex was coded as female (0) and male (1). We collected Z Score achieved by each respondent in the university entrance examination. We also inquired whether respondents had grandparents or any other relatives, who had influenced them, living with them during school days (yes [1] or no [0]), and the role of mother, i.e., in a paid employment (1) or housewife (0). These characteristics of the respondents are shown in Table 2.

Table 2. Individual and socio-demographic characteristics

	Engineering	Architecture	IT
Z Score in university entrance examination:			
Mean	2.2	2.5	1.6
Std. Deviation	0.4	0.9	0.3
Age:			
Mean	20.92	20.75	21.29
Std. Deviation	1.24	0.72	0.76
Minimum	19	19	19
Maximum	21	21	22
Sex (%):			
Male	71.7	45.8	62.9
Female	28.3	54.2	37.1
Siblings:			
Mean	1.73	1.62	1.89
Std. Deviation	0.87	0.74	0.68
Minimum	0	0	0
Maximum	4	5	4
Mode	1	1	2
During school days, grandparents or any other relatives lived with your family, who had an influence on you? (%):			
No	48.1	53.0	51.4
Yes	51.9	47.0	48.6
Mother's role (%):			
Housewife	55.4	65.8	60.0
In paid employment	44.6	34.2	40.0

The measures were subjected to appropriate internal consistency reliability, factor structure, convergent validity, discriminant validity, and construct reliability. Principle component factor analysis with Varimax rotation was performed on the variables of information skills and information behaviour. As expected the factors yielded corresponded with Appendix 1. Analysis of variance (ANOVA) was used to understand differences between the three cohorts. Regression analysis was used to identify how far information skills and information behaviour were influenced by individual and family-related characteristics.

3. RESULTS AND DISCUSSION

Table 3 shows the comparison of information skills and information behaviour across disciplines. The rank order based on the mean score is also shown in Table 3. As shown in Table 3, ANOVA results suggest some significant differences between the three cohorts. For example, even though all three groups scored the least for managing information, differences are significant for both information skills and information behaviour. Overall, based on the data shown in Table 3, H1 is partially supported. The data for the inquiry on first-year cohorts' willingness to undertake formal instruction on IL is shown in Table 4. Since none of the cohorts were exposed to formal instruction on IL, their willingness suggests their enthusiasm to enhance their IL.

Table 3. Comparison of IL

Information skills							Information behaviour				
Engineering	Architecture	IT	F	Differences:	Type	Type	Engineering	Architecture	IT	F	Differences:
Mean (Rank)	Mean (Rank)	Mean (Rank)					Mean (Rank)	Mean (Rank)	Mean (Rank)		
2.71 (1)	2.90 (1)	2.79 (1)	4.577*	Between Eng. and Arch.is significant	Apply information	Decision-making	2.83 (1)	2.93 (1)	2.71 (3)	1.537	-
2.71 (1)	2.77 (4)	2.69 (2)	0.514	-	Access needed information	Computer literacy	2.77 (2)	2.84 (2)	2.73 (2)	0.817	-
2.64 (3)	2.89 (2)	2.54 (4)	9.496***	Between Eng. and Arch. is significant. Between Arch. and IT is significant	Use information ethically, legally and respectfully	Organization and planning	2.68 (4)	2.77 (4)	2.74 (1)	1.508	-
2.58 (4)	2.82 (3)	2.60 (3)	8.661***	Between Eng. and Arch. is significant. Between Arch. and IT is significant.	Evaluate information and information sources	Capacity for analysis and synthesis	2.66 (5)	2.58 (5)	2.64 (5)	1.252	-
2.26 (5)	2.51 (5)	2.25 (5)	10.250***	Between Eng. and Arch. is significant. Between Arch. and IT is significant.	Manage information	Information management	2.70 (3)	2.83 (3)	2.70 (4)	3.819*	Between Eng. and Arch. is significant.

Table 4. Favour for formal instruction of IL (%)

	Engineering	Architecture	IT
Yes	60.1	58.0	77.1
No	39.9	42.0	22.9

A series of regression analysis were conducted to identify whether individual and family-related characteristics influence IL. Of the five information skills, only one, i.e., evaluate information and information sources, was found to be significantly associated with IL. None of the information behaviour was found to be significantly associated with individual and family characteristics. The results were shown in Table 5. Skills to evaluate information and information sources were predicted by whether mother being a housewife/paid employment, where undergraduates who had their mother as housewives showing the possession of the skill more than their counterparts. Overall, H2 is partially supported.

Tabel 5. Effect of individual and socio-demographic characteristics

	Evaluates information and information sources			
	Beta	R^2	**Adj R^2**	***F***
Z Score	.042	.031	.016	2.170[*]
Age	.051			
Sex	-.010			
Siblings	-.031			
Grandparents/ relatives lived	.051			
Mother's role	-.146[**]			

Note: significant results are shown

Discussion and implications

We investigated IL of three first-year undergraduate cohorts in Sri Lanka. The results showed the level of IL in terms of possession and confidence of the three groups. First, when IL is measured based on the information skill scale of Clark and Catts, the results showed in Table 3 suggest significant differences between the groups except for accessing needed information. When confidence in IL is measured with the information behaviour scale of Pinto and Sales, the results showed significant differences only in information management between engineering and architecture undergraduates, where architecture students showing the highest level of confidence. However, as shown in Appendix 1, the two scales used for the study measured the same areas of IL, where one scale measured possession of skills while the other measured confidence in the use of the skills. Hence, the results suggest more gaps in the possession of IL compared to confidence in the use of the skills. Further, when the rank order of the IL is taken into consideration, as shown in Table 3, in terms of the information skills scale all groups ranked applying information as the highest and managing information as the last; the other three skills were ranked differently by the three groups. However, when the rankings of the information behaviour skills were taken into consideration, the engineering cohort and architecture cohort ranked decision-making as the highest whereas the IT group ranked it as the third. Still, all three groups ranked capacity for analysis and synthesis as the last suggesting more improvements are needed in this area. Second, the majority of all the three groups identified the importance of developing their IL and shown willingness to attend such a programme. Third, the results

showed that the role of the mother is important in developing information skill of "evaluate information and information sources", where students who had their mother as a housewife showed higher levels of skill than when mother in paid employment. As discussed in the below paragraphs in detail, our study contributes to the existing literature in several aspects and has implications for the current undergraduate education practice.

Theoretical contributions of the findings

First, the IL literature identifies the field of user-focused studies as important since outcomes of such studies are helpful if designing better instructional programmes acknowledging users' IL gaps. Building on the IL literature on user-focused studies, we investigated three undergraduate cohorts in a university in a developing country (Pinto and Sales, 2007; de Arenas et al., 2014). When literature does not provide sufficient knowledge on users from different study disciplines and different region/country contexts, it limits the advancement of knowledge and the understanding of the applicability of Western-based methodologies in other parts of the world. Therefore, our study is novel and contributes to the existing literature.

Second, our investigation is about user-focused studies within the broader area of IL. Students who make the transition from secondary to tertiary education were found to possess an inadequate level of IL appropriate for university degree programmes (Gabridge et al., 2008; Lwehabura, 2016; Price et al., 2011). An understanding of users' existing levels of IL and the areas of improvement are the basis for designing instructional programmes. Unless their IL is assessed at the beginning of the studies at the university, the libraries find difficulties in designing instruction programmes addressing the real needs of the students. The literature provides evidence for different designs of user studies. Some studies already provide evidence of conducting user studies to identify a particular user cohort about their information needs and use (Seamans, 2002; Michalak et al., 2017). Getting responses from a larger sample of three students cohorts is a challenge compared to data collecting from small samples of faculty and librarians, and we successfully met the objectives set for our study.

Third, self-assessment of IL skills using a survey was used to determine the undergraduates' perception of their possession and confidence in IL. We used two different scales to evaluate IL- information skills scale and information behaviour scale. The literature supports the use of the self-assessment method and reveals that self-reported measurement scales are as reliable and valid as IL test scores (Gustavson and Nall, 2011). Although the items in these two scales correspond to similar IL areas (IL components), the two scales measured two different things. The information skills scale measures the perceived level of possession of IL whereas the information behaviour scale measures the perceived level of general competence achieved. We believe our user-oriented approach concerned with three different cohorts' perceptions have provided unique information about the IL needs of different cohorts of undergraduates. In this context, our investigation is novel and contributes to the literature.

Fourth, as stated above, investigations on IL demand the study of both possession of and confidence in IL. Achievement is not only based on the possession of necessary skills but also the confidence to use the skills (Bandura, 1977). Therefore, we investigated both areas in our study across three undergraduate cohorts. Findings presented in this article indicate the value of IL research across disciplines worldwide for further enhancement of the understanding.

Fifth, it is well accepted that students commence university education with limited IL skills and this is common in both developed and developing countries. Although data from developing countries are widely available, it is very rare to be found about developing countries. We provided an understanding of the IL instructional needs of three groups of first-year undergraduates at the beginning of their studies from a developing country. All three groups can be identified as below proficient in IL since all groups scored below average scores for all most all IL components (when 3 is considered as the middle point of a 5-point Likert scale) scores. The findings provide a deeper understanding of each group's requirements when designing and developing IL instructional programmes.

Implications of the findings for practice

Developing countries, like Sri Lanka, do not have its own standards, guidelines, principles, and models for IL in students at any level of education, such as high school or university levels. The results of our study may provide encouragement in the design and development of such for the wellbeing of its citizens. Unless IL is contextualized in one's context, it is difficult to provide evidence for achievements in IL.

Second, the acceptance of the need for IL as a graduate attribute emphasizes the need for IL instruction at universities. Our study showed that majority of undergraduates across the three disciplines at entry-level to the university identifying the value of formal instruction to acquire IL for academic achievements. This may push universities in developing countries to identify IL as part of the undergraduate education and ensure that IL to be recognised as part of the degree programme curricular.

Third, findings on undergraduate users and their possession and confidence in IL are the basis for the development of user-centric library services. The findings of users' IL are important in reaching out to undergraduates from different disciplines, like engineering and architecture, and making adjustments to library services to better serve respective undergraduate cohorts.

Fourth, in connection to the above, the IL components investigated in the study showed significant differences between the cohorts suggesting the requirement of customising IL instruction from one cohort to another. It is one of the most important contributions of our study since it is very rare to find studies of IL across different disciplines.

This section describes the results of data analysis based on the monitoring and evaluation of respondents to a questionnaire related to information systems in the university library conducted at the Raja Ashman Shah Library, Sultan Azlan Shah University (USAS).

4. CONCLUSION

The study investigated three cohorts of first-year undergraduates from the disciplines of engineering, architecture, and IT to identify each group's IL levels at the time they commence their university education. We inquired first-year students' uses and perceptions of IL by using two smiler scales of IL that evaluate the possession of the skills and information behaviour. We have shown some similarities and differences between the cohorts in their use of information. The findings of the study provide valuable information about first-year students, their skill deficiencies, and improvements needed for them to succeed during their undergraduate education, which can be used by faculty and the libraries in providing library instruction and services. The majority of first-year students from the three cohorts expressed the need and willingness to participate in formal instruction on IL. Results also suggest that individual and family characteristics can influence IL of students.

The findings make contributions to the existing knowledge on IL and implications for the development of IL in students as discussed in detail in the above paragraphs.

As an initial attempt, we investigated IL based on two scales that were more applicable to our study context when Sri Lanka does not have developed IL standards and practices to adhere to. Second, the study solely relied on data collected from a survey of first-year cohorts from the three study disciplines. We interpreted results based on the possession of information skills and confidence in information behaviour of the students, and undergraduate learning process from faculty and library perspectives. Data collection from other sources such as faculty and librarians may have broadened the scope of the study. Future research could enhance the understanding further by investigating reasons why students may not have left secondary schooling with accepted levels of IL. We inquired into a few selected individual and family-related characteristics and only one characteristic was found to be significant. Future research could include other possible variables as moderators of first-year undergraduates' levels of IL across disciplines. Furthermore, it is also possible to assume that students' instructional preferences of IL may also be affected by such characteristics. The last but not least, we investigated first-year undergraduates' levels of IL when they commence their university degree programme. However, we have not investigated whether the use of information is consistent across the three study disciplines. Since we have investigated three science and technology areas, it is possible to assume more consistent IL expectations. However, there can be differences when it comes to technology areas and social sciences. Therefore, establishing levels of IL expectations across study disciplines in future research would provide valuable information for academics, practitioners, and policymakers.

5. AUTHOR'S NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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