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Developing the Quality of ICT Competency Instrument for Lower Secondary School Students

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Abstract

This study aimed to develop and investigated the quality of ICT competency instrument. The respondents were 364 lower-secondary school students and research instrument was ICT self-assessment questionnaire. To ensure the instrument quality, the reliability was checked Cranach's alpha coefficient using SPSS and content validity was examined through IOC analysis. Moreover, the construct validity was examined through the secondary-order confirmatory factor analysis using LISREL. Results reveal that the reliability of questionnaire was very high. In addition, the questionnaire had acceptable content validity and the secondary-order CFA showed that the measurement model of ICT competency fitted the data quite well.

1. Introduction

In the present day information-based society, students need to have ability to apply technology for learning. Digital skills are important for preparing students to work, live, and contribute to their communities. The students should meet the following standards and performance indicators: creativity and innovation, communication and collaboration, research and information fluency, critical thinking, problem solving, and decision making, digital citizenship and technology operations and concepts (ISTE,2007). The emphasis of educational policies in Thailand has been revised in order to precipitate the development of educational management that can keep pace with the fiercely competitive and rapidly changing world nowadays. One of the development policies is to promote and enhance the ICT competency of both education personnel and students. In particular, students need to acquire ICT competency so as to make use of ICT as a tool for facilitating their learning process, achieving their full potential, and contributing to the development of the country as a result. To prepare students for the approaching ASEAN community, the Office of the Basic Education Commission (2009) in Thailand has in consequence put forward three

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crucial desired characteristics that Thai students are supposed to possess: knowledge of ICT, ICT skills, and attitude toward ICT. In addition, Thai students in the coming ASEAN community are expected to acquire basic ICT skills and take advantage of ICT in the most constructive way possible. On this account, the Office of the Basic Education Commission in Thailand has set the indicators that reflect success of lower-secondary school students in the constructive use of ICT for their own benefits. These indicators can be observed through the percentage of students who are able to utilize ICT for the sake of learning and designing, creating, presenting, and publishing their work as well as sharing their work on the ASEAN community scale. Since ICT competency is increasingly of great importance to student learning and the development of the country, proper education management should be launched with regard precisely to the promotion of ICT competency that is most suitable for students' current ICT competence level, while at the same time satisfying students' ICT competency needs in tandem. In this regard, an effective self-assessment tool is of the essence for teachers to reliably and validly measure student's ICT competency level and this means that the self-assessment tool must, of necessity, be reliable and valid particularly in terms of both content and construct.

1.1. Definition of Terms

Competency refers to the ability resulting from individual's knowledge, skills, characteristics, and attitude in carrying out work to achieve success. Competency is made up of knowledge, skills, and attitude. Knowledge refers to what individual has learned in class, from experience, and from understanding of a particular subject. Skill refers to the ability to capitalize on knowledge to perform work in an appropriate and accurate way. Attitude refers to stance, feeling, or internal characteristics of individuals that express a sense of realizing the benefit and value of a particular thing.

ICT competency refers to knowledge, skills, and ability to take advantage of ICT for the purpose of gathering, processing and presenting information in support of activities among different groups of people for working (UNESCO, 2008; NICS, 2010; Albirini, 2006), relaxing and communicating purposes (European Commission ,2004). It also serves as a basic skill in the information-based society (Cha et al., 2011).

Individuals who are regarded as having ICT competency must be able to produce necessary documents, find out solutions to problems, choose proper ICT tools for problem solving and effective work. They must also be able to collect and share information in an ethical way, and possess fundamental ICT knowledge as well as develop and use novel ICT tools in an effective way.

1.2. Frameworks of ICT Competency.

ICT competency is composed of three major dimensions: knowledge, skill, and attitude (Belgium, 2005; UNESCO, 2008). Details of these dimensions are as follows.

1) Knowledge refers to the knowledge that users have in terms of ICT and the value that users realize with regard to ICT on a daily basis. It also involves the understanding of technology and benefits of using technology in daily life. The understanding includes the knowledge of ICT and its relevant contents.

2) Skill refers to the ability to capitalize on ICT knowledge and skills in performing work through the following skills: 1) information access and processing, 2) information evaluation 3) information production, 4) information management, 5) information communication and 6) the use of the Internet network.

3) Attitude refers to the understanding of the benefits and consequences of the use of ICT and the understanding of the use of ICT in developing societies as well as the realization of the value and responsibility for communication and other purposes. It also involves the critically evaluative skills that lead to social and ethical competencies. Belgium (2005) stated that social and ethical competencies can enhance attitude to such an extent that encompasses honesty and responsibility for the use of novel technology. Moreover, social and ethical competencies drive users to follow ethical agreements with a view to utilizing ICT properly and ethically as well as helping others when they face some difficulty using ICT.

1.3. Assessment of ICT Competency

The assessment of competency by means of self-assessment is the assessment method that is widely adopted and acknowledged among education personnel worldwide. It includes the checklist for each individual to gauge his or her own competency by themselves. The information gained from this way is essentially derived from individuals' desire or needs that cannot be objectively observed. The focus of the present assessment method is upon self-perception and belief in relation to a specific competence that individual possesses (Schneckenberg, 2007).

2. Research Objective

The primary purpose of this study is to develop ICT competency self-assessment tool and examine the quality of the tool for assessing ICT competency level of lower-secondary school students in Thailand.

3. Research Methodology

3.1. Participants and Procedure

The participants in this study are 364 lower-secondary school students from schools under the Office of the Basic Education Commission. The participants were randomly selected from extra large-sized schools, large-sized schools, and medium-sized schools. Among 364 students, 156 are male students and 208 are female students. Forty eight students are grade 7 students, 181 students are grade 8 students, and 135 are grade 9 students. All of the participants are between 12 and 15 years old.

3.2. Research Instrument

The research instrument of the current study is the ICT competency questionnaire, which consists of two parts. The first part deals with background information of students and the second part has to do with ICT competency of students. The instrument was developed based primarily upon the ICT competency framework of UNESCO, which is made up of ICT knowledge, ICT skills, and ICT attitude and ethic. The questionnaire is a 5 -point Like scale format and consists of 40 questions altogether.

3.3. Instrument Development

The development of the current research instrument was divided into four stages. The first stage was concerned with the synthesis of relevant documents and literature in relation to ICT competency. The purpose of this stage was to define the components and the scope of the ICT competency for data collection process and for formulating operational definition and the structure of the variables to be measured. The second stage dealt with the construction of the table of specification for creating questionnaire items based on the operational definition. This will help ensure that the questionnaire would fit the target context and participants of interest. Forty questionnaire items were then examined by my advisor and were once again revised as the first draft. The third phrase was to reexamine the first draft of the questionnaire by having five ICT experts check the content validity of the questionnaire in terms of the comprehensiveness of the content, the appropriateness for the target respondents, and the clarity of the language used. Then the questionnaire was revised and improved in accordance with the suggestions and comments from the experts. The final stage dealt with the pilot of the questionnaire and final revision of the questionnaire for actual implementation. The questionnaire was piloted with 20 students who were not the target participants in order to

recheck the appropriateness of the questionnaire and the clarity of the language. The questionnaire was revised and developed again as the final questionnaire for actual data collection.

3.4. Data analysis

The data analysis involves the investigation of content validity of the ICT competency self-assessment tool by analyzing the Item Objective Congruency Index (IOC) based on the information obtained from five experts. In addition, the construct validity of the instrument was examined by means of the secondary-order confirmatory factor analysis (CFA) using LISREL and the reliability of the tool was examined via Cranach's alpha coefficient.

4. Research Results

In respect of the development of the ICT competence self-assessment questionnaire, the result shows that the assessment tool is composed of three components. The first component is ICT knowledge which can be observed by two indicators (IT_ Knowledge and CT_ Knowledge). The second component is ICT skills which can be observed through five indicators (Access, Management, Evaluation, Creation& Integration and Communication). The last component is ICT attitude and ethic which can be observed via two indicators(Attitude and Ethic). The ICT competency assessment instrument is a self-assessment questionnaire with five rating scales and contains 40 questions in total.

With respect to the quality of the ICT competence self-assessment instrument, the result reveals that the instrument has its content validity with the IOC index of between .60 and 1.00. This indicates that the instrument meet the standard content validity as the IOC index is beyond .50. In terms of reliability, the result in Table 1 shows that Cronbach's alpha coefficient of the whole questionnaire is .95 and of the three measurement models, ICT knowledge is .87, ICT skill is .92 and ICT attitude and ethic is .89. This means that the reliability of the instrument is very high.

Table 1. Reliability of ICT competency instrument

Factors	Weight (%)	Amount of Item	α(Cronbach's Alpha)
ICT knowledge	25.00	10	.87
ICT skill	50.00	20	.92
ICT attitude and ethic	25.00	10	.89
Overall questionnaire	100.00	40	.95

As for construct validity, the secondary-order confirmatory factor analysis demonstrates that the measurement model of ICT competency fits the data quite well , the goodness-of-fit indexes as follows: χ^2 = 14.888 (df =12), p=.248, GFI =.99, AGFI =.96, CFI = .99, RMSEA =.026, as shown in Table 2 and Figure 1.

Table 2. Result of secondary-order confirmatory factor analysis of student's ICT competency Measurement model

Component	Factor loading			t	R^2	FS
	b	β	SE			
First order CFA						
ICT Knowledge						
IT_ Knowledge	.591	.896	<-->	<-->	.803	.816
CT_ Knowledge	.530	.776	.037	14.374***	.603	.419
ICT Skill						
Access	.551	.701	<-->	<-->	.491	.031
Management	.681	.886	.034	19.812***	.785	.675
Evaluation	.630	.827	.034	18.737***	.684	.351
Creation& Integration	.599	.769	.064	17.810***	.591	.048

Component	Factor loading			t	R^2	FS
	b	β	SE			
Communication	.545	.658	.038	14.286[***]	.433	.011
ICT Att& Ethic						
Attitude	.647	.886	<-->	<-->	.784	.664
Ethic	.640	.823	.037	17.349[***]	.677	.529
Secondary -order CFA						
ICT competency						
Knowledge	.840	.840	.052	16.221[***]	.706	
Skill	.999	.999	<-->	<-->	.998	
Attitude & Ethic	.857	.857	.053	16.043[***]	.735	

Chi-square = 14.888 df = 12 P=.248 GFI =.991 AGFI =.966 CFI =.999 RMR =.020 RMSEA =.026

Correlations between constructs Matrix

	Knowledge	Skill	Attitude & Ethic	ICT competency
Knowledge	1.000			
Skill	.839	1.000		
Attitude & Ethic	.720	.856	1.000	
ICT competency	.840	.999	.857	1.000

Note.[***]p< .001 . Based on t $_{364}$, two-tailed test ,<--> constrained parameter

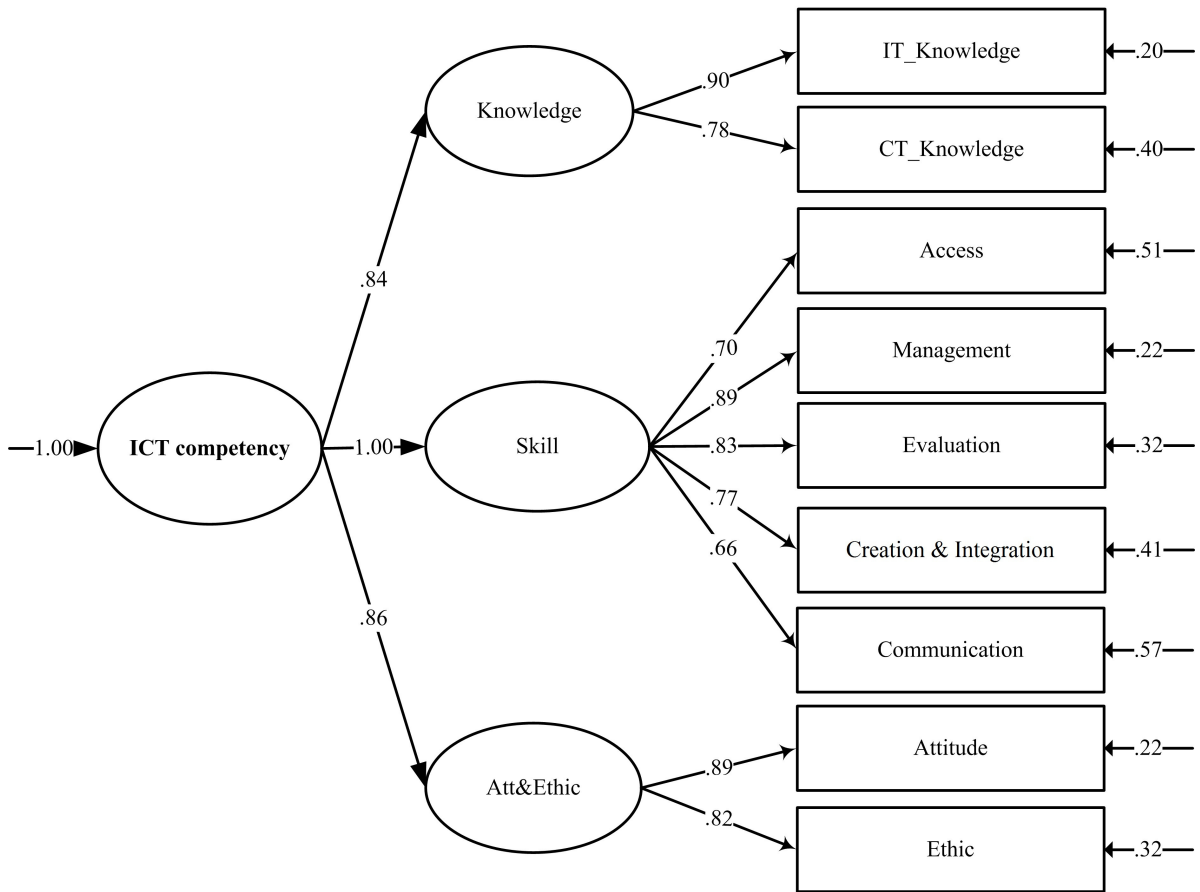**Chi-square = 14.89 df = 12 P-value= .24763   RMSEA = .026**

Figure 1. Result of secondary-order confirmatory factor analysis of student's ICT competency Measurement model

Factor scale of ICT competency

ICT competency = .816 IT_ Knowledge +.419 CT_ Knowledge +.031 Access +.675 Management
                        +.351Evaluation +.048 Creation& Integration +.011 Communication +.664 Attitude +.529 Ethic

The comparison of student's ICT competency between level and gender, the results reveals a non-significant, $F_{(2,361)} = 2.70$, p =.069, that   no different ICT competency between education level   and   There is a significant effect for gender, $t(364) = 3.55$, p < .001, with male students have higher scores than female students, as shown in Table 3 and Table 4.

Table 3. One-way analysis of variance of student's ICT competency by education level

Source	df	SS	MS	F	P
Between Groups	2	22.265	11.132	2.70	.069
Within Groups	361	1489.880	4.127		
Total	363	1512.145			

Table 4. Student's ICT competency mean for male and female

	Gender		t	df
	Male	Female		
student's ICT competency	13.22 (2.13774)	12.46 (1.90518)	3.55**	311.82

*Note.*** p<.05 . Standard Deviations appear in parentheses below means.

5. Conclusion and Discussion

The present study aims to develop and examine the quality of the ICT competence self-assessment tool of lower-secondary school students in Thailand. The result indicates that the assessment tool is valid in terms of both content and construct. It can thus be said that the present instrument can be employed to retrieve the information from the respondents.

In terms of reliability, it was found that the entire questionnaire and three sub-sections of the questionnaire are highly reliable with the values of between.87-.92. These reliability estimates meet the minimal criterion of.70, suggested by Hair et al. (2010). Therefore, the data obtained from the questionnaire can be used for secondary-order CFA purposes.

As regards construct validity, the result points out that three secondary-order measurement models and nine first-order measurement models of the ICT competency construct fit the data. This result is consistent with the ICT competency theory of McClelland (1973), upon which this study is based. The theory points out that ICT competency is composed of individual's knowledge, skills, and attitude. The present ICT competency assessment tool is also based on the ICT framework, proposed by UNESCO (2008) as well as relevant literature review. In addition, the indicators of the ICT skill component correspond with the findings of Cha et al.(2011).

In respect of the construct validity of the three ICT competency components, the result shows that the three factors have construct validity values of between .71-.99. These estimates meet the minimal criteria of.70, proposed by Hair et al. (2010). Moreover, the indicators of each factor have factor loading of between .84 and .99, which exceeds the minimal criteria set by Hair et al. (2010).

The present study employs the secondary-order CFA, which is considered as an effective technique as it requires strong theoretical support and rigorous examination of underpinning theory and actual data. Therefore, it is commonly used and most appropriate to investigate the quality of measurement tools and the result provided by secondary-order CFA is more insightful and valid. The use of the secondary-order CFA to examine construct validity of the instrument is in line with Reungtrakul, Watcharasin, and Charoensuk (2012). Furthermore, the present study obtained the data from sufficient number of respondents, and thereby enhancing the power of the statistical test, as mentioned by Hair et al. (2010). Hair et al. mentioned that the SEM model consisting of less than 7 latent factors should involve 5-20 respondents per one parameter and the proper number of respondents for enhancing the power of the test is between 10 and 20 respondents per one parameter.

Since the present study closely followed the criteria mentioned above, the current ICT competency self-measurement tool is reliable and valid and thus it can be employed to assess lower-secondary school students' ICT competency level.

6. Recommendation

It is recommended that the ICT competency self-assessment tool, developed by the current study, should be adopted as a tool to measure lower-secondary school students' ICT competency level with a view to investigating and maximizing students' ICT competency nationwide. Further research should be conducted to investigate the invariance of the measurement models of lower-secondary school students' ICT competency across, for example, gender, education level, and different school style. Moreover, further studies should take into account the comparison of the assessment results between teacher evaluation and students' self-assessment as well.

Acknowledgements

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