

The Measurement of Information Technology Literacy : A Case of Thai Graduates

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Abstract

The main objectives of this research are to develop a measurement tool for determining information technology literacy (ITL) and to assess the ITL of Thai graduates. ITL in this study is categorized into three components: fundamental knowledge, skills, and applications. The study consists of two parts. The first part relates to developing a measurement tool for assessing the ITL of the Thai graduates. The components of ITL in the measurement tool were obtained through questionnaires which were answered by HR managers of fifty Thai companies listed on the Stock Exchange of Thailand (SET). The second part details the use of the measurement tool to assess the ITL of Thai graduates. The research findings, besides showing the level of literacy of non-IT Thai students at the time of finishing their Bachelor's degree, may also prove useful when deciding on adjustments to IT teaching in Thai universities so that such teaching more effectively meets the needs of the country's labor market.

1. Introduction

Information technology (IT); consisting of computers, communication, and computer networks [14]; has been one of the significant factors affecting and shaping the development of many aspects of Thai society since the beginning of the 1980s. Many Thai organizations, both in public and private sectors, have adopted IT for improving their management, efficiency, and competitive advantage. IT is also used in innovative projects. Trends show increased use of computers and IT for enhancing quality and production. The importance of computer technology to the country's development was firmly stated in the latest report of Thailand's National Economic and Social Development Plan (2002-2006), (Office of the National Economic and Social Development Board [11]).

It is widely recognized among Thai institutions, social educators, and leaders that the development of human resources capable of using computers and IT technology effectively in their work is vital to the economic growth and well-being of both the country and individuals [11]. The most common places where Thai people acquire their computer and IT knowledge are in educational institutes and the workplace. Universities play an important part in supplying the labor market with the number and quality of new employees. Thai graduates are often inadequately prepared in computer and IT skills for the work they must do after entering employment. Therefore, many Thai organizations need to spend significant amounts of time and money to train them in IT competency sufficient to meet the requirements of the workplace. It is; therefore, essential for Thai educational programs to adjust their curriculum and course content to make them more relevant to the labor market's needs.

Many countries have conducted studies which assess the ITL of their university graduates. Many studies and tests on ITL have been conducted by researchers and institutes in the U.S. [1],[2],[3],[5], [7],[8],[10],[14], and [15]. ITL in the U.S. studies includes an understanding of computer software and hardware, telecommunications and computer networks, the selection of different computer configurations, artificial intelligence, database, and Internet use. One of the purposes of these studies was to develop benchmarks for improving educational programs in IT. In Singapore, ITL is constantly monitored by the National Institute. "The 2002 Information Literacy Survey", a study carried out in Singapore in 2002 [8], is an example of the significance of this type of research and how it can contribute to a country's development. The research investigates the level of information and communication literacy of the Singapore resident population and workforce; specifically, to carry out electronic transactions, communication, and access of services. The research findings were consequently used to identify areas for improvement in the country's education and training.

The literature review of this study summarizes past studies that focused on measuring ITL. Even though these studies deal with many similar aspects of ITL, their definitions of ITL do not include the same components. Based on a review of past research studies, this current study categorizes ITL into three components: fundamental knowledge, skills, and applications. Moreover, many studies evaluate literacy through self-assessment methods. This research aims to develop an objective measure of ITL that can be used with Thai graduates. It appears to be the first study of its kind in Thailand. The findings of the research can be used for two main purposes. Firstly, they can be used by Thai universities in refining their curriculums to make them more appropriate to the IT needs of the Thai labor market. Secondly, the measurement tool of ITL created for this study can be used in further studies in this area.

2. Research Objectives

- 2.1 To develop a measurement tool for determining the ITL of Thai graduates in the areas of fundamental knowledge, skills, and applications.
- 2.2 To examine the accuracy of the tool by comparing the results obtained with actual performance using a computer.
- 2.3 To assess the ITL of recent Thai graduates, from both public and private universities, whose major was not in IT.
- 2.4 To measure any significant discrepancies between the ITL of Thai graduates and the entry level ITL requirements of Thai business organizations.

3. Research Framework

Figure 1 illustrates the framework of this research. The target population of ITL measurement is Thai graduates who were completing the last year of their bachelor’s degree in non-IT subjects and who would enter the Thai labor market soon after their graduation. ITL in this research consists of three components: fundamental knowledge, skills, and applications. “Fundamental knowledge” is the basic understanding of computer hardware and software essential for using computers at work and how to use new technology. “Skill” covers the ability to use relevant tools to process information which will be useful in the field of work. “Application” refers to the ability to use and follow up on new technologies in the profession as well as daily life.

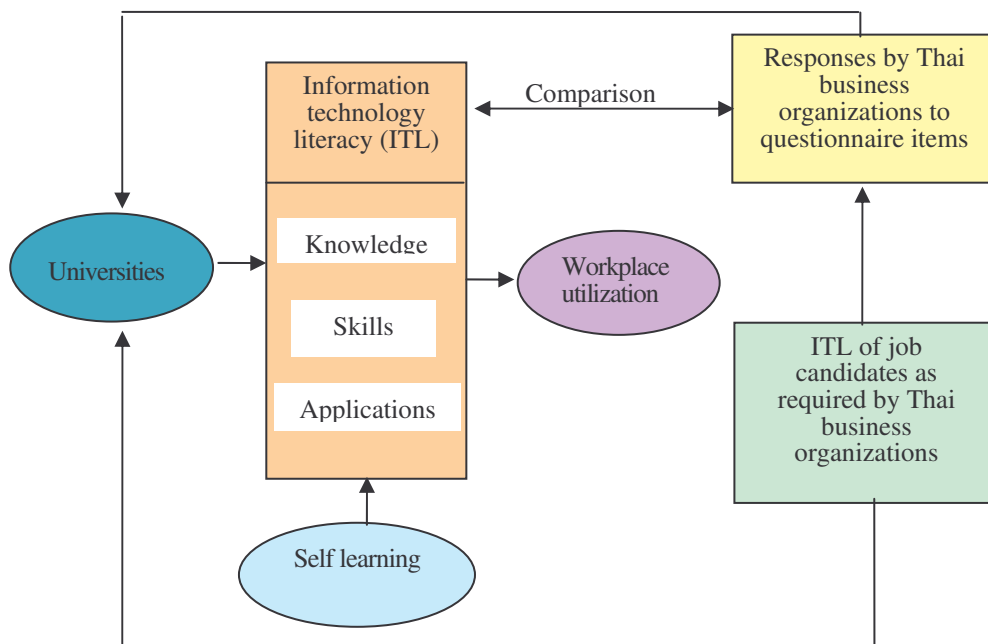


Fig. 1 The research framework

Thai graduates usually acquire their ITL through formal education in university and through self-study. The ITL of Thai graduates at the time they enter employment may or may not meet the ITL requirements of their employers. This depends on job characteristics and employers’ expectations. If the ITL of Thai graduates is insufficient for performing their jobs, Thai universities will need to revise their curriculum in order to make it more appropriate to the needs of the Thai labor market.

4. Methodology

4.1 Sample

There are two groups of participants in this research: (a) Human resource (HR) managers of Thai business organizations listed on the Stock Exchange of Thailand (SET), and (b) Thai students of both science and liberal arts disciplines who were completing the last year of a bachelors' degree which was not in IT. The students would later graduate and enter the Thai labor market. The HR managers provided information on ITL required by job candidates. The students provided measures of ITL considered indicative of the ITL of Thai graduates in general.

Fifty Thai business organizations on the SET were selected based on two considerations. Firstly, they were representative of companies and the range of business areas on the SET list. Secondly, each company was among the top companies in the industry in terms of performance. It was assumed that the performance of top companies was the standard to which other companies aspire. HR managers were selected by the research team for answering the questionnaire sent to business organizations because of their unique ability to identify the qualities of employees required by the organization. Moreover, past experience in conducting research studies in Thailand showed that Thai HR managers were more willing than other line managers to cooperate and provide information for completing the research work. This was shown in the high response rate (45%-50%) in the self-administration questionnaire survey.

There were two groups of Thai graduates participating in this research. The first group consisted of 121 participants from 3 universities. These students took part in the evaluation of the "skills part" of the ITL measurement. The results obtained through actual practice on a computer were then compared to the results obtained from the "paper-and-pencil" test. The second group was students from 10 public and private universities. The ITL of this second group was assessed through the measurement tool, "a paper-and-pencil test", developed for this study. Two hundred students from each university were selected to complete the test: 60 students who majored in science and 140 students who majored in fields other than science. In the group whose majors were in non-science subjects, 60 were majoring in liberal arts and philosophy and the remaining 80 in business administration, political science, and economics. The ITL analysis in this research was based on the responses from 1,953 Thai graduates.

Table 1: Profile of the 1,953 Thai graduates who participated in the ITL measurement using the paper-and-pencil test

Item	Percentage	Item	Percentage
<i>University type</i>		<i>Grade Point Average</i>	
Public	70.4	<2.50	24.9
Private	29.6	2.51-3.00	35.1
		3.01-4.00	34.5
<i>Major</i>		No answers	5.5
Science	30.4		
Arts	22.6		
Social science	47.0		

4.2 Measurement

The research methodology consists of four steps: (1) a survey of Thai business organizations; (2) forming the ITL framework; (3) developing and testing a measurement tool; and (4) measuring the ITL of Thai graduates.

Step 1: A survey of Thai business organizations

This step assessed the ITL requirements of Thai business organizations for job applicants. The participants were HR managers of the fifty selected business organizations listed on the SET. The questionnaire sent to the HR managers consists of 97 questions organized into three categories: fundamental knowledge, skills, and applications. The questionnaire was designed by the nine researchers who conducted this research and was based on a review of local and international research on ITL. Of the total 97 questions, 40 related to fundamental knowledge, 49 related to skills, and 8 related to applications. Participants responded by choosing one of four choices for each question. Each choice indicates the extent to which the item is essential to the ITL required for new employees in the company. The four choices are: essential, somewhat essential, not essential, and not sure. Table 2 details the major topics of ITL covered in the questionnaire.

The questionnaire was pre-tested by 10 HR managers who were studying in the Master's Program in Human Resource Development (HRD) at the National Institute of Development Administration (NIDA). After this pre-test, the questionnaire was sent to the selected 50 companies.

Table 2: Results of survey regarding the ITL required for job candidates by Thai business organizations

Item	Major topics	Number of questions	
		The questionnaire to HR managers	The measurement tool
Section I: Fundamental knowledge		40	33
1	Computer	2	2
2	Components of computer systems	2	1
3	Functions of computer components	10	6
4	Computer system operations	2	1
5	Computers available in the market	2	2
6	Management of computer performance	8	8
7	Software	8	7
8	Communication systems and computer network	6	6
Section II: Skills		49	49
1	Use of basic equipment	3	3
2	Use of peripherals	4	4
3	Fundamental file management	8	8
4	Applications of trouble-shooting strategies in solving hardware and software problems	4	4
5	Use of word processing	7	7
6	Use of spreadsheets	6	6
7	Use of power-point	7	7
8	Use of E-mail	6	6
9	Use of the Internet	4	4
Section III: Applications		8	8
1	Use of IT in daily life	1	1
2	Use of IT in various job assignments	1	1
3	Use of IT in professional area	1	1
4	Use of multimedia and computer	1	1
5	Keeping pace with IT advancement	1	1
6	Ability to analyze the impact of IT use	1	1
7	Ability to make risk analysis of computer crime	1	1
8	Being ethical in IT use	1	1
		97	90

Step 2: Forming the ITL framework

The responses to the questionnaire provided by the fifty HR managers were used as a basis for developing a measurement tool for assessing the ITL of Thai graduates. If more than 50 per cent of responses were either essential or somewhat essential, the item was included in the measurement tool. If more than 50 per cent of responses were either not essential or not sure, the item was not included in the measurement tool. Of the total 97 questions in the questionnaire, seven were deleted based on the criteria described above. The remaining 90 items were reviewed again by the research advisors to decide whether those items were appropriate for ITL measurement. Table 2 summarizes: (a) the major topics of each of the three components of the measurement tool, (b) the questions in the questionnaire sent to HR managers, and (c) the questions used as a basis for building the ITL measurement tool.

Step 3: Developing and testing a measurement tool

After items from the questionnaire were selected and validated as described above, they were re-written in question form. That is for each question, four possible responses were given. These questions were then used in a "paper-and-pencil" test for evaluating the ITL of Thai graduates. The "paper-and-pencil" test was made in order to ensure that the measuring tool was valid, practical, and cost and time effective. There were 90 questions divided into three categories: 33 relating to fundamental knowledge, 49 relating to skills, and 8 relating to applications. The questions relating to fundamental knowledge and applications appeared to be adequate to assess ITL. However, the research team has reservations about the adequacy of the paper test format for measuring skills.

To validate the skills part of the ITL measurement tool, a group of 121 students from one private and two public universities were evaluated through both their responses to the paper-and-pencil test, and through actual use of the skills on a computer (see Table 3). The results of these two tests were then compared using statistical methods. The

Spearman's correlation coefficient is 0.456 and p-value is 0.000 indicating that both tests have a positive statistical correlation. Moreover, the statistical tests of the scores of science and non-science students yielded Spearman's correlation coefficients of 0.343 and 0.514 respectively. It was therefore concluded that there was a positive correlation between the scores of students both from the paper-and-pencil test and from the hands-on computer tests. This means that a student who obtains a high score in the paper-and pencil test is likely to have a high score in the hands-on computer test as well.

Table 3: Results of the paper-and-pencil test and the hands-on computer test of the skills section of the ITL measurement tool.

Test	Total score	Lowest score	Highest score	Mean	Standard deviation
Paper-and-pencil	42	14.00	34.00	23.97	3.85
Hands-on	60	6.50	59.00	42.84	11.73

Some improvements in the measurement tool were also made according to suggestions given by some of the 121 students who took the tests. Another group of 40 students participated in the second administration of the measurement tool. For this administration, the Spearman's correlation coefficient was 0.522 and the p-value was 0.001. Furthermore, the questions in the paper-and-pencil test were once again analyzed to verify the difficulty index, discriminating power, and reliability-coefficient of internal consistency. The results show that the questions in the measurement tool contain a discriminating power and difficulty index within the normal range. The final version of the ITL measurement tool consists of 80 questions grouped into 5 parts: 19 questions on hardware; 5 questions on software, 6 questions on communications and networking; 43 questions on IT skills, and 7 questions on applications. The measurement tool is ready to be used for assessing the ITL of Thai graduates. Figure 2 illustrates the steps used in forming the questions in the questionnaire.

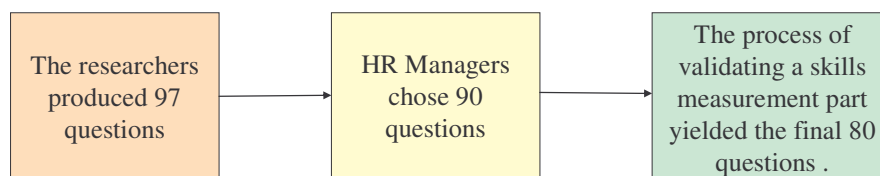


Fig. 2 The steps used in forming the questions in the questionnaire

Step 4: Measuring the ITL of Thai graduates

The paper-and-pencil measurement tool completed in step 3 was utilized for assessing the ITL of Thai graduates. A total of two thousand students from ten universities were randomly selected to participate in this stage of the research - 200 students from each of 7 public and 3 private universities. The selected students were studying in their fourth year and would be entering jobs soon after their upcoming graduation. The research findings were analyzed from the responses of 1,953 participants whose answers were complete according to the research objectives (for more on the participants' profiles see Table 1).

5. Research Findings

5.1 The findings of this research show that every item in the skills and applications parts of the ITL measurement tool was identified by HR managers of Thai business organizations as essential or somewhat essential to ITL. The findings may indicate the increasing importance of ITL skills and applications for new graduates. Furthermore, the findings indicate that even though individual countries have unique characteristics, data on ITL obtained from studies in some countries can be applied in ITL studies in other countries. The ITL measurement tool in this research is based on a combination of: (a) the findings of ITL research conducted in countries outside Thailand, and (b) the experience in IT and ITL research in Thailand of the research team. The majority of the items in the questionnaire to HR managers prepared by the researchers for assessing the ITL requirements of Thai business organizations were retained (90 out of 97). The findings may also indicate that IT is a subject of universal relevance. In order for the technology to be effective, it must be compatible and applicable worldwide.

5.2 The measurement tool developed in this study; which consists of fundamental knowledge, skills, and applications; is applicable for assessing the ITL of Thai graduates. The tool has 80 questions in total and was assembled into five parts: 1. hardware; 2. software; 3. communications and networking; 4. IT skills; and 5. applications. The statistical tests show a positive relationship between the test scores of a paper-and-pencil test and the results of a hands-on computer test for a group of 121 students who took both tests. Students who scored well in the paper-and-pencil test also did well in the hands-on computer test and vice versa. Thus, the findings seem to demonstrate that the ITL measurement tool supplies a practical and cost effective approach to mass assessment of ITL.

5.3 In general, the level of ITL of Thai students measured in this study was acceptable for entering the labour market. Thai students have adequate IT knowledge and skills, as well as the ability to apply these, for Thai business organizations. In addition, the findings also show that students with a high grade point average are likely to have high ITL as well. However, there are some areas in which a number of students did not perform well and needed to improve. These areas are those in which more than one third of the 1,953 students answered less than 50 percent of the questions correctly. They were skills in using Microsoft Excel, Microsoft Power Point, Microsoft Word, and e-mail/Internet. Table 4 summarizes the results.

Table 4: ITL measurement of Thai graduates

Item	Score (Mean/ Total)	Percent of participants scoring less than 50% of total scores	ITL to be improved ^I	Mean differences between groups of students in different majors ^{II}
1. Fundamental knowledge in computer hardware	10.95/19	29.2	1. Capabilities, limitations, and applications of different computer types 2. The role of RAM 3. Selecting a personal computer and understanding of computer accessory facilities	Y 10.40 ^a
				X 10.90 ^b
				Z 11.24 ^b
2. Fundamental knowledge in computer programs	3.62/5	17.9	-	Y 3.45 ^a
				X 3.58 ^{ab}
				Z 3.72 ^b
3. Fundamental knowledge in communications and networking	4.50/6	10.4	-	X 4.33 ^a
				Y 4.45 ^{ab}
				Z 4.62 ^b
4. Computer skills				
4.1 Microsoft Word	4.73/7	34.5	1. Formatting a paper page	Y 4.45 ^a
				X 4.72 ^b
				Z 4.79 ^b
4.2 Microsoft Excel	2.48/6	52.7	1. Workbook and worksheet management 2. Formatting the worksheet display 3. Formatting statistical graphic pictures	Y 2.22 ^a
				X 2.47 ^b
				Z 2.61 ^b
4.3 Power Point	3.83/8	41.4	1. Formatting slide displays and background 2. Text arrangement 3. Slide presentation	Y 3.60 ^a
				X 3.74 ^a
				Z 4.00 ^b

Table 4: ITL measurement of Thai graduates

Item	Score (Mean/ Total)	Percent of participants scoring less than 50% of total scores	ITL to be improved ^I	Mean differences between groups of students in different majors ^{II}
4.4 File management	7.56/12	21.7	1. File creation	Y 7.36 ^a
			2. File searching	X 7.53 ^a
			3. Changing file names	Z 7.67 ^a
4.5 E-mail/ Internet	5.09/10	36.3	1. Keeping e-mails at drafts	X 4.79 ^a
			2. Using search engines	Y 5.08 ^b
			3. Building automatically attached signatures, names, addresses	Z 5.28 ^b
			4. Defaulting frequent web sites as homepages	
5. IT applications	4.49/7	26.0	1. Applying IT to specific professional use	Y 4.27 ^a X 4.32 ^a Z 4.71 ^b

.Note.

- ^I are the ITL questions which less than 50 percent of the participants answered correctly.
- ^{II} consists of three categorical majors; X is science, Y is arts, and Z is social science.
- ^{a, b} Means having the same superscripts are not statistically different.
- RAM is random access memory.

6. Discussion

6.1 From the statistical findings, the ITL of Thai graduates in social science is higher than that of graduates in science and arts. This may be due to the fact that most social science students who participated in this research were graduates in business administration and economics. These students are usually required to register for IT courses. This is a common requirement in bachelor's degree courses in public and private universities in Thailand. Therefore, social science students are given a chance to develop the ITL fundamental knowledge, skills, and applications generally needed by the labour market. The ITL skills of science students; however, are normally related to their specific profession, not directly to the needs of the labour market.

6.2 This research had the following objectives: (a) to find a practical way to assess the ITL of Thai graduates when a hands-on computer test is not easily accessible; and (b) to create assessment techniques which measure the real ITL of graduates; not their perception of their ITL. The findings seem to confirm that, if carefully constructed, a paper-and-pencil approach is as valid a tool as is the hands-on method for assessing the ITL of large groups. However, when possible, it is recommended that both paper-and-pencil and hands-on tests should be used for assessing a persons' ITL. This increases the accuracy of the measurement.

6.3 The findings show that the participants performed better in tests of fundamental knowledge of computer programs than in tests on computer hardware - 72.4% compared to 57.6%. This may be due to the students' educational background which stressed active use of computers rather than theory of computers. Knowing how to use computer programs is seen as more relevant to their career than knowing about computer equipment which is usually seen as the work of a computer specialist. The findings also show that at least one third of the 1,953 assessed students scored less than 50 per cent on the IT skills part which relates to using common office programs such as Microsoft Excel, Microsoft Power Point, Microsoft Word, and e-mail/Internet. The findings may signify the need for Thai universities to design educational activities that would prepare their graduates to effectively use the most common programs in the workplace.

6.4 The research findings confirm that IT is a subject that is critical to Thai graduates' job competence. The findings give a satisfactory indication of Thai students' ITL in terms of meeting business organizations' requirements. However, current ITL may not be enough to meet future demand. The findings indicate that many universities in Thailand, both public and private, have performed well in planning their curricula for bachelor's degrees that are intended to prepare graduates to enter the workplace. Nevertheless, the results demonstrated in Table 4 indicate an urgent need for universities in Thailand to continue improving their teaching of IT so as to strengthen graduates' readiness for

employment. There are still many areas in which Thai graduates do not possess adequate ITL. Universities need to adapt their IT teaching plan to remedy this situation.

7. Limitations

Following, are some possible limitations of the research findings. Firstly, the basis for identifying the required ITL of job candidates by business organizations was based on the opinions of HR managers. Usually, Thai HR managers have only a moderate level of ITL. Not many have a high level. Their answers, which were used to benchmark the level of ITL for job candidates, may reflect only a minimal level; not the level that is actually required to work successfully in highly competitive situations. The research team compensated for this by selecting HR managers who worked in companies that were industry leaders. However, a more representative sample might be obtained by including responses from line managers in other areas such as marketing, production, or sales.

Secondly, each of the forty-three questions in the skills part of the paper-and-pencil measurement tool was designed to have four answer choices. In practice, there are usually a number of ways in which computers can be used to perform the same task. Therefore, even though all of the questions were constructed with careful counterchecks in order to produce the best possible answer choices, responses to some questions could probably have included other alternatives.

Thirdly, it is crucial when making a good ITL measurement tool that the information obtained during the developing and testing, as well as the measuring stages, was accurate. If some of the students participating in those stages did not pay adequate attention, the results might distort the precision of the tool and the research findings. The research team tried to minimize this limitation by providing monetary incentives to those students who scored highest in each university. However, a better method than monetary reward to increase and ascertain the students' interest/concentration in completing the testing is recommended for future research.

8. Conclusion

Due to the rapid advancement in technology and globalization, the ITL of the workforce will continue to be an important issue in Thailand. The measurement of ITL among Thai graduates can provide benchmarks for adjusting teaching programs in universities and therefore more effectively prepare graduates for the workplace. In order to produce valuable research findings, an effective ITL measurement tool and techniques are critical. This research, possibly the first of its kind in Thailand, presents three main conclusions: (a) that ITL measurement research should actively involve key people in the labour market, those who can provide the currently needed ITL; (b) that the ITL measurement tool must contain the critical components of ITL i.e. basic knowledge, skills, and applications; and (c) that a carefully constructed paper-and-pencil ITL measurement tool can be used as an alternative in situations where a hands-on technique is not possible. It is recommended that the ITL measurement tool and the ITL measurement techniques should be continuously examined by scholars or researchers in this area because accurate findings will be useful to individuals and institutions.

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Titles listed in brackets { } were published in the Thai language. Titles provided here are English translations.

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