Integrated Instruction to Develop Information Literacy Skills of Undergraduate Students

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This study designed a technologically integrated course to develop the information literacy skills of 100 first-year students from the Faculty of Arts, Silpakorn University, Thailand. The Technological Pedagogical Content Knowledge (TPACK) model was integrated into an information literacy skills instructional design. A pre-and post-test design was adopted to measure the students' information literacy skills. During the sessions, interactive open sources were employed as the technology-integrated instruction for the online classroom learning activities. After the course completion, participants retook the test, from which it was found that the post-test information literacy scores were significantly higher than the pre-test scores for all information literacy components. However, the low-performing students' pre-and post-test scores for information evaluation showed no statistically significant differences. Therefore, developing the information evaluation skills of this group should be considered. This study's findings could be beneficial for instructors and learning designers seeking to design courses that develop the information literacy skills of undergraduate students.

Keywords: information literacy skills, integrated instruction, interactive open sources, Technological Pedagogical Content Knowledge (TPACK), technology-integrated instruction

INTRODUCTION

Advances in digital technology and the significant increase in social networking have affected 21st-century education. As all learners can now seek self-development by harnessing technology, knowledge acquisition has changed from teacher-centered to student-centered (Nair, 2019). Thai higher education reforms have focused on self-development by promoting information literacy, which includes discovering the joy of reading and learning new things, having the ability to find information from a variety of learning sources, using information technology wisely, thinking critically and systematically, developing communication skills, using language correctly, and gaining the skills to synthesize received information to benefit themselves and society (Lao, 2019).

Information literacy skills were defined as a key skill in the 21st-Century Learning Framework by the Partnership for 21st-Century Skills. Today, people live in a technology and media-driven environment where they can access abundant information. However, because of the rapid changes in technological tools, people of working age need to be able to effectively access, evaluate, and use information, that is, information literacy has become essential for everyone. Ideally, the development of information literacy should start from childhood to allow people to continuously pursue knowledge throughout their lives. Therefore, as information literacy has become a key competency in the digital age, educational and human

development institutions need to focus on developing information literacy skills in their students and employees to ensure the development of quality citizens (González-Pérez & Ramírez-Montoya, 2022).

Higher education generally employs student-centered learning to encourage students to pursue lifelong learning. In this form of learning, higher education instructors encourage learners to develop rational thinking and diagnostic problem-solving skills by studying on their own and seeking knowledge from various information resources. However, most students lack the critical thinking, searching, and knowledge-processing skills to successfully self-study, which has become a major impediment to student-centered learning (Bury, 2016; Lanning & Mallek, 2017; Weber et al., 2018). Therefore, it is important to develop the learners' information literacy skills.

As education has changed because of the significant advances in information and communication technologies, educational institutions must use these technologies to assist their learners in correctly seeking, exchanging, sharing, and disseminating information (Fernández-Gutiérrez et al., 2020). Therefore, as integrating technology into learning activities can develop multiple intelligences and be adapted to different learning styles, educational institutions must have policies that support and promote their instructors' abilities to use technology in their classroom instruction (Goh & Sigala, 2020).

Based on these concerns, this study used technology-integrated instruction to develop the information literacy skills of first-year students from the Faculty of Arts at Silpakorn University in Thailand. It was hoped that this study could provide guidelines for curriculum development and teaching preparation to promote and develop information literacy skills of undergraduate students.

Research Questions

1) What are the information literacy skills of the students after integrated instruction?
2) What are the information literacy skills of the different genders after the integrated instruction?
3) What are the information literacy skills of students with different performance levels (high, medium, and low) after integrated instruction?

LITERATURE REVIEW

Information Literacy Skills

Information literacy is a 21st-century skill that requires people to identify their own information needs, use tools to identify information sources, and effectively assess, synthesize, and use information (American Library Association, 2000). Information literacy has been related to lifelong education, a lifetime process in which a person continues to access knowledge throughout their lives in formal, informal, or non-formal environments, such as their families, schools, workplaces, communities, and societies. Lifetime education allows people to independently develop their economic, political, social, and cultural skills; however, such gains are impossible without information literacy. International organizations, such as UNESCO, have highlighted the importance of information literacy to lifelong education in four main areas: education for sustainable development; health service and life quality improvements; human resource-centered business and economic development; and participation in political and public administration (Horton, 2008).

Over the last few decades, information literacy has become increasingly important in library and information science. The emergence of the knowledge-based economy concept has driven the demand for people that both know how to learn and can continuously self-educate. Developing undergraduates into information-literate people has also been a key focus in developed countries, such as the United States, the United Kingdom, Australia, New Zealand, and Singapore (Cameron et al., 2007), all of which have developed information literacy standards for undergraduate studies to ensure information literacy development. As there are no comparable local information literacy standards in Thailand, foreign standards are being considered to guide information literacy development. However, before these foreign standards are used to develop information literacy in undergraduate students, libraries, information departments, and programs directly related to information literacy need to understand the strengths and weaknesses of these foreign standards (Lanning & Mallek, 2017).

This study focused on three information literacy components: information accessibility, evaluation, and usage.

1) Information accessibility is defined as the ability to identify sources, strategically search for knowledge using normal and electronic databases, and then classify, modify, analyze, synthesize, create, and communicate using the found knowledge.
2) Information evaluation is defined as the ability to synthesize, interpret, and make decisions about information reliability based on facts and accuracy.
3) Information usage is defined as the ability to understand the economic, social, cultural, and legal issues related to information and how to efficiently manage this information.

Integration of the Technological, Pedagogical, and Content Knowledge (TPACK) Into a Classroom Context

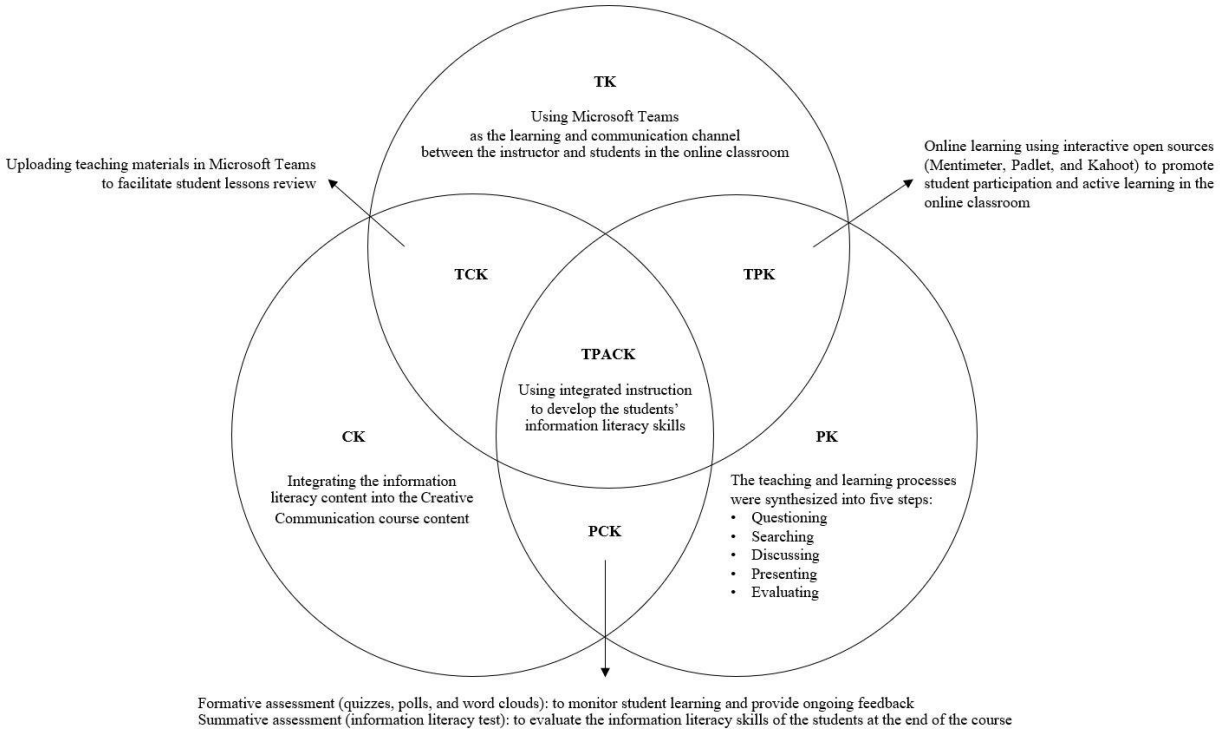
TPACK is an integrated instructional design concept that can assist instructors when designing learning activities. The TPACK model distinguishes three basic dimensions and the intersections between them, with the model identifying seven dimensions for different contexts (Mishra & Koehler, 2006).

1) Technological Knowledge (TK): the ability to use and learn new integrable technologies. Instructors should know about pedagogical technology and the ability to select the best tools for their teaching styles to maintain student enthusiasm.
2) Pedagogical Knowledge (PK): refers to learning management knowledge, which includes concepts, techniques, mechanisms, student learning support, curriculum understanding, learning management design, learning environment landscaping, and student assessment.
3) Content Knowledge (CK): refers to content knowledge, of which the instructor should have a thorough and accurate understanding.
4) Technological Pedagogical Knowledge (TPK): the ability to utilize technology to improve teaching methods and learning management quality, such as cloud-based classrooms and Massive Open Online Courses.
5) Technological Content Knowledge (TCK): the ability to use technology for content management and searching.
6) Pedagogical Content Knowledge (PCK): the ability to integrate teaching methods to improve the content and expand the scope.
7) TPACK: an ability to integrate a wide range of technologies into the content and learning management process to make teaching and learning more effective.

Although integrating technology with the teaching methods and content in classroom activities would allow instructors to fully use their learning management and integration skills and allow the students to understand the content more creatively (Rodríguez Moreno et al., 2019), many instructors are reluctant to use technology because of concerns such as technological inexperience, limited time, and overconfidence in their teaching methods (Rasheed et al., 2020; Haşiloğlu et al., 2020; Kohnke, 2021; Khlaif et al., 2023; Hennessy et al., 2022). Educational institutional policies and technological access have also been found to be major obstacles to TPACK-integrated learning management (Huang & Teo, 2020; Adams, 2019).

As an instructor in the Creative Communication course, the researcher applied the TPACK model to an instructional design to develop student information literacy skills (Figure 1).

FIGURE 1
INTEGRATING THE TPACK MODEL INTO THE INSTRUCTIONAL DESIGN FOR THE CREATIVE COMMUNICATION COURSE



METHODOLOGY

Participants

A sample group of 100 first-year students enrolled in the Creative Communication course at the Faculty of Arts at Silpakorn University, Thailand, was selected. This quasi-experimental research followed a one-group pre/post-test design because the human research ethics committee at the university had concerns about students' equality; that is, as the students had to receive the same treatment and assessments, no control group could be used. The students were classified into high, medium, and low groups based on their performances. The student classification details are shown in Table 1. All student information was kept confidential.

TABLE 1
STUDENT CLASSIFICATIONS

Grade point average	Level of performers
3.50 to 4.00	High
3.00 to 3.49	Medium
Less than 3.00	Low

Procedure

The experimental research was conducted two and a half hours per week over four months. Participants completed the pre-test using Google Forms, after which Microsoft Teams was used in the online classrooms because of its ability to create groups using university email accounts and systematically store the data and

files. Three interactive open sources; Mentimeter, Padlet, and Kahoot; were used to create quizzes, polls, and word clouds to engage the students and eliminate awkward silences. The researcher applied teaching methods from various sources to improve the learners' information literacy skills (Julien et al., 2018; Fraillon et al., 2020; De Paor & Heravi, 2020; Jones-Jang et al., 2021). The teaching and learning processes for this course were synthesized into five key steps, as follows:

1) Questioning: the instructor asked questions about information accessibility, information evaluation, and information usage in a technology and media-driven environment.
2) Searching: each group of learners searched and analyzed information to come up with a variety of answers.
3) Discussing: learners discussed and expressed their opinions on the information they gathered.
4) Presenting: each group presented their findings to the instructor and classmates.
5) Evaluating: the instructor gave feedback to the learners and evaluated the learning outcomes.

Information literacy content was integrated into the Creative Communication course's lesson plans and learning activities, which were divided into nine main areas: creative communication, critical sending and receiving of messages, cross-cultural communication, information literacy, information accessibility, information evaluation, information usage, social media communication, and digital society law. At the end of the course, the students took the information literacy test again.

Measuring Tool

The pre/post-test, consistent with other valid information literacy tests (Cameron et al., 2007; Boh Podgornik et al.,2016; Scherer et al., 2017), was designed to assess the students' information literacy skills. The test was developed based on the following principles.

1) Aim: the information literacy test measured the students' information literacy skills. The test focused on three components: information accessibility (10 items); information evaluation (10 items); and information usage (10 items).
2) Target population: the test was specifically designed for students in higher education.
3) Instrument type: multiple-choice test with four answer options.
4) Length and estimated completion time: 30 items in 30 min.

The reliability of the internal consistency of the information literacy test assessed using the Kuder-Richardson 20 (KR-20) was 0.77, deemed acceptable. The test had several difficulty levels ranging from $p = 0.12$ (very difficult) to $p = 0.81$ (very easy).

RESULTS

Information Literacy Skills after the Integrated Instruction

The interpretation of the student's information literacy skills is presented in Table 2. The post-test scores were significantly higher than the pre-test scores. Before the integrated instruction, the students had intermediate-level information literacy skills, but after the integrated instruction, the students had skilled-level information literacy skills. Table 3 shows the significant differences between the pre-and post-tests. When classified by the information literacy components, the post-test scores were significantly higher than the pre-test scores for all information literacy components (Table 4).

TABLE 2
INFORMATION LITERACY SCORES

Scores	Interpretation
21 to 30	Skilled
11 to 20	Intermediate
1 to 10	Beginner

TABLE 3
MEAN AND STANDARD DEVIATIONS FOR THE PRE- AND POST-TEST INFORMATION LITERACY SCORES

Test	n	M	SD	t	p
Pre-test	100	19.10	3.51	10.38	0.00*
Post-test	100	22.92	3.29		

Notes: *p < 0.05

TABLE 4
MEAN AND STANDARD DEVIATIONS FOR THE PRE- AND POST-TEST INFORMATION LITERACY SCORES CLASSIFIED BY THE INFORMATION LITERACY COMPONENTS

Test	Information accessibility				Information evaluation				Information usage			
	M	SD	t	p	M	SD	t	p	M	SD	t	p
Pre	5.69	1.59	6.37	0.00*	6.71	1.47	5.58	0.00*	6.71	1.80	5.21	0.00*
Post	7.17	1.71			7.89	1.41			7.91	1.30		

Notes: *p < 0.05

Information Literacy Skills by Gender after the Integrated Instruction

Table 5 shows the information literacy skill results by gender. Both males and females showed significant improvements; however, the standard deviation of the males decreased (SD = 3.48), while the standard deviation for the females was the same (SD = 3.26). While the post-test scores for the females were slightly less distributed than for the males, the average information literacy skill scores were similar. Table 6 shows the independent sample t-test that compared the gender differences, from which it can be seen that there were no significant differences; therefore, the effects of the integrated instruction on the acquisition of information literacy skills did not vary by gender. When information literacy components classified the male and female scores, it was found that the female post-test scores were statistically significantly higher than the pre-test scores for all information literacy components, and the male post-test scores were statistically significantly higher than the pre-test scores for information evaluation and information usage. However, the male pre-and post-test scores for information accessibility showed no statistically significant differences (Table 7).

TABLE 5
INFORMATION LITERACY SKILL RESULTS BY GENDER

Test	Male (n = 18)				Female (n = 82)			
	M	SD	t	p	M	SD	t	p
Pre-test	19.00	4.61	3.64	0.00*	19.12	3.26	9.75	0.00*
Post-test	22.44	3.48			23.02	3.26		

Notes: *p < 0.05

TABLE 6
INDEPENDENT SAMPLE T-TEST COMPARING THE INFORMATION LITERACY SKILL GENDER DIFFERENCES

Test	Gender	N	M	SD	t	p
Pre-test	Male	18	19.00	4.61	0.13	0.89
	Female	82	19.12	3.26		
Post-test	Male	18	22.44	3.48	0.67	0.50
	Female	82	23.02	3.26		

TABLE 7
INFORMATION LITERACY SKILL RESULTS CLASSIFIED BY INFORMATION LITERACY COMPONENTS AND GENDER

Components of information literacy	Male (n = 18)				Female (n = 82)			
	M	SD	t	p	M	SD	t	p
Information accessibility (pre)	5.83	1.86	1.95	0.07	5.66	1.54	7.76	0.00*
Information accessibility (post)	6.72	1.84			7.27	1.67		
Information evaluation (pre)	7.06	1.76	2.65	0.02*	6.63	1.39	6.14	0.00*
Information evaluation (post)	8.28	1.41			7.80	1.41		
Information usage (pre)	6.11	2.11	2.62	0.02*	6.84	1.71	6.41	0.00*
Information usage (post)	7.50	1.29			8.00	1.29		

Notes: *p < 0.05

Information Literacy Skills of Students With Varied Performances (High, Medium, and Low) After the Integrated Instruction

Table 8 shows the information literacy skill results by learning performance level. All student types showed a post-test increase, especially the high- and medium-performing students, both groups for which had similar average post-test scores. The analysis of variance found that the post-test scores for all three groups were similar, as shown in Table 9. Therefore, it was concluded that the integrated instruction improved students' information literacy skills with different learning performances. Table 10 shows the information literacy skill results classified by information literacy components and learning performance levels. The high- and medium-performing students had post-test scores statistically significantly higher than their pre-test scores for all information literacy components, and the low-performing students had post-test scores statistically significantly higher than their pre-test scores for information accessibility and information usage. However, the low-performing students' information evaluation pre-and post-test scores had no statistically significant differences. Therefore, it was concluded that although the low-performing students had statistically higher post-test scores than pre-test scores, greater instructor efforts may be needed to develop teaching activities that focus on developing the information evaluation skills of this group.

TABLE 8
INFORMATION LITERACY SKILL RESULTS BY LEARNING PERFORMANCE LEVELS

Test	High (n = 51)				Medium (n = 32)				Low (n = 17)			
	M	SD	t	p	M	SD	t	p	M	SD	t	p
Pre	19.08	3.39	8.20	0.00*	19.69	3.20	5.41	0.00*	18.06	4.35	3.51	0.00*
Post	23.35	2.98			23.03	3.73			21.41	3.06		

Notes: *p < 0.05

TABLE 9
ANALYSIS OF VARIANCE RESULTS FOR THE INFORMATION LITERACY SKILLS FOR THE DIFFERENT LEARNING PERFORMANCE GROUPS (POST-TEST)

Source of the variance	SS	df	MS	F	p
Between groups	48.627	2	24.313	2.301	0.11
Within groups	1024.733	97	10.564		
Total	1073.36	99			

TABLE 10
INFORMATION LITERACY SKILL RESULTS CLASSIFIED BY INFORMATION LITERACY COMPONENTS AND LEARNING PERFORMANCE GROUPS

Components	High (n = 51)				Medium (n = 32)				Low (n = 17)			
	M	SD	t	p	M	SD	t	p	M	SD	t	p
Information accessibility (pre)	5.82	1.62	5.11	0.00*	5.75	1.39	4.78	0.00*	5.18	1.85	2.49	0.02*
Information accessibility (post)	7.31	1.57			7.47	1.92			6.18	1.38		
Information evaluation (pre)	6.63	1.36	5.98	0.00*	6.81	1.47	2.97	0.01*	6.76	1.82	1.95	0.07
Information evaluation (post)	8.04	1.23			7.66	1.60			7.88	1.58		
Information usage (pre)	6.65	1.90	4.57	0.00*	7.13	1.60	3.09	0.00*	6.12	1.76	2.85	0.01*
Information usage (post)	8.04	1.34			8.00	1.22			7.35	1.22		

Notes: *$p < 0.05$

DISCUSSION AND CONCLUSION

This study provided empirical evidence to answer the following research questions. 1) What are the information literacy skills of students after integrated instruction? 2) What are the information literacy skills of students of different genders after integrated instruction? 3) What are students' information literacy skills with different performance levels (high, medium, and low) after integrated instruction? It was found that the participants had significantly higher information literacy post-test scores for all information literacy components than pre-test scores, and there were no significant differences between the male and female information literacy skill improvements. Therefore, it was concluded that integrating technology into teaching methods can improve the information literacy skills of both male and female students, which was consistent with the results of Encheva et al. (2020), who taught information literacy using fun and innovative game technologies to improve the humanities' competencies of higher education students and assist them in recognizing fake content. Educational games were used to encourage active learning through investigation, experimentation, competition, and teamwork. The integration of game technology into information literacy training for Bachelor level Humanities students was found to have positive impacts on both male and female information literacy skills.

The students from different performance levels (high, medium, and low) all had increased post-test scores. The high- and medium-performing students had statistically significantly higher post-test scores than pre-test scores for all information literacy components; however, the low-performing students' pre-and post-test scores for information evaluation showed no statistically significant differences. Therefore, instructors should develop techniques to develop the information evaluation skills of low-performing students, such as collaborative learning and peer-assisted learning. Wang et al. (2020) found that low-performing students participating in online collaborative learning had greater interactions and higher learning outcomes. In collaborative learning environments, instructors could also integrate peer-assisted learning into the learning processes for low-, medium-, and high-performing students. The low-performing students could gain knowledge from their peers, whereas the high- and medium-performing students could benefit from revising their knowledge (Arco-Tirado et al., 2020). Guo & Wang (2020) suggested that learning by doing and experimenting was also a good alternative for low-performing students as learning through trial and error in real situations can improve understanding better than lecture-based instructional approaches.

This study used three interactive platforms; Mentimeter, Padlet, and Kahoot; to organize the learning activities for a large class in an online classroom, all of which were able to better engage the students and eliminate any awkward classroom silences. Previous studies have reported on the efficacy of using educational technologies to facilitate and enhance teaching efficiency. For example, Mohin et al. (2022) surveyed the perceptions of students about Mentimeter. They found that it had a positive impact on the students' attitudes and performances. Mehta et al. (2021) investigated undergraduate Dentistry and Bioscience student perceptions of Padlet mediated learning and found that it had allowed the students to become mutual resource and content co-creators. Padlet has also been found useful for sharing content and ideas in posts. Göksün & Gürsoy (2019) studied gamified learning experiences using Kahoot and found that the assessments conducted using gamification were more positive than conventional assessments. Because of the positive effects of using technology for evaluations, it was emphasized that instructors should use technology for evaluation activities when conducting formative-grading assessments.

Integrating technology into teaching is important to overcome the generation gap between instructors and students. However, technological integration requires instructor effort, especially for senior instructors not yet proficient in modern technological tools.

FUTURE RESEARCH

This study indicated challenges for curriculum developers, educators, and instructors when planning and designing courses to improve the information literacy skills of their undergraduate students. However, as there were more females than males in this study's sample, future studies could employ purposive sampling methods to ensure no gender bias. Further, as this study focused on the information literacy skills of first-year students, future studies could investigate the information literacy skills of second, third, and fourth-year students to broaden the research results.

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