Information Research - Vol. 28 No. 3 (2023)

An inquiry-based teaching intervention to embed information literacy instructions into a library and information science curriculum in Bangladesh

Md Arman Hossain and Eero Sormunen
DOI: https://doi.org/10.47989/ir283332

Abstract

Introduction. This paper describes a novel pedagogical practice and reports its effectiveness in improving library and information science students' information literacy knowledge. In addition, it addresses the association of students' information and communication technology (ICT) self-efficacy with their information literacy learning.

Method. Pre- and post- test-based teaching interventions with a control group were carried out to test the effectiveness of the pedagogical practice. The study was quasi-experimental and used an equivalent group design.

Analysis. SPSS (version 27) was employed for the statistical analyses of the data. A one-way analysis of covariance (ANCOVA) was conducted to examine the differences between the intervention group (n= 35) and the control group (n= 36). Independent samples t-tests were carried out to see the differences between various groups. Pearson's correlations were conducted to measure relationships among dependent variables.

Results. Students who attended the novel guided-inquiry based information literacy instructions scored higher in the post-test than those who participated in regular class lectures. In addition, the students in the intervention group learned course subject contents as well as the controls. Students' ICT self-efficacy did not influence their overall learning of information literacy knowledge.

Conclusion. Considering the short duration of the intervention, the learning outcomes in information literacy were satisfactory. We gathered some experiences implementing a novel student-centred pedagogical practice in a developing country to help educators and researchers take such initiatives.

Introduction

During the last decades, we have witnessed how the role of academic libraries has been challenged by internet search engines as the primary channel to information resources. This revolution has made information more accessible for university students but, at the same time, created some educational problems (Williamson et al., 2008). Search engines offer easy access to various information resources, both high and low quality, without quality control. In the new situation, students need better skills for evaluating and applying easily accessible but heterogeneous information resources to avoid quality losses in learning and professional development (Metzger, 2007). Thus, teachers and curriculum developers have widely acknowledged the importance of information literacy (IL) instructions for university students. University librarians should also move forward and take the role of information literacy educators to help students overcome the challenges (McKinney, 2014).

University librarians in developed countries are accruing the responsibility of teaching information literacy skills to students. The librarian's educational role has become challenging as the focus has shifted from the effective use of library resources to more overall information literacy competences (Julien et al., 2018). Some information literacy elements are long been taught in some library and information science (*f*schools throughout the curriculum (Ishimura and Bartlett, 2009). However, a survey of library and information science students in eighteen countries found that library and information science students encountered problems in starting their research assignments. They faced difficulties evaluating online sources and regarded their knowledge as inadequate in referencing, citing, and plagiarism issues (Saunders et al., 2015). Lamb (2017) suggested that library and information science students should receive extensive training in information literacy (and pedagogy) since they have a crucial role in teaching library users.

In this paper, information literacy was defined as 'the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning' (cf., Association of College and Research Libraries, 2016). A rapidly growing number of attempts have been made to improve information literacy skills of university students in developed countries. In most cases, library professionals provide library orientation, handouts, and one-shot lectures or demonstrations to develop students' basic information skills (Julien et al., 2018; Julien et al., 2013; McGuinness, 2009). However, very few studies (e.g., Lamb, 2017; Pinto and Fernández-Pascual, 2019) reported information literacy training initiatives for library and information science students, the future library professionals. The scenario of information literacy teaching is even more disappointing in many developing countries (Lwehabura and Stilwell, 2008). For example, in Bangladesh, only a few private universities or their libraries arranged occasional workshops and short training for their users and library professionals (Begum et al., 2020; Shoeb, 2013).

Traditionally, some information literacy elements have been taught in library and information science schools (Baro, 2011; Ishimura and Bartlett, 2009; Julien, 2005). Information literacy belongs to complex knowledge work competences (Brand-Gruwel et al., 2005) that can be learned only through extensive, repeated, and long-term practice in varying instructional contexts (Lakkala and Ilomäki, 2011). Because deep learning of information literacy skills is complex, traditional teacher- and lecture-centred pedagogies cannot effectively solve the learning gap (Detlor et al., 2012). A variety of methods have been employed to improve teaching of information literacy skills among university students (e.g., Dolničar et al., 2017) and library staff (e.g., Liu, 2021). Previous studies indicate that constructivist approaches such as inquiry-based learning (IBL) (McKinney, 2014) and problem-based learning (PBL) (Dolničar et al., 2017) are more effective than traditional pedagogical models.

The problem with the traditional teacher-centred pedagogy dominating higher

education in developing countries is that learning complex skills and practices such as information literacy remains superficial (Johnston and Webber, 2003). Traditional approaches also emphasise the skills related to information sources, searching techniques, and the criteria of information evaluation. However, from the information literacy point of view, the processes of searching and evaluating information become meaningful only in the personal use of searched information in realistic tasks. Inquiry-based approaches have the potential to solve this problem since they put the student to practice information literacy skills in realistic learning tasks (Kuhlthau, 2021). Further, if information literacy instructions are embedded into several courses in the library and information science curriculum, it is quite likely that information literacy skills become an integrated part of personal and professional practices. This expertise could help librarians to adopt a solid professional role as information literacy educators.

The present study aims to develop a novel learner-centred inquiry-based pedagogical practice, i.e., guided inquiry for information literacy (GIIL), to improve information literacy knowledge of library and information science students in a developing country. The guided inquiry for information literacy (GIIL) was integrated into a compulsory course for first-semester bachelor's students in a library and information science school, and the effectiveness of the practice was tested through information literacy knowledge pre- and post-tests. The paper describes the pedagogical practice and reports its effectiveness in increasing information literacy knowledge of library and information science students. In addition, it addresses the association of students' ICT self-efficacy with their information literacy learning.

Literature review

Traditional lecture-based and teacher-centred pedagogical practices are common in higher education. In developing countries such as Bangladesh, most university teachers still use the oft-used teaching method of providing long lectures (Andaleeb, 2003) in traditional classroom settings (Sarker et al., 2019). The lecture-based instruction promotes rote learning, and students have little chance to create knowledge collaboratively.

A wide range of learner-centred pedagogical practices, models and frameworks, therefore, are challenging the traditional teacher-centred pedagogy (Haider and Sundin, 2022, p. 91; Lonka et al., 2018, p. 51). For example, constructivists argue that learners construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences (Bereiter, 1994). Socio-constructivists or socio-cultural theories suggest that people learn through cultural interaction with other people. Since the human mind is constantly evolving, learners need different types of scaffolding at different stages of the learning process (Limberg et al., 2012; Lonka et al., 2018). Pedagogical practice is an established professional routine in which educators employ various types of teaching and learning activities (Rapley, 2018). Education is not simply the sum of teaching and learning, but a cooperative activity of the educated and the educator. The educated is an individual who acquires information in the form of personal knowledge, individual experience, conscious relations, etc. The educator is an individual who creates conditions for forming a system of knowledge, skills and attitudes in the educated (Dimova and Loughran, 2009).

Inquiry-based learning (IBL) is a widely recognised and advocated pedagogical approach in higher education. The method is being practised in various disciplines (e.g., Archer-Kuhn and MacKinnon, 2020; Mieg, 2019; Oliver, 2007) for both undergraduate and postgraduate students and both smaller and larger classes (Aditomo et al., 2013). It is a powerful pedagogy that engages a learner in a task as a more meaningful way to learn and enables her to experience knowledge creation. It is a student-centred and active approach where learning is stimulated by inquiry. Several studies used inquiry-based learning for social sciences and first-year undergraduates. Researchers, who implemented inquiry-based learning for first-year university students, highlighted that as soon as students enter university, they should be introduced to

inquiry-based learning to utilise their acquired skills throughout their university education (Spronken-Smith, 2012). Inquiry-based learning has proven more effective than traditional teaching for obtaining a broad range of learning outcomes, including academic achievement, process skills, analytical abilities, and critical thinking (Prince and Felder, 2006).

Inquiry-based learning has also proven effective in improving information literacy among all students (Allen, 2008; Cleland and Walton, 2012). Inquiry-based pedagogical models and frameworks have been developed for instructing information literacy (Kuhlthau et al., 2012; McKinney, 2014).

Eisenberg and Berkowitz (1999) introduced an inquiry-based information literacy pedagogical model called Big6 for K-12 education, comprising a set of information and technology skills which form the inquiry process. The Big6 model is a systematic approach to information literacy which includes six significant stages, each of which has two sub-stages (Eisenberg, 2008). Another inquiry process model, the Super3 model, was developed by Eisenberg and Robinson (2007). Teachers and researchers used this model to integrate information literacy into young students' curricula (Chen, 2011). One of the most widely used inquiry-based learning frameworks for information literacy is guided inquiry design (GID) (Kuhlthau et al., 2012). The framework was developed based on studies on students' Information Search Process (ISP) (Kuhlthau, 2004). Guided inquiry (GI) is an intentional, directed, and controlled intervention during the process of inquiry learning. Students receive guidance and intervention throughout their learning process (Kuhlthau, 2010).

A growing number of teaching interventions are being carried out to improve information literacy knowledge and skills among students in elementary (e.g., Chen et al., 2017; Chu et al., 2011) and secondary schools (e.g., Alamettälä and Sormunen, 2020; Argelagós and Pifarré, 2012; Baji et al., 2018) using inquiry-based learning models. Inquiry-based frameworks such as guided inquiry have been integrated into schools' curricula (e.g., Heinström and Sormunen, 2019, Kuhlthau et al., 2015).

In higher education, a variety of pedagogical approaches have been employed to improve students' information literacy in engineering (Liu, 2021), business (Stonebraker and Fundator, 2016), life sciences and health study (Dolničar et al., 2017), sports and exercise (Walton and Hepworth 2011), and library and information science (Lamb, 2017). Students received instructions online (Argelagós et al., 2022; Lamb, 2017), face-to-face (Dolničar et al., 2017), and blended (Walton and Hepworth, 2011) methods through one-shot sessions (Liu, 2021), dedicated credit-bearing courses (Argelagós et al., 2022; Dolničar et al., 2017; Lamb, 2017; Stonebraker and Fundator, 2016; Walton and Hepworth 2011), and embedded-curriculum (Adams et al., 2016; Johnson-Grau et al., 2016; Wang, 2011). There was a lack of research that reported curriculum-embedded information literacy instructions in library and information science schools.

Some researchers used traditional lecture-based instruction (Liu, 2021) and online tutorials (Lamb, 2017) or engaged students in reviewing scientific literature (Argelagós et al., 2022). Only a few (e.g., Dolničar et al., 2017; Walton and Hepworth, 2011) employed learner-centred problem-based approaches for information literacy instructions. Problem-based learning (PBL) and inquiry-based learning (IBL) are subsets of active learning and PBL is integrated into IBL (Spronken-Smith et al., 2007; Spronken-Smith, 2012). Research findings suggest that, regardless of pedagogical methods used, students' overall information literacy knowledge and skills were improved by participating in teaching interventions (Argelagós et al., 2022; Stonebraker and Fundator, 2016).

Dolničar et al (2017) employed three teaching methods for three credit-bearing information literacy courses at a university in Slovenia and compared the effectiveness of the methods in improving information literacy skills of the students. The effectiveness of lecture-based learning (LBL), project-based learning (PjBL), and problem-based learning (PBL) were measured with pre- and post-tests using an information literacy test tool. The test tool included forty multiple-choice questions based on Association of College and Research

Libraries standards (Association of College and Research Libraries, 2000) and Bloom's cognitive levels (Anderson and Sosniak, 1994). The findings suggest that active learning methods, i.e., PBL and PjBL were more effective than the LBL in improving learners' information literacy skills.

Walton and Hepworth (2011) carried out three problem-based information literacy teaching interventions for first-year sport and exercise undergraduate students in the UK. The primary pedagogical method was learning by doing. The findings suggested that, instead of traditional individually focused information literacy workshops, information literacy teaching and learning interventions should be group-oriented and problem-based. Instead of transferring knowledge, teachers should guide students to solve problems collaboratively. The study also found that when students are assigned to complete a task collaboratively, they learn from each other during the completion of the task and exhibit deeper understanding at the end of the process.

Lamb (2017) arranged an introductory course for incoming library and information science students with forty-six systematic online tutorials to improve their information literacy to prepare them for graduate study. The tutorials were divided into four sections and included various aspects of information and technology skills. The pre-tests were used to determine which tutorials students must complete, and post-tests and proficiency projects were used to identify if students' skills improved. The findings suggest that the course was successful in improving learners' skills. Although the study aimed to enhance students' information literacy, the tutorials mainly focused on enhancing learners' knowledge of using information technology. The effectiveness measurement of the intervention was critical. In the post-test, students were needed to complete only the sections for which their mean scores were less than 85% in the pre-test. Students were allowed to review the tutorials and practice pages and retake the post-test multiple times until they scored more than 85%. Therefore, the results do not inform us clearly about the effectiveness of the course and how much time and effort students spent to pass the course.

ICT self-efficacy is defined as an individual's belief regarding his/her ability to utilise information and communication technologies (Papastergiou et al., 2011). Studies suggested that students with high ICT self-efficacy beliefs tend to improve their ICT skills (Aesaert et al., 2017). Students with low self-efficacy are likely to shy away from complex tasks and have low aspirations and weak commitment to developing their skills (Bandura, 1993). In our time, information literacy is practised in an ICT and Internet-dominated information environment. Thus, it is logical to assume that higher ICT self-efficacy could support the development of information literacy skills, especially in a developing country where digital divide is a serious problem (Hatlevik et al., 2018; Rohatgi et al, 2016). In one of the few studies published, Tang and Tseng (2013) found that ICT self-efficacy is positively related to students' actual information literacy competences.

To sum up the literature review, it is well justified to argue that there is an obvious research gap in the target area of this study. Most intervention studies on inquiry-based teaching embedded into the regular curriculum have been carried out in primary (Chen et al., 2017; Chu et al., 2011) and secondary (Alamettälä and Sormunen, 2020; Argelagós and Pifarré, 2012; Baji et al., 2018) education. Only a few studies were found that integrated inquiry-based information literacy instruction into the university's curriculum (McKinney, 2014). Inquiry based learning is an effective pedagogical model in higher education (Justice et al., 2009), and information literacy knowledge and skills are recognised as essential competences for library and information science students (Lamb, 2017). However, very few attempts have been made yet to measure the effectiveness of inquiry-based learning in improving information literacy knowledge and skills of library and information science students. The lack of research is most apparent, and the need to develop information literacy instruction based on inquiry-based learning in library and

information science schools is most urgent in developing countries.

Research objectives

The present study intends to develop and test a pedagogical practice, guided-inquiry for information literacy (GIIL), to improve information literacy knowledge of library and information science students in a developing country.

The paper discusses the answers to the following main research questions:

a) Does library and information science first-year students' information literacy knowledge improve by participating in an inquiry-based teaching intervention?

b) Do library and information science first-year students learn the subject content of a course better by participating in the teaching intervention?

c) Do high ICT self-efficacy beliefs support the learning of information literacy knowledge?

Research methods

A pre- and post- test-based teaching intervention with a control group was carried out to test a novel pedagogical practice for teaching and learning Information Literacy (IL). The study was quasi-experimental and used an equivalent group design.

Participants

The teaching intervention and the pre-and post-tests were carried out in a library and information science (LIS) school of a public university in Bangladesh. LIS 100, 4 Credits is one of the four mandatory courses for bachelor first year-first semester students of the school. As a part of the LIS 100 course, all the library and information science first-semester students (n= 76) participated in this study. About 57% of the participants were male, and about 43% were female. More than 63% of the students were from rural areas (villages), about 28% were from small towns, and only 9% of the students were from large cities or the capital city. Among the participants' parents, only about 29% of fathers and less than 12% of mothers had at least a bachelor's degree or higher. About 12% of fathers and more than 14% of mothers had no institutional education. A strong positive correlation was found between parents' educational qualifications and household income. The data represents that poor parents tend to have low academic qualifications or vice versa. About 67% of the students informed that their monthly household income was less than USD 200.

More than 89% of the students reported having a personal computing device, at least a smartphone. Students' average experience of using computers and the internet was more than three years. More than 91% of the participants reported that they attended mandatory information and communication technology (ICT) courses at their secondary and upper secondary schools. The remaining participants (six students) had completed an ICT course only at their upper secondary school.

Teaching intervention

Guided- inquiry for information literacy (GIIL)

A novel pedagogical practice, guided- inquiry for information literacy (GIIL), was developed to improve information literacy of library and information science undergraduate students in Bangladesh. The pedagogical practice was influenced by the guided-inquiry design (GID) (Kuhlthau et al., 2012). It is an inquiry-based teaching and learning framework where the students are expected to learn the course contents through inquiry on the internet, discussing the topics in learning circles, and writing assignments. The teachers provide short lectures and guide and intervene only when necessary. During the guided inquiry for the writing assignments, students are also expected to learn how to locate, evaluate, select, and retrieve information, and create and share new knowledge.

A short-term teaching intervention was carried out in a library and information science school in Bangladesh from January 2020 to March 2020 to test the effectiveness of the pedagogical practice, i.e., guided-inquiry for information literacy (GIIL). The objective of the

teaching intervention was to achieve two main learning goals: (a) to understand the course content deeply and (b) to improve information literacy knowledge and skills. The students completed one collaborative and one solo writing assignment on the pertinent topics for the course. They worked in nine small learning circles for their collaborative assignment and individually for the solo assignment. Students' score in the information literacy knowledge pre-test was taken into consideration to formulate balanced learning circles.

After participating in the teaching intervention, students were expected to

a) understand the course contents deeply.
b) be able to
   - locate information by preliminary, exploratory, comprehensive and summary searches on the Internet and library database.
   - evaluate expertise, accuracy, currency, perspective and quality of information.
   - use retrieved information responsibly and wisely.
   - create new knowledge by interpreting facts and organising ideas.
   - share new knowledge using different methods.

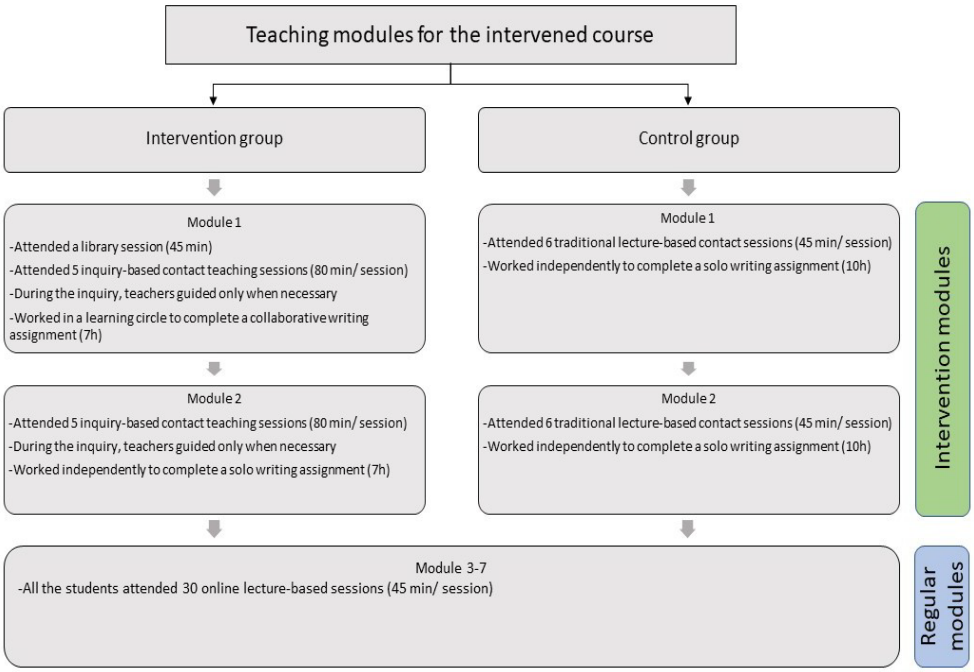


Figure 1. Teaching modules for intervention and control group

Teaching modules for the intervention and the control group: The intervened course comprised seven modules, and the intervention was carried out through the first two modules. The intervention group attended a library session (forty-five minutes) and ten inquiry-based contact sessions. The duration of each inquiry-based session was eighty minutes. Moreover, they worked approximately seven hours in learning circles to complete a collaborative writing assignment and seven hours individually to complete a solo assignment.

The control group was taught following the regular course practice. The students attended twelve lecture-based classes for the first two course units (intervention part). The duration of each class was forty-five minutes. Therefore, the course teacher provided nine hours of

lectures in the classroom. Moreover, the control group students worked at least twenty hours individually to complete two writing assignments.

Evaluation methods for course contents: In the library and information science school, for every course, students get 20% of their credits from in-course assessments, which include class tests, presentations, group works, and writing assignments. They get 80% of their credits from the final written examination. Students' total grading for the course was considered to assess their learning of the course contents.

Instruments

Questionnaire

An online questionnaire was used to collect data about students' socio-economic status. Students were asked to provide information about their household income, parents' educational qualification, geographical location of their home, and their experience of using computers and the internet. All the questions were optional, and students were allowed to skip the questionnaire (see Appendix I).

ICT self-efficacy assessment tool (ICT-SEAT)

We used a variation of the self-report questionnaire developed by Hossain and Sormunen (2019) to assess self-estimated ICT skills (ICT self-efficacy) of library and information science students in Bangladesh. Since the present study participants were first-semester library and information science students, three questions were excluded from the questionnaire about students' skills in professional software. The final version of the ICT-SEAT included nineteen questions about students' self-efficacy beliefs in computer and internet skills. Students were asked to rate their self-estimated skills on a five-point Likert scale from 1 (poor) to 5 (excellent) (see Appendix II).

An exploratory factor analysis (EFA) was carried out using the maximum likelihood extraction method and direct oblimin rotation to determine the factor structure of nineteen items. Four cross-loaded items were eliminated. The Kaiser–Meyer–Olkin measure of sampling adequacy (.80) and Bartlett's test of sphericity ($\chi 2$ (105) = 824.83, $p < .001$) indicated that applying EFA in this data sample was meaningful. Eigenvalues >1 and a four-factor solution were suggested by the scree plot. We grouped these sub-tasks into four main tasks, (a) general computer tasks, (b) general internet tasks, (c) advanced ICT tasks and (d) evaluation of online resources.

Information literacy knowledge assessment tool (ILKAT)

An information literacy assessment tool (ILKAT) was designed and developed based on the Association of College and Research Libraries framework (Association of College and Research Libraries, 2016) for examining information literacy knowledge of university students. Both versions include fourteen multiple-choice questions, and all the questions were mandatory to complete the test. The questions in the instrument can be categorised into three knowledge domains: a) searching and retrieving online information (items 1-5), b) evaluating online information (items 6-10) and c) understanding value of information (items 11-14) (see Appendices III and IV). For this study, we defined the term searching and retrieving online information as knowledge of various information sources, search strategies, search tools, formulating search queries, and access to or lack of access to information. The term evaluating online information refers to knowledge of evaluating information in various online sources. Moreover, the term understanding value of information refers to students' knowledge of citation and plagiarism, and ethical and legal use of information (Association of College and Research Libraries, 2016).

ILKAT had two versions, blue and white, which included two separate but similar sets of questions for their information literacy knowledge test. Two versions were needed to avoid topic-related learning bias (scores always improve from pre-test to post-test if arranged within a few weeks). Obviously, the items in the two test versions might vary in difficulty

requiring a balancing test design. To balance the scores each tested group is divided into two subgroups. One subgroup took the blue version in the pre-test and the white one in the post-test. The other subgroup took the versions in the opposite order (see data collection for details).

Data collection

The students (n= 76) provided their background information through an optional online questionnaire and assessed their ICT self-efficacy beliefs with an online self-report questionnaire, ICT-SEAT. Then they were randomly selected and divided into green and red groups for the information literacy pre-test with the ILKAT. The green group (n= 38) participated in the pre-test with the blue version of ILKAT, and the red group (n= 38) participated with the white version of ILKAT. Then both the green and red groups were ranked separately based on students' scores in the information literacy knowledge pre-test and divided into odds and evens. The odd sub-group from the green group and the odd sub-group from the red group were grouped as intervention group. Similarly, the even sub-group of the green group and the even sub-group of the red group were grouped as control group (Figure 2).

In the information literacy knowledge pre-test, the average score of the intervention group was M= 2.540 (SD= 0.890), and the control group was M= 2.599 (SD=0.701). An independent sample's t-test reveals no difference between the intervention and control group in terms of their total scores in the information literacy knowledge pre-test, $t(69)= -0.307$, $p= > 0.05$. No differences were found between the intervention and the control groups regarding their knowledge in information searching and retrieval, $t(69)= 0.167$, $p= > 0.05$, evaluating online information, $t(69)= -1.299$, $p= > 0.05$, and understanding value of information, $t(69)= 0.650$, $p= > 0.05$. Thus, the intervention and the control groups were balanced in terms of their measured information literacy knowledge.

The intervention group attended the GIIL sessions, and the control group followed their regular class lectures. After the teaching intervention, the green group (n= 37) participated in the information literacy post-test with the white version and the red group (n= 36) attended with the blue version of ILKAT (Figure 2). Seventy-six students participated in the pre-tests, but three were absent in the post-tests. Therefore, the effect of the teaching intervention on information literacy knowledge was measured by using the data of seventy-three students attending both the pre-and post-tests. The ILKAT instrument was web-based and administered using an online test and survey tool Webropol. The students were required to participate in the tests in the nschool's computer laboratory.

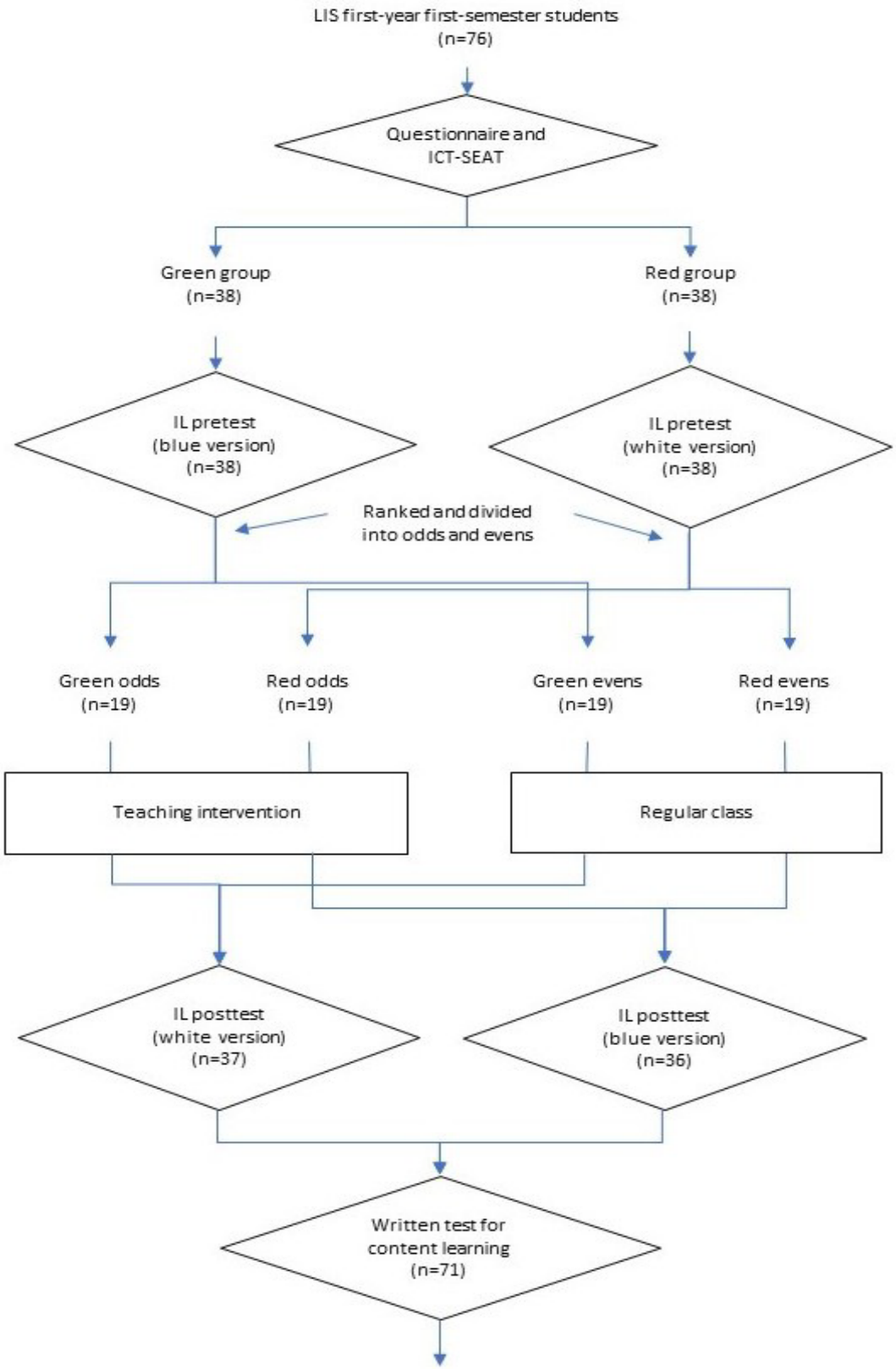


Figure 2. Design of data collection

Data analysis

SPSS (version 27) was employed for the statistical analyses of the data. A one-way ANCOVA was conducted to examine the differences between the intervention group (n= 35) and the control group (n= 36) in the IL knowledge post-test, with IL knowledge pre-test as covariance. The students were divided equally into intervention and control groups based on their scores in the IL knowledge pre-test. Therefore, there was no difference between the groups in the IL knowledge pre-test that met the assumption for ANCOVA. Levene's test and normality checks were conducted, and the assumptions were met. Two outliers were detected and thus excluded from the analysis. An independent samples t-test was carried out to see the difference between male and female students in IL pre- and post-tests.

An independent samples t-test was also conducted to measure the difference between the intervention and control groups in their content learning scores. A Pearson's correlation was performed to measure if students' ICT self-efficacy beliefs associate with their information literacy learning. A Pearson's correlation was also carried out to measure if students' information literacy knowledge scores in pre-and post-tests and their final gradings for the course correlated with their parents' educational qualification, household income, and geographical background.

Results

Information Literacy Knowledge (ILK)

In the information literacy knowledge post-test, the mean score of the intervention group was higher than the control group in overall information literacy knowledge [F= 10.139, p= 0.002] and in two of its subdomains: *information searching and retrieval* [F= 4.305, p= 0.042], and *understanding value of information* [F= 4.152, p= 0.045]. No difference was observed between the experimental and control groups in the *evaluation of online information* [F= 2.857, p= 0.096] (Table 1).

Items	Means (SD)			ANCOVA			Gender difference (t-test) Male (n= 40), Female (n= 31)							
							Pre-test				Post-test			
	First-year students (n=71)	Inter. Group (n= 35)	Contr. Group (n= 36)	F	p	m_{pp}^{22}	M	F	t	p	M	F	t	p
Overall score in IL knowledge post-test	2.88 (.774)	3.13 (.765)	2.64 (.711)	10.139	.002	.130	2.40	2.79	-2.077	.042	2.80	2.98	-.973	.334
Information searching and retrieval	2.62 (1.100)	2.89 (1.231)	2.36 (.899)	4.305	.042	.060	2.15	2.74	-2.588	.012	2.45	2.84	-1.489	.141
Evaluating online information	3.34 (1.055)	3.51 (.951)	3.17 (1.134)	2.857	.096	.040	3.20	3.32	-.472	.638	3.30	3.39	-.343	.733
Understanding value of information	2.64 (1.277)	2.96 (1.324)	2.33 (1.163)	4.152	.045	.058	1.72	2.18	-1.892	.063	2.63	2.66	-.118	.906

Table 1. Difference between intervention and control group in information literacy learning

In the pre-test, the female students outperformed the male students in *overall information literacy knowledge* (p= 0.042) *and information searching and retrieval* (p= 0.012). However, there was no difference between the male and female students in their post-test scores (Table 1).

The answer to the first research question is therefore: the first-year students benefitted by participating in an inquiry-based teaching intervention. Their knowledge improved in two subdomains: 1) information searching and retrieval and 2) understanding the value of information.

Content Learning

An independent samples t-test result shows no difference between the intervention (M= 3.32) and the control groups (M= 3.19) in their final grade points (GP) for the course (Table 2). The students of the novel inquiry-based class learned course subject contents as intensely as the students in the traditionally taught class. The answer to the second research question is therefore: learning information literacy did not lead to losses in learning course subject contents.

Item	Total (n= 71)	Intervention (n= 35)	Control (n= 36)	t	P
GP Mean (SD) for the intervening course	3.26 (.366)	3.32 (.335)	3.19 (.388)	1.474	.145

Table 2. Course content learning in the intervention and control groups

ICT self-efficacy (ICT-SE)

A Pearson's correlation test reveals that students' *ICT self-efficacy beliefs* do not relate to their *overall information literacy* learning. As shown in table 3, only a weak positive correlation was found between students' self-efficacy beliefs in *general computer skills* and their knowledge of *understanding value of information*, r = .266 (p< .05). Students with higher SE beliefs in general computer skills tended to learn the values of information better than the students with lower SE beliefs in general computer skills. The answer to the third research question is: only weak evidence was found for the view that higher ICT self-efficacy beliefs support learning information literacy knowledge.

	ICT self-efficacy beliefs						IL knowledge			
	1	2	3	4	5	6	7	8	9	10
1. ICT-SE:_Overall computer skills	1	.558**	.578**	.454**	.423**	.373**	.157	-.022	.142	.211
2. ICT-SE:_Overall internet skills		1	.369**	.474**	.510**	.331**	.216	.058	.181	.209
3. ICT-SE:_General computer skills			1	.502**	.547**	.555**	.189	.061	.068	.266*
4. ICT-SE:_General internet skills				1	.537**	.418**	.146	-.009	.196	.117
5. ICT-SE:_Online resource evaluation skills					1	.559**	.113	-.012	.088	.160
6. ICT-SE:_Advanced ICT skills						1	.010	-.039	-.054	.119
7. IL post-test:_Overall score							1	.695**	.646**	.706**
8. IL post-test:_Information searching and retrieval								1	.125	.267*
9. IL post-test:_Evaluating online information									1	.203
10. IL post-test:_Understanding value of information										1

* $p < .05$.

** $p < .01$ (two-tailed).

Table 3. Correlations between ICT-SE and IL learning (n= 71)

Potential intervening variables

A set of additional analyses were conducted to check that no variables external to the research design explain the observed intervention effect. Results from a Pearson's correlation revealed that parents' educational qualification, household income, and geographical background did not correlate with students' information literacy pre- or post-test scores, or their final gradings for the course. Students' computer and internet experience did not associate with their information literacy knowledge. A negative correlation was found between students' ownership of personal computers and their information literacy pre-test scores in *information searching* and *evaluation*, but this did not hold for the post-test.

Discussion

Guided-inquiry for information literacy (GIIL) is a learner-centred pedagogical practice that allows students to choose their topic of inquiry and gives them the freedom to learn their lesson independently. The method offers students authority over their learning which increases their motivation to engage themselves in the learning process. The key to the success of any learning method is the teacher acts here as a facilitator or sometimes as a co-learner. The findings suggest that the GIIL (Guided Inquiry for Information Literacy) sessions helped students improve their overall information literacy knowledge. Students who attended the GIIL sessions scored higher in the post-test than those who attended the regular class lectures. The intervention group outperformed the control group in two out of three information literacy knowledge sub-domains. These findings are in line with previous studies reporting on successful information literacy teaching interventions (e.g., Alamettälä and Sormunen, 2020; Argelagós and Pifarré, 2012; Baji et al., 2018). No difference was found in evaluating online information which has been a problematic skill to teach in previous intervention studies

(Alamettälä and Sormunen, 2020) as well. The present study contributes to the earlier findings that even short-term inquiry-based teaching interventions improve at least some components of information literacy competences (e.g., Alamettälä and Sormunen, 2020).

The experimental group scored slightly higher in content learning than the control group, but the result was not statistically significant. Chen, Huang, and Chen (2017) integrated information literacy instructions for six years through inquiry-based learning and examined the effects of the intervention on students' memory and comprehension of subject content. They found that students' fact memorisation and understanding of subject content improved by participating in the inquiry processes. We assume that the teaching intervention for the present study was too short to substantially improve learners' content learning. Despite having additional learning goals, i.e., information literacy knowledge and skills, and some challenges, the intervention group did not lose in their content learning compared to the control group.

Students' ICT self-efficacy beliefs were not correlated with their overall learning of information literacy knowledge. Students' ICT self-efficacy did not influence their learning of information literacy knowledge. However, we found a weak signal that learners with high self-efficacy in general computer skills developed their knowledge of value of information better than others. Therefore, we can conclude that although students' self-efficacy in general computer skills influenced their learning of the understanding value of information, their ICT self-efficacy did not mediate in the intervention effects of improving their overall information literacy knowledge, knowledge in searching and retrieval, and knowledge in evaluating information.

Some problems observed during the course characterise the situation of a student starting their studies in a public university in a developing country. The teacher had to spend a considerable amount of time teaching them how to use computers and search engines before starting the intended learning process. Most of the students had smartphones, but only a small number of students had desktop or laptop computers. All the students received at least one formal training on information and communication technology (ICT) at their secondary or upper secondary schools. However, their scores in the information literacy knowledge pre-test were at an average level. Students alleged that there were well-equipped computer laboratories in their higher secondary schools, but they seldom got the opportunity to use those. They had some theoretical lessons on ICT, but they did not receive proper training to operate a computer.

Since the students were newcomers to the university, we observed that they were unfamiliar with the advanced teaching and learning methods. Although most of the students were curious to learn new knowledge and skills, initially, some of them found the learning process challenging. Irrespective of the level of education, with tiny exceptions, all the teachers in Bangladesh teach their students with traditional lecture methods due to a large number of students in classrooms and lack of resources and training. Therefore, inquiry-based learning was a completely new learning method for the students. They were not familiar with collaborative learning; some were unsure about the usefulness of discussing a topic in a learning circle.

Some studies have found that the extent and duration of students' information search process often depend on the deadlines of the tasks. They feel stress throughout their projects and consider completing the project as the end of their struggle (Holliday and Li, 2004; Hyldegard, 2006). It was challenging for the teacher to convince the students that the tasks should be completed collaboratively instead of dividing the work into pieces and compiling the small pieces into a final product. They were encouraged to emphasise the learning process instead of focusing on the final product.

The findings suggest that students' socio-economic background does not correlate with their information literacy knowledge or information literacy learning. Students' family income, parents' educational qualification, and geographical location of their home did not influence their scores in both pre-and post-tests. However, in practice, we could see that students from rural areas and poor economic backgrounds were less confident in using computers despite having a similar level of information literacy knowledge to their counterparts. In the initial stages, they needed motivation and scaffolding to participate actively in the learning process.

Limitations of the study

In the pre-test, students attended both the information literacy knowledge and performance tests. Due to the COVID-19 pandemic, the university suspended contact teaching just after the information literacy knowledge post-test. Thus, the original plan to test students both for information literacy knowledge and performance had to be reduced to a knowledge test only. Obviously, the lack of performance data is a major limitation in assessing the effectiveness of the teaching intervention.

A long-term teaching intervention with information literacy performance tests would give us a clearer picture of implementing the guided-inquiry for information literacy (GIIL) for university students in a developing country. Moreover, a supplementary qualitative study could bring us an alternative view on the effects of the novel pedagogical practice beyond the quantitative test results.

Conclusion

Considering the duration of the intervention, the learning outcomes of the guided-inquiry for information literacy (GIIL) course were satisfactory. We found some evidence that inquiry-based teaching intervention showed at least short-term learning effects. We gathered some experiences of implementing a novel pedagogical practice in a developing country to help educators and researchers take such initiatives in library and information science and other schools in Bangladesh and other developing countries. Embedding information literacy instructions throughout a university program in Bangladesh is challenging due to large numbers of students in classrooms, a small number of faculty members, traditional classroom settings, lack of computers in classrooms, lack of training for faculty members, and administrative regulations of the university.

Traditionally, at public universities in Bangladesh, due to a lack of resources, a teacher is responsible for conducting a class. Teaching assistant (TA) positions are not common in public universities that may help teachers during and after teaching sessions. Teachers have heavy workloads and are forced to deliver monotonous lectures to students and have very little or no time to interact with their students (Ullah, 2020). For the GIIL course, we temporarily hired and trained two senior library and information science students who helped the teacher during the teaching sessions. For example, the teaching assistants were very useful during the inquiry-based sessions, when several groups of students needed teachers' guidance at the same time. Since the computer laboratory was very old, and some computers were not working properly, the TAs helped to make the computers ready before the pre- and post-tests. The university authorities or their schools may think of hiring some advanced master's degree (thesis) students to assist teachers during the inquiry-based learning sessions.

In Bangladesh, top students are usually hired as lecturers at public universities. Often, they have no teaching and research experience since it is not an obligatory selection criterion. Although several countries are introducing mandatory pedagogical training for university teachers (Ödalen et al., 2019), public universities in Bangladesh do not provide any formal training to new faculty members. They are immediately assigned to teach multiple courses based on schools' needs (Ullah, 2020). In the best cases, their subject knowledge is not

questionable but all of them might not have knowledge and experience about pedagogy and

teaching methods other than the present ones. Studies suggest universities arrange pedagogical training for new faculty members so that they adopt effective pedagogical methods (Chowdhury and Sarkar, 2018; Raqib, 2019) to teach information literacy knowledge and skills to their students.

Implementing a guided-inquiry for information literacy (GIIL) course for bachelor students can be a good starting point for introducing learner-centred pedagogy at university education in Bangladesh. It might influence other teachers in the library and information science school and other schools in the university. The public universities in Bangladesh are autonomous, so the administrative reforms could be done easily if senior faculty members understand the necessity and applicability of inquiry-based learning instructions in university education. Nowadays, many university projects are being funded by the government and the University Grants Commission (UGC) of Bangladesh (2023), and many infrastructural developments are being carried out through the projects. The university authority and the project members just need to realise the changing needs of classroom settings in a university that support collaboration and active participation.

The entrance exams at the public universities (government funded) in Bangladesh are highly competitive, so students with similar academic qualifications and backgrounds are admitted to different schools at public universities. Therefore, it can be assumed that the guided-inquiry for information literacy (GIIL) programme might be equally effective for students in library and information science schools and other social science schools at all the public universities in Bangladesh. In this paper, we presented the socio-economic status and previous experiences of using computers and the internet of our subjects. University students in other developing countries with similar socio-economic conditions and previous ICT experience might be benefited from similar courses.

Acknowledgements

The authors of this paper would like to thank Professor Tuomas Harviainen for his valuable comments to improve the quality of the paper. The first author wants to thank the Kone Foundation for awarding a working grant for this study.

About the authors

Md Arman Hossain is a Doctoral student at the Faculty of Information Technology and Communication Sciences, Tampere University, Finland. His research interests include information literacy, information and communication technology literacy, and library and information science education. He can be reached at mdarman.hossain@tuni.fi

Eero Sormunen is Professor Emeritus at the Faculty of Information Technology and Communication Sciences, Tampere University, Finland. He received his PhD from the same university, and his research interests are in information literacy, online research and learning. He can be contacted at eero.sormunen@tuni.fi

References

Adams, C., Buetow, S., Edlin, R., Zdravkovic, N., & Heyligers, J. (2016). A collaborative approach to integrating information and academic literacy into the curricula of research methods courses. *The Journal of Academic Librarianship, 42*(3), 222-231. https://doi.org/10.1016/j.acalib.2016.02.010

Aditomo, A., Goodyear, P., Bliuc, A. M., & Ellis, R. A. (2013). Inquiry-based learning in higher education: principal forms, educational objectives, and disciplinary variations. *Studies in Higher Education, 38*(9), 1239-1258. http://dx.doi.org/10.1080/03075079.2011.616584

Aesaert, K., Voogt, J., Kuiper, E., & van Braak, J. (2017). Accuracy and bias of ICT self-efficacy: an empirical study into students' over-and underestimation of their ICT competences. *Computers in Human Behavior, 75*, 92-102. https://doi.org/10.1016/j.chb.2017.05.010

Alamettälä, T. & Sormunen, E. (2020). The effect of a teaching intervention on students' online research skills in lower secondary education. *Information Research, 23*(2), paper 861. http://www.informationr.net/ir/25-2/paper861.html (Archived by the Internet Archive at https://bit.ly/2ziBs14)

Allen, M. (2008). Promoting critical thinking skills in online information literacy instruction using a constructivist approach. *College & Undergraduate Libraries*, *15*(1-2), 21-38. https://doi.org/10.1080/10691310802176780

Andaleeb, S. S. (2003). Revitalizing higher education in Bangladesh: insights from alumni and policy prescriptions. *Higher Education Policy, 16*(4), 487-504. https://doi.org/10.1057/palgrave.hep.8300036

Anderson L.W. & Sosniak L. A. (eds.). (1994). *Bloom's taxonomy: a forty-year retrospective*. University of Chicago Press.

Archer-Kuhn, B., & MacKinnon, S. (2020). Inquiry-based learning in higher education: a pedagogy of trust. *Journal of Education and Training Studies*, *8*(9), 1-14. https://doi.org/10.11114/jets.v8i9.4929

Argelagós, E., & Pifarré, M. (2012). Improving information problem solving skills in secondary education through embedded instruction. *Computers in Human Behavior, 28*(2), 515-526. https://doi.org/10.1016/j.chb.2011.10.024

Argelagós, E., Garcia, C., Privado, J., & Wopereis, I. (2022). Fostering information problem solving skills through online task-centred instruction in higher education. *Computers & Education*, *180*, 104433. https://doi.org/10.1016/j.compedu.2022.104433

Association of College and Research Libraries (2000). *Information Literacy Competency Standards for Higher Education.* http://hdl.handle.net/11213/7668 (Archived by the Internet Archive at https://bit.ly/42HBXJs)

Association of College and Research Libraries (2016). *Framework for information literacy for higher education*. http://www.ala.org/acrl/sites/ala.org.acrl/files/content/issues/infolit/Framework_ILHE.pdf (Archived by the Internet Archive at https://bit.ly/462Dexz)

Baji, F., Bigdeli, Z., Parsa, A., & Haeusler, C. (2018). Developing information literacy skills of the 6th grade students using the Big 6 model. *Malaysian Journal of Library & Information Science, 23*(1), 1-15. https://doi.org/10.22452/mjlis.vol23no1.1

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, *28*(2), 117-148. https://doi.org/10.1207/s15326985ep2802_3

Baro, E. E. (2011). A survey of information literacy education in library schools in Africa. *Library Review, 60*(3), 202-217. https://doi.org/10.1108/00242531111117263

Begum, D., Roknuzzaman, M., & Elahi, M. H. (2020). Online information literacy training for users during COVID-19 pandemic: a case study of East West University Library, Dhaka, Bangladesh. *Journal of Knowledge & Communication Management, 10*(2), 81-98. https://www.indianjournals.com/ijor.aspx?target=ijor:jkcm&volume=10&issue=2&article=001

Bereiter, C. (1994). Constructivism, socioculturalism, and Popper's world 3. *Educational researcher*, *23*(7), 21-23. https://doi.org/10.2307/1176935

Brand-Gruwel, S., Wopereis, I., & Vermetten, Y. (2005). Information problem solving by experts and novices: analysis of a complex cognitive skill. *Computers in Human Behavior*, *21*(3), 487-508. https://doi.org/10.1016/j.chb.2004.10.005

Chen, L. C. (2011). The effects of integrated information literacy in science curriculum on first-grade students' memory and comprehension using the Super3 Model. *Knowledge Management & E-Learning: An International Journal*, *3*(3), 399-411. https://doi.org/10.34105/j.kmel.2011.03.028

Chen, L. C., Huang, T. W., & Chen, Y. H. (2017). The effects of inquiry-based information literacy instruction on memory and comprehension: a longitudinal study. *Library & Information Science Research, 39*(4), 256-266. https://doi.org/10.1016/j.lisr.2017.11.003

Chowdhury, R., Sarkar, M. (2018). Education in Bangladesh: changing contexts and emerging realities. In: R. Chowdhury, M. Sarkar, F. Mojumder, & M. Roshid (eds), *Engaging in educational research*. Springer. https://doi.org/10.1007/978-981-13-0708-9_1

Chu, S. K. W., Tse, S. K., & Chow, K. (2011). Using collaborative teaching and inquiry project-based learning to help primary school students develop information literacy and information skills. *Library & Information Science Research, 33*(2), 132-143. https://doi.org/10.1016/j.lisr.2010.07.017

Cleland, J., & Walton, G. (2012). Online peer assessment: helping to facilitate learning through participation. *Journal of Learning Development in Higher Education*, *4*. https://doi.org/10.47408/jldhe.v0i4.124

Detlor, B., Booker, L., Serenko, A., & Julien, H. (2012). Student perceptions of information literacy instruction: the importance of active learning. *Education for information*, *29*(2), 147-161. https://doi.org/10.3233/EFI-2012-0924

Dimova, Y., & Loughran, J. (2009). Developing a big picture understanding of reflection in pedagogical practice. *Reflective Practice, 10*(2), 205-217. https://doi.org/10.1080/14623940902786214

Dolničar, D., Podgornik, B. B., & Bartol, T. (2017). A comparative study of three teaching methods on student information literacy in stand-alone credit-bearing university courses. *Journal of Information Science*, *43*(5), 601-614. https://doi.org/10.1177/0165551516655084

Eisenberg, M. B. (2008). Information literacy: essential skills for the information age. *DESIDOC journal of library & information technology*, *28*(2), 39-47. https://doi.org/10.14429/djlit.28.2.166

Eisenberg, M. B., & Berkowitz, R. E. (1999). *Teaching information & technology skills: the Big6 in elementary schools.* Linworth.

Eisenberg, M. B., & Robinson, L. E. (2007). *The Super3: information skills for young learners.* Linworth.

Haider, J & Sundin, O. (2022). *Paradoxes of media and information literacy: the crisis of information.* Routledge.

Hatlevik, O. E., Throndsen, I., Loi, M., & Gudmundsdottir, G. B. (2018). Students' ICT self-efficacy and computer and information literacy: determinants and relationships. *Computers & Education, 118*, 107-119. https://doi.org/10.1016/j.compedu.2017.11.011

Heinström, J. & Sormunen, E. (2019). Structure to the unstructured - guided inquiry design as a pedagogical practice for teaching inquiry and information literacy skills. In *Proceedings of ISIC, The Information Behaviour Conference,* Krakow, Poland, 9-11 October: Part 2. Information Research, 24(1), paper isic1824. http://InformationR.net/ir/24-1/isic2018/isic1824.html (Archived by WebCite® at http://www.webcitation.org/76lX543BH)

Holliday, W. and Li, Q. (2004). Understanding the millennials: updating our knowledge about students to improve library instruction. *Reference Services Review, 32*(4), 356-366. https://doi.org/10.1108/00907320410569707

Hossain, M. A., & Sormunen, E. (2019). ICT skills of Library and Information Science (LIS) students in Bangladesh. *International Information & Library Review, 51*(4), 285-299. https://doi.org/10.1080/10572317.2018.1559661

Hyldegard, J. (2006). Collaborative information behavior-exploring Kuhlthau's information search process model in a group-based educational setting. *Information Processing and Management, 42*(1), 276-298. https://doi.org/10.1016/j.ipm.2004.06.013

Ishimura, Y., & Bartlett, J. C. (2009). Information literacy courses in LIS schools: emerging perspectives for future education. *Education for Information, 27*(4), 197-216. https://doi.org/10.3233/EFI-2009-0883

Johnson-Grau, G., Archambault, S. G., Acosta, E. S., & McLean, L. (2016). Patience, persistence, and process: embedding a campus-wide information literacy program across the curriculum. *The Journal of Academic Librarianship, 42*(6), 750-756. https://doi.org/10.1016/j.acalib.2016.10.013

Johnston, B., & Webber, S. (2003). Information literacy in higher education: a review and case study. *Studies in higher education, 28*(3), 335-352. https://doi.org/10.1080/03075070309295

Julien, H. (2005). Education for information literacy instruction: a global perspective. *Journal of education for library and information science, 46* (3), 210-216. https://doi.org/10.2307/40323845

Julien, H., Gross, M., & Latham, D. (2018). Survey of information literacy instructional practices in US academic libraries. *College & research libraries, 79*(2), 179-199. https://doi.org/10.5860/crl.79.2.179

Julien, H., Tan, M., & Merillat, S. (2013). Instruction for information literacy in Canadian academic libraries: a longitudinal analysis of aims, methods, and success. *Canadian Journal of Information and Library Science, 37*(2), 81-102. https://doi.org/10.1353/ils.2013.0007

Justice, C., Rice, J., Roy, D., Hudspith, B., & Jenkins, H. (2009). Inquiry-based learning in higher education: administrators' perspectives on integrating inquiry pedagogy into the curriculum. *Higher Education*, *58*(6), 841-855. https://doi.org/10.1007/s10734-009-9228-7

Kuhlthau, C. C. (2004). *Seeking meaning: a process approach to library and information services.* Libraries Unlimited.

Kuhlthau, C. C. (2010). Guided inquiry: school libraries in the 21st century. *School Libraries Worldwide, 16*(1), 1-12. https://doi.org/10.29173/slw6797

Kuhlthau, C. C. (2006). Information literacy through guided inquiry: preparing students for the 21st century. Paper presented at the International Association of School Librarians Annual Conference, Lisbon, Portugal. https://doi.org/10.29173/iasl7898

Kuhlthau, C. C., Maniotes, L. K., & Caspari, A. K. (2012). *Guided inquiry design: a framework for inquiry in your school.* ABC-CLIO.

Kuhlthau, C. C., Maniotes, L. K., & Caspari, A. K. (2015). *Guided inquiry: learning in the 21st century*. Libraries Unlimited.

Lakkala, M., & Ilomäki, L. (2011). Unfolding experienced teachers' pedagogical practices in technology-enhanced collaborative learning. In H. Spada, G. Stahl, N. Miyake & N. Law (eds), *Connecting Computer-Supported Collaborative Learning to Policy and Practice CSCL2011 Conference Proceedings Volume I – Long Papers* (pp. 502-509). ISLS International Society of the Learning Sciences.

Lamb, A. (2017). Debunking the librarian 'gene': designing online information literacy instruction for incoming library science students. *Journal of Education for Library and Information Science, 58*(1), 15-26. https://doi.org/10.12783/issn.2328-2967/58/1/2

Limberg, L., Sundin, O., & Talja, S. (2012). Three theoretical perspectives on information literacy. *Human IT: Journal for Information Technology Studies as a Human Science, 11*(2), 93-130. https://humanit.hb.se/article/view/69/51 (Archived by the Internet Archive at https://bit.ly/3NsMWAY)

Liu, G. (2021). Information literacy instruction for international graduate engineering students: a case study at University of Windsor. *The Journal of Academic Librarianship, 47*(5), 102415. https://doi.org/10.1016/j.acalib.2021.102415

Lonka, K. (2018). *Phenomenal learning from Finland*. Edita.

Lwehabura, M. J., & Stilwell, C. (2008). Information literacy in Tanzanian universities: challenges and potential opportunities. *Journal of Librarianship and Information Science, 40*(3), 179-191. https://doi.org/10.1177/0961000608092553

McGuinness, C. (2009). Information skills training practices in Irish higher education. *Aslib Proceedings: New information perspectives, 61*(3), 262-281. https://doi.org/10.1108/00012530910959817

McKinney, P. (2014). Information literacy and inquiry-based learning: evaluation of a five-year programme of curriculum development. *Journal of Librarianship and Information Science, 46*(2), 148-166. https://doi.org/10.1177/0961000613477677

Metzger, M. J. (2007). Making sense of credibility on the Web: models for evaluating online information and recommendations for future research. *Journal of the American society for information science and technology*, *58*(13), 2078-2091. https://doi.org/10.1002/asi.20672

Mieg, H. A. (2019). Introduction: inquiry-based learning-Initial assessment. In H. A. Mieg (ed.), *Inquiry-Based Learning–Undergraduate Research* (pp. 1-16). Springer. https://doi.org/10.1007/978-3-030-14223-0_1

Ödalen, J., Brommesson, D., Erlingsson, G. Ó., Schaffer, J. K., & Fogelgren, M. (2019). Teaching university teachers to become better teachers: the effects of pedagogical training courses at six Swedish universities. *Higher Education Research & Development, 38*(2), 339-353. https://doi.org/10.1080/07294360.2018.1512955

Oliver, R. (2007). Exploring an inquiry-based learning approach with first-year students in a large undergraduate class. *Innovations in Education and Teaching International*, *44*(1), 3-15. https://doi.org/10.1080/14703290601090317

Papastergiou, M., Gerodimos, V., & Antoniou, P. (2011). Multimedia blogging in physical education: effects on student knowledge and ICT self-efficacy. *Computers & Education*, *57*(3), 1998-2010. https://doi.org/10.1016/j.compedu.2011.05.006

Pinto, M., & Fernández-Pascual, R. (2019). How a cycle of information literacy assessment and instruction stimulates attitudes and motivations of LIS students: a competency-based case study. *Journal of Librarianship and Information Science, 51*(2), 370-386. https://doi.org/10.1177/0961000617742447

Prince, M. J., & Felder, R. M. (2006). Inductive teaching and learning methods: definitions, comparisons, and research bases. *Journal of engineering education, 95*(2), 123-138. https://doi.org/10.1002/j.2168-9830.2006.tb00884.x

Rapley, E. (2018). 'Seeing the light.' Personal epiphanies and moving towards interpretivism; a researcher's tale of exploring teacher pedagogic practice. *Ethnography and Education, 13*(2), 185-203. https://doi.org/10.1080/17457823.2017.1315311

Raqib, A. A. (2019). Innovations in teacher training at higher education in Bangladesh. *Social Science Review [The Dhaka University Studies, Part-D], 36*(1), 221-231. https://ssrn.com/abstract=3453063

Rohatgi, A., Scherer, R., & Hatlevik, O. E. (2016). The role of ICT self-efficacy for students' ICT use and their achievement in a computer and information literacy test. *Computers & Education, 102*, 103-116. https://doi.org/10.1016/j.compedu.2016.08.001

Sarker, M. F. H., Al Mahmud, R., Islam, M. S., & Islam, M. K. (2019). Use of e-learning at higher educational institutions in Bangladesh: opportunities and challenges. *Journal of Applied Research in Higher Education, 11*(2), 210-223. https://doi.org/10.1108/JARHE-06-2018-0099

Saunders, L., Kurbanoglu, S., Boustany, J., Dogan, G., Becker, P., Blumer, E., Chowdhury, S., Dobreva, M., Gendina, N., Grgic, I. H., Haddow, G., Koltay, T., Kortelainen, T., Krakowska, M., Majid, S., Mezhova, M., Repanovici, A., Rudžioniene, J., Schneider, R., … Todorova, T. Y. (2015). Information Behaviors and Information Literacy Skills of LIS Students: An International

Perspective. *Journal of Education for Library and Information Science, 56*(1), 80–99. https://doi.org/10.12783/issn.2328-2967/56/S1/9

Shoeb, M. Z. H. (2013). Shaping up information literacy in a new venue, a university in Bangladesh. *Higher Education of Social Science, 4*(2), 13-24. http://cscanada.net/index.php/hess/article/view/j.hess.1927024020130402.2991 (Archived by the Internet Archive at https://bit.ly/46nOwNc)

Spronken-Smith, R. (2012). Experiencing the process of knowledge creation: the nature and use of inquiry-based learning in higher education. In International Colloquium on Practices for Academic Inquiry. University of Otago, 1-17.

Spronken-Smith, R., Angelo, T., Matthews, H., O'Steen, B., & Robertson, J. (2007). How effective is inquiry-based learning in linking teaching and research? In *An International Colloquium on International Policies and Practices for Academic Enquiry*, Marwell, Winchester, UK.

Stonebraker, I. R., & Fundator, R. (2016). Use it or lose it? A longitudinal performance assessment of undergraduate business students' information literacy. *The Journal of Academic Librarianship, 42*(4), 438-444. https://doi.org/10.1016/j.acalib.2016.04.004

Tang, Y., & Tseng, H. W. (2013). Distance learners' self-efficacy and information literacy skills. *The Journal of Academic Librarianship*, *39*(6), 517-521. https://doi.org/10.1016/j.acalib.2013.08.008

Ullah, M. N. (2020). Ingredients of quality education at tertiary level: an assessment of higher education in Bangladesh. *International Journal of Engineering Applied Sciences and Technology, 4*(11), 546-556. https://doi.org/10.33564/IJEAST.2020.v04i11.097

University Grants Commission (UGC) of Bangladesh (2023, March 26). *Research support and publication division: Activities.* http://www.ugc.gov.bd/site/page/00d8153b-5f83-4420-8fa9-7dd0cae74cd4/- (Archived by the Internet Archive at https://bit.ly/3NrGRpC)

Walton, G., & Hepworth, M. (2011). A longitudinal study of changes in learners' cognitive states during and following an information literacy teaching intervention. *Journal of Documentation, 67*(3), 449-479. https://doi.org/10.1108/00220411111124541

Wang, L. (2011). An information literacy integration model and its application in higher education. *Reference Services Review, 39*(4), 703-720. https://doi.org/10.1108/00907321111186703

Williamson, K., Bernath, V., Wright, S., & Sullivan, J. (2008). Research students in the electronic age: impacts of changing information behavior on information literacy needs. *Communications in Information Literacy, 1*(2), 47-63. https://doi.org/10.15760/comminfolit.2008.1.2.9

Appendix I

Questionnaire on Students' background information

1. Contact information

   Name:

   Roll:

   Email:

2. Gender
   - Male
   - Female
   - I don't want to declare
3. Your father's educational qualification
   - No institutional education
   - Primary
   - SSC (Secondary School Certificate)
   - HSC (Higher Secondary Certificate)
   - Degree pass (3 years bachelor's degree)
   - University graduate (at least 4 years bachelor's degree)
4. Your mother's educational qualification
   - No institutional education
   - Primary
   - SSC (Secondary School Certificate)
   - HSC (Higher Secondary Certificate)
   - Degree pass (3 years bachelor's degree)
   - University graduate (at least 4 years bachelor's degree)
5. Parents' monthly income (approximately)
   - 20000 BDT or less
   - 21000- 40000 BDT
   - 41000- 60000 BDT
   - 61000+ BDT

6. Which of the following geographical areas are you from?
    - Capital city
    - Metropolitan city
    - District sadar
    - Thana/ Upazila
    - Village
7. How long have you been using computers (e.g., Desktop computer, Laptop, Tablet, Smartphone etc.)?

   Please specify full year(s) (Numbers only): [ ]
8. How long have you been using the Internet?

   Please specify full year(s) (Numbers only): [ ]
9. Do you have a personal computer/ laptop/ notebook/ netbook/ tablet/ smartphone?
    - Yes
    - No
10. Did you complete any course on "Computer or ICT" at your SSC or HSC level?
    - Yes
    - No

Appendix II

ICT Self-efficacy Assessment Tool (ICT-SEAT)

1. Contact information

Name:	
Roll:	
Email:	

2. Please rate your overall computer skills based on the following definitions:

Poor (1) = I am able to start up, log on and shut down a computer.

Average (2) = I can create folders and various types of files and save those in the desired location. I can write using the word processor; can select, copy and paste text in a document or a desired location.

Good (3) = I have good command in word processing, spreadsheet software, and graphics presentation.

Very good (4) = I can install and maintain operating systems and other software on computers.

Excellent (5) = I have skills in programming languages. I can develop software or applications.

	1	2	3	4	5
Please rate your overall computer skills	○	○	○	○	○

3. Please rate your overall internet skills based on the following definitions:

Poor (1) = I am able to launch any of the web browsers. I can use social networking sites (e.g., Facebook, Twitter, etc.)

Average (2) = I can send and open attachments using email service. I can download different types of files and images from a web page.

Good (3) = I can use search engines to access the desired information.

Very good (4) = I can create and maintain my own blog. I can use cloud storage (e.g., Google Drive and One drive).

Excellent (5) = I can record videos and publish them online. I can design web pages.

	1	2	3	4	5
Please rate your overall internet skills	○	○	○	○	○

4. Rate your knowledge and skills on the following tasks? (please respond to all the subcategories).

(1= 'poor' to 5= 'excellent').

Items	1	2	3	4	5
Using search engines to access information	○	○	○	○	○
Browsing different websites on the internet	○	○	○	○	○
Downloading/ uploading files, images and videos from/ on the internet	○	○	○	○	○
Installing software on desktop computers or mobile devices	○	○	○	○	○
Using email tools and services	○	○	○	○	○
Installing an operating system	○	○	○	○	○
Presentation graphics (MS PowerPoint)	○	○	○	○	○
Word processing (MS Word)	○	○	○	○	○
Evaluate services on the internet	○	○	○	○	○
Evaluate information on the internet	○	○	○	○	○
Evaluate software on the internet	○	○	○	○	○

Creating and maintaining own blog	○	○	○	○	○
Programming	○	○	○	○	○
Database software (e.g., MS Access)	○	○	○	○	○
Using cloud storage	○	○	○	○	○
Designing web pages	○	○	○	○	○
Spreadsheet software (MS Excel)	○	○	○	○	○
Record and publish videos	○	○	○	○	○
Notebook software (e.g., MS OneNote, Evernote)	○	○	○	○	○

Appendix III

Information Literacy Knowledge Assessment Tool (ILKAT) (BLUE)

1. Contact information

   Name:

   Roll:

   Email:

2. Suppose you want to know the number of Royal Bengal tigers currently alive in Sundarban of Bangladesh. You are searching in Google. Which of the following search terms can be used to find your information in Google?

○ How many Royal Bengal tigers are left in Sundarban of Bangladesh?

○ Royal Bengal tigers in Sundarban of Bangladesh

○ Royal Bengal tigers Sundarban Bangladesh

○ All the options above can be used

3. Which of the following terms will retrieve you the largest number of web pages/ hits in Google search?

○ Cat

○ Black cat

○ North-American black cat

○ Mexican black cat

4. Suppose you want to write an essay for your department's magazine. You want to write about economic development of Bangladesh and how women have contributed to the process. You have searched Google by terms "economic development" and found many

web pages but they were mainly useless. Which of the following terms might retrieve you the most relevant information only (a small number of useful webpages)?

○ Economic development and women

○ Economic development in Bangladesh

○ Economic growth in Bangladesh

○ Women's participation in economic development in Bangladesh

5. Suppose you have searched in Google and found an important article for your writing assignment. The article is from an open-access journal. What should you do now?

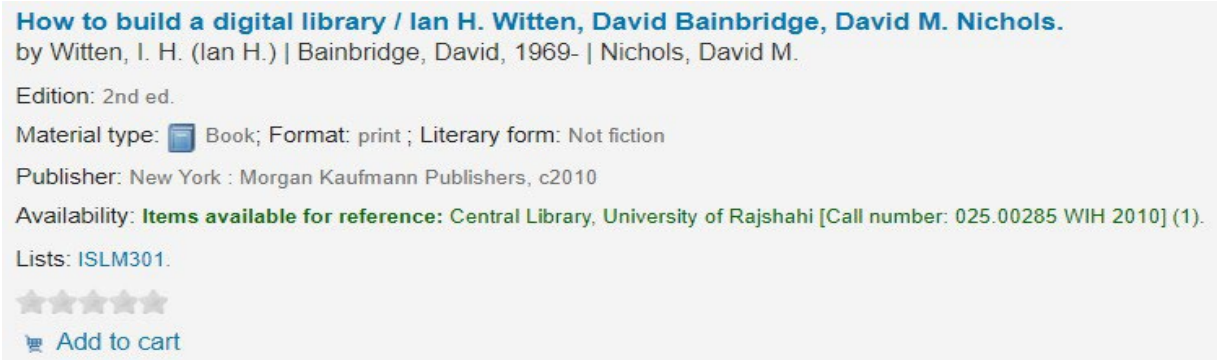
○ I will download the article but will delete it after reading

○ I will download the article and will save it on my computer for later use

○ I will not download the article because it is unethical

○ I will not download the article because it is illegal

6. You needed some information on 'digital library'. You have searched the online catalogue of RU central library and found the following information about a book. Which of the following information is the most important to find the book on a shelf?



○ Date of publication

○ Title of the book

○ Name of the author(s)

○ Call number

7. One of your friends has shared an interesting news article through Facebook or other social media. What makes you trust the article?

○ I know my friend is smart

○ The piece of news was published in a newspaper

○ The person who shared the news is my close friend

○ I will trust it after cross-checking the original source of the news

8. You want to know how many public and private universities there are in Bangladesh at this moment. You have searched in Google and found different information from different sources. Which of the following information is the most trustworthy and reliable?

○ wikipedia.org says: 46 public and 97 private universities

○ ontaheen.com says: 37 public and 92 private universities

○ ugc.gov.bd says: 45 public and 105 private universities

○ kolohol.com says: 45 public and more than a hundred private universities

9. Imagine that you have searched in Google and found an interesting article published in the "International Journal of Computer Science". Which of the following statements is correct in the context of trustworthiness?

○ I will trust it because an international journal cannot be fake

○ If the journal is commercially published, then it is reliable

○ If the journal is commercially published, then it is not reliable

○ The name does not matter, I must check the reliability of the journal

10. Which of the following lists is most likely presenting a correct order of information sources from the least to the most trustworthy one?

○ blog, daily newspaper, scholarly journal

○ blog, scholarly journal, daily newspaper

○ daily newspaper, blog, scholarly journal

○ scholarly journal, blog, daily newspaper

11. Suppose you are writing an essay for one of your courses. You have searched in Google and found a piece of useful information in a Bengali daily newspaper. Which of the following statement is justified in this context?

○ I can use the information if I cite the news

○ I am not allowed to use any information from a daily newspaper

○ I should not use information from a newspaper because there is no way of citing a newspaper

○ I need permission from the news editor to use this information in my essay

12. Suppose you have read a book and found interesting information about the Liberation war of Bangladesh. Now, you have written an essay and used some information found in the book in your essay. Who should get the credit for the interesting information you have used in your essay?

○ The publisher of the book

○ The funding authority for the book

○ The author(s) of the book

○ I should get the credit for the information

13. Suppose your teacher asked you to write an essay. You went to the university library and found an interesting book on the related topic. You only wrote two paragraphs from the book in your essay. You took the rest of the texts from other sources. What would be your responsibility in this context?

○ I can write two paragraphs directly from the book if I give credit to the author(s)

○ I must ask for a permission of the author(s) of the book

○ I am not allowed to write two paragraphs directly from the book

○ I must ask for a permission of my teacher

14. Read the following bibliographical information. Who is the author(s) of this document?

Bowler, L., & Nesset, V. (2013). Information literacy. In Beheshti, J. and Large, J.A. (Ed.), The Information Behavior of a New Generation: Children and Teens in the 21st Century (pp. 45–63). Lanham: The Scarecrow press.

○ The Scarecrow press

○ Bowler, L. and Nesset, V.

○ Beheshti, J. and Large, J.A.

○ Children and Teens in the 21st Century

15. Suppose you are writing an assignment for a course. You have included a reference list for all the sources you have used for your assignment. You have arranged the sources by numbers (e.g., 1,2,3….). Which of the following statements is correct in this context?

○ All sources mentioned on the reference list must also be cited in the text

○ The list should be arranged alphabetically not by numbers

○ A reference list is not required for an assignment

○ This is the appropriate way of referencing

Appendix IV

Information Literacy Knowledge Assessment Tool (ILKAT) (WHITE)

1. Contact information

Name:	
Roll:	

Email:

2. Suppose one of your friends claims that the population of Bangladesh is now more than 175 million. But you think that the population is less than 170 million. So, you want to check the information on Google. Which of the following search terms can be used to find your information in Google?

○ How many people Bangladesh has in 2020?

○ Bangladesh population 2020

○ Bangladesh 2020 population

○ All the options above can be used

3. Which of the following terms will retrieve you the smallest number of web pages/ hits in Google search?

○ School

○ Primary school

○ Teachers of primary school

○ Teachers of primary school in Bangladesh

4. Suppose you are writing an essay for a course. In your essay, you want to discuss the ability of Library and Information Science students in Bangladesh to use Information and Communication Technology (ICT) for academic and personal tasks. Which of the following terms might retrieve the largest number of web pages?

○ ICT skills of Library and Information Science students

○ ICT skills of Library Science students in Bangladesh

○ ICT skills of Information Science students in Bangladesh

○ ICT skills of Library and Information Science students in Bangladesh

5. You have searched in Google and found some useful results. When you clicked on a link, you saw that you can read only the abstract of an article and the publisher asks you to pay some money to read the full paper. What would be your next step to read the full article?

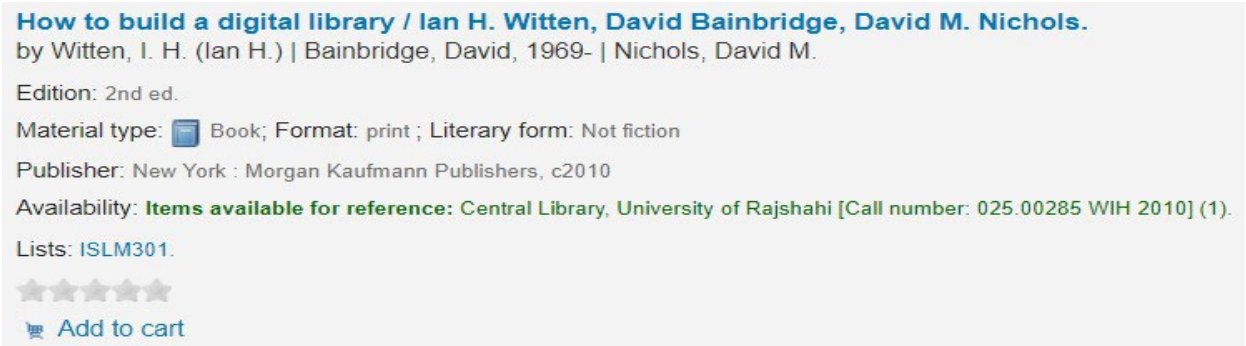
○ I will pay for the article. If I don't have a credit card, I will request my friends

○ I will send an email to the author(s) and request to send me a copy of the article

○ I will search in the university library database if it has access to the article

○ I will ask my teacher if s(he) has the article

6. Suppose you need some information on 'digital library'. You have searched the online catalogue of RU central library and found the following document. Which of the following statements about the document is not correct?



○ This item is available in the central library of RU

○ It is a printed book and I can read it in the library

○ The book discusses designing a digital library

○ I can borrow the book from the library if I have a library card

7. One of your friends has shared a controversial or sensitive news through Facebook in the morning. In the evening, you have seen that many people have liked the news and some of them shared it. How would you react to this news?

○ I will also like it but will not share it because many people have already shared it

○ I will try to check the accuracy of the news first

○ I will also like it and share it for other people

○ I will not like it but share it so that I can get the news when necessary

8. Suppose you want to apply for a passport. One of your friends told you that government will introduce an electronic passport soon with ten years of validity, so you can apply for it then. Your other friend told you that the government already has started to give an electronic passport so you can apply for it now. So, you searched in Google to check the information but found different information from different sources. Which of the following sites you would rely on?

○ dhakatribune.com

○ dip.gov.bd

○ thedailystar.net

○ bdnews24.com

9. You read an article in the editorial section of the most popular newspaper in Bangladesh. You found some useful information in it for your writing assignment. Which of the following statements is correct in the context of trustworthiness?

○ I must be aware of the difference between the fact and the author's own opinion

○ Information published in a newspaper is not reliable

○ I can trust the information if it is published in English

○ I will check the author's profile. If (s)he is famous, I will trust the information

10. Which of the followings is the most trustworthy or reliable source of information?

○ Commercial website

○ Personal blog

○ Scientific journal

○ Daily newspaper

11. Suppose you are writing an essay for a course. You have searched in Google and found some useful information on a commercial website. Which of the following statements is true in this context?

○ Commercial websites are not a reliable source of information

○ I can use the information if I cite the website

○ I should not use information from a commercial website because there is no rule about citing a commercial website

○ I need permission from the head of the company

12. Suppose you have read an article in a scientific journal or newspaper about a public library. Your teacher has asked you to write an essay on public libraries in Bangladesh. You have used some information from the article you read earlier. You did not copy anything from the article, but you have used some information in your essay that you read in the article. What should you do now?

○ I must put a reference to the article in my essay

○ I did not copy anything, so I do not need to do anything

○ I should inform my teacher that I took the information from the article

○ I must take permission from the author of the article

13. Your teacher has asked you to write an essay. You have searched on the internet and found a useful article on the topic of your essay. You need to write some text from the article in your essay. What should you do in this context?

○ I can take some text directly from the article if I give a proper reference

○ I must write the text of the article in my own language and give credit to the author(s)

○ It is not permitted to write text from the article(s)

○ I must take permission from the author(s)

14. Read the following bibliographical information. What kind of information source it is about?

Bowler, L., & Nesset, V. (2013). Information literacy. In Beheshti, J. and Large, J.A. (Ed.), The Information Behavior of a New Generation: Children and Teens in the 21st Century (pp. 45–63). Lanham: The Scarecrow press.

○ Book

○ Journal article

○ A chapter in a book

○ A conference presentation

15. You are writing an assignment for a course. You have included a reference list for all the sources you have used for your assignment. You have arranged the sources alphabetically by author (e.g., Adams, Bowden, Christopher…). Which of the following statements is correct in this context?

○ The list should be arranged by numbers not alphabetically

○ The sources must also be cited in the text

○ A reference list is not required for an assignment

○ I do not need to do anything else

Appendix V

Teaching intervention process

Visiting the university's central library (45 minutes)

Before starting the teaching intervention, an Assistant librarian (LIS graduate) of the university's central library provided a presentation for the new students (intervention group) on general library services and online information searching and retrieval through the library database.

Contact session 1

Lecture (30 minutes)

a. Importance of the contents: why should the contents be learnt?

b. Introducing the learning methods for the intervention. A handout about the planned intervention was provided to all students. But students were not informed about the post-test as a precaution to sharing their learning with the control group.

c. Forming the Learning Groups (LG); 9 groups were formed based on their pre-test scores.

Reading circle (50 minutes)

a. Printed copies of the regular lecture materials were provided to all the students (the same materials were provided to the control group). Students also got printed copies of the rules for the reading circle.

b. Each group was assigned to read a section of the material; each group member had different roles in the group, i.e., Discussion leader, Connector, Academic illuminator, and Word master.

    i. Discussion leader came up with one-two questions concerning the most important ideas in the reading section and personal views to stimulate discussion.

    ii. Connector related the reading content with real-life examples, e.g., a novel, a film, a song, or a personal experience.

    iii. Academic illuminator selected one to two sentences from the reading section and explain why s/he considers these as important.

    iv. Word master came up with important and unfamiliar words from the text and their definitions from the text or from the internet.

c. Students read their selected reading section in the classroom and were encouraged to continue reading until the next contact session.

d. They were asked to discuss the content of their reading section within their LG.

e. Approximate length of the reading section for each group was two hundred words.

Contact session 2

Reading circle (continues) (80 minutes)

a. Each student in the LG presented their assigned roles to the whole class. Members in the same group and other groups participated in the discussion. The teacher helped to stimulate the discussion.

b. Each group got 10 minutes to present their roles and discuss the contents of their reading section.

Contact session 3

Selecting a topic (30 minutes)

a. Students were encouraged to discuss in their LG to select a preliminary general topic of their writing assignment related to the issues in the reading material.

b. Teachers guided and intervened at this stage.

c. Then the students were instructed on how to make a preliminary search on the internet.

d. The LGs searched the internet to select a topic for their writing assignment.

e. At the first stage, LGs performed a preliminary search to get an overview of the general topic. They got an idea of the amount and type of materials available on the topic.

Exploring for focus (20 minutes)

a. At the second stage, LGs conducted an exploratory search to have a better understanding of the general topic and ways to focus the inquiry. They gathered information to define and extend the topic and to lead the inquiry to be focused.

b. Students were asked to reflect on their search results. They were encouraged to express what research questions came to their mind.

c. They were encouraged to explore interesting ideas rather than collecting information.

d. Teachers motivated and guided them in this critical phase.

e. At the end of this stage, students were able to identify a meaningful research question.

Formulating a focus (30 minutes)

a. At the third stage, LGs were asked to formulate a focused topic similar to but not the same as other groups for their writing assignment.

b. The LGs were asked to follow the following four criteria to formulate a focus:

    i) What was interesting to them? ii) What was the requirement of the assignment?

    ii) How much information was available? iv) How much time did they have?

Contact session 4

Evaluating and collecting information (50 minutes)

a. At the fourth stage, LGs performed a comprehensive search to collect specific and relevant information on the focused area of the topic. Teachers guided them to formulate effective search queries to find out pertinent information on the focused topic they are interested in.

b. Students needed to refine and revise their focus at this stage.

c. Teachers guided students to evaluate expertise, accuracy, currency, perspective and quality of available information through lectures and practical demonstrations.

Evaluating and collecting information (continues) (30 minutes)

a. After evaluating the sources, the LGs will gather information on their focused topic and take notes. Students will be encouraged to take notes either in Bengali or in English.

b. In this stage, the students will be able to evaluate and identify specific information pertinent to their focus.

Contact session 5

Assignment writing (50 minutes)

Teachers will demonstrate how to write an academic assignment. It will cover three main issues.

a. Different structures of academic writing.

b. How to interpret facts and organize ideas from retrieved information?

c. How to use information ethically and responsibly with a special focus on paraphrasing and APA citation method?

Sharing new knowledge (20 minutes)

Teachers will demonstrate different methods to share new knowledge. For example, through personal, academic or professional blog, professional newsletter, academic and professional groups in social media, news board of academic club, or magazine of their school.

Instructions for submitting assignment (10 minutes)

a. Students got one week to write an assignment in their LG.

b. Length of assignments: 3-5 pages for the collaborative assignment and 1 page for the solo assignment (Excluding cover page and reference list).

c. Students were allowed to work face-to-face or online to write the assignment.

d. The assignments were submitted in printed paper or through email as a word or pdf file.

Note. The five contact sessions were repeated for each module.