Development of ICT Competency Domains for Undergraduate Students in Thailand

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Abstract - **This study aimed to develop necessary competency domains on information and communication technology (ICT) for undergraduate students in Thailand. Using questionnaires and focus group discussion as data collection, the qualitative analysis was conducted with 2 steps: 1) explore the experts' opinions on the competency domains and 2) hold a group discussion of experts to approve the domains. Through purposive sampling, the key informants of both research steps were the 9 experts on Information and Communication Technology, Computer Technology, Computer Education, Computer Science, and Computer Engineering from both public and private higher education institutions with at least 10 years of relevant field experience. Closed-ended and open-ended questionnaires were employed to preliminarily confirm and conclude the ICT competency domains, respectively. The acquired data were analyzed in frequency, percentage, typology, and taxonomy. The findings revealed 7 expert-concluded key ICT competency domains, 2 components, and 56 variables. The results of this study are to be used in a further confirmatory factor analysis during the next phase of the study.**

Keywords - **Domain, Competency, Information and Communication Technology, Focus Group Discussion**

I. INTRODUCTION

It can be said that "competency" is a latent characteristic in men that controls individual's impulses to outperform the required duty, responsibility, and goal to survive the globalization [1-3] and transition of Thailand 4.0 [1, 4]. There are many competencies necessary for students e.g. communication, thinking, problem-solving, utilization of life skills, and ICT literacy. Technological advancements have a significant effect on the modern life and become a significant and sustainable educational momentum behind the transformation of learning and wisdom society [5-8]. To be a successful part of the momentum, youths of all nations should possess the ICT competencies which are crucial in self-education and development [9-11]. Information and Communication Technology Master Plan (No. 3) 2011-2020 (B.E. 2554-2563) aims to foster a "Smart Thailand" development that focuses on advancing the ICT competencies among youths of higher education coupled with implementing a problem-solving curriculum using ICT as an educational tool [1, 4]. When investigating the

actual use of ICT in the current education, it was found that there have been attempts to implement the ICT in higher-education's teaching management. Nonetheless, it was also found that the students lacked necessary skills and knowledge to utilize the ICT in the learning process [1, 12, 13] and such incompetence has proven to be a significant obstacle to an educational practicality [10, 11, 14]. From the need and necessity, it is especially imperative to enhance the ICT skills and knowledge of learners to ensure that they are up for a competition in the ever-changing world as well as the transition of Thailand 4.0. The studies of Tasir, Z., Abour, K.M.E.A., Halim, N.D.A., Harun, J., Sysoyev, P.V., Evstigneev, M.N., Ng, W.K., Miao, F., Lee, M., Thamasan, S., Punnee, L., and Paitoon, P. [9, 15-17] revealed a common fact that the students are critically facing an issue of ICT incompetence. However, the issue can contextually be solved. Congruently with Punnee, L., Kamba, M.A., Thamasan, S., Paitoon, P., Guo, R.X., Dobson, T., and Petrina, S. [4, 8, 17, 18], following the principles of competency development, competency can be developed through training. Competency training is a result-oriented process and a developmental guide for learners who wish to enhance a specific skill or knowledge essential to effectively succeed in fulfilling a duty or activity under certain performance criteria. To run a session of competency development, it is important to brainstorm the experts to determine what competency domains are necessary. To refine the quality of the research, one of the possible approaches is to hold a focus group discussion as it encourages the experts to supply reasons, reflect ideas, share attitudes, develop hypotheses, raise research questions, and clarify questions with ambiguous or imprecise answers. As a higher-education lecturer, the researcher takes a keen interest in the development of necessary ICT competencies and, therefore, conducts a study on the development of ICT competency domains for the undergraduate students by the experts through a focus group discussion. The obtained results are further expected to be used in a confirmatory factor analysis and develop into a competency training course to enhance the necessary ICT competencies for the undergraduate students during the next phase of the study.

II. RESEARCH OBJECTIVE

To develop the necessary ICT competency domains for the undergraduate students by the experts through questionnaires and focus group discussion.

III. RESEARCH METHODOLOGY

A. Sources of Information
Through purposive sampling, the nine key informants in both research steps were selected. These include the experts on Information and Communication Technology, Computer Technology, Computer Education, Computer Science, and Computer Engineering from both public and private higher education institutions with at least 10 years of relevant field experience.

B. Research Tools
To ensure data validity, this qualitative study comprises two following steps of data collection:

1) **Step 1:** A closed-ended questionnaire was employed, in this step, to preliminarily confirm the ICT competency domains. Following the concepts of Thamasan, S., Punnee, L., and Paitoon, P. [17], the response items of the questionnaire, to be answered by a simple "yes" or "no", covered seven key domains with two components each totaling up to 14 domains and 131 variables. In terms of content validity, the questionnaire was evaluated by the thesis advisor and co-advisor. Later, the response items were used to collect the data prior to the focus group discussion.

2) **Step 2:** An open-ended questionnaire was employed, in this step, to conclude the details of necessary ICT competency domains. The preliminarily confirmed response items on seven key domains in two components or a total of 14 domains with 131 variables that were evaluated for content validity by the thesis advisor and co-advisor during step 1

were used in the data collection during the focus group discussion.

C. Data Collection Procedures

Two of the following data collection phases were employed with the experts:

1) **Phase 1:** The research tool was sent to the experts in advance to obtain a preliminary confirmation of the ICT competency domains. Nine sets (100%) of the responded questionnaire were returned within the scheduled period: January 13 - February 15, 2018.

2) **Phase 2:** On March 30, 2018, the derived data from phase 1 were analyzed into domains which they were later presented in the focus group discussion to conclude the key variables and ICT competency domains.

D. Data Analysis Procedures

With similar nature to the data collection, the data analysis comprised two phases as follows:

1) **Phase 1:** The data were analyzed using frequency and percentage. To pass the confirmation in this phase, a percentage of "yes" supplied by the experts must exceed 50% [17].

2) **Phase 2:** Through the focus group discussion of the experts, a confirmatory factor analysis involving 131 variables and an open-ended questionnaire were used to determine and categorize all factors into levels. From these factors, the necessary ICT competency domains were then selected for undergraduate students of all faculties and fields. Experts' unanimous resolution was employed as a final confirmation approach. The selected data were then analyzed in frequency and percentage for the final data classification and management. At this point, any ICT competency domain with unanimous approval was deemed necessary for undergraduate students.

IV. FINDINGS

The development of the necessary ICT competency domains yielded the following results:

A. The Result of Phase 1

The result of phase 1 is as shown in Table I, demonstrating the preliminarily confirmed ICT competency domains that the experts produced.

TABLE I
THE PRELIMINARY RESULT OF THE NECESSARY ICT COMPETENCY DOMAINS
FOR THE UNDERGRADUATE STUDENTS THAT THE EXPERTS PRODUCED DURING PHASE 1

Domains of ICT Competencies	Components of ICT Competencies	variables	Percent (%)	Meaning
1. Fundamental of Computers and Information Technology	1.1 Cognitive domains	8	90.28	which are the competency variables
	1.2 Psychomotor domains	6	94.44	which are the competency variables
2. Accessing Information	2.1 Cognitive domains	6	83.33	which are the competency variables
	2.2 Psychomotor domains	8	90.28	which are the competency variables
3. Integrating Information	3.1 Cognitive domains	10	84.44	which are the competency variables
	3.2 Psychomotor domains	14	84.13	which are the competency variables
4. Creating Information	4.1 Cognitive domains	9	95.06	which are the competency variables
	4.2 Psychomotor domains	11	94.95	which are the competency variables

5. Communicating Information	5.1 Cognitive domains	6	91.11	which are the competency variables
	5.2 Psychomotor domains	14	82.54	which are the competency variables
6. Managing Information	6.1 Cognitive domains	11	88.89	which are the competency variables
	6.2 Psychomotor domains	14	86.51	which are the competency variables
7. Evaluating Information	7.1 Cognitive domains	10	81.11	which are the competency variables
	7.2 Psychomotor domains	4	80.56	which are the competency variables
A total		**131**	**87.69**	**which are the competency variables**

According to Table I, the result of necessary ICT competency domains based on the closed-ended questionnaire responses from nine experts in phase 1 revealed that all 131 variables under the 14 necessary ICT competency domains for undergraduate students, seven core domains with two dimensions each, passed the 50% confirmatory threshold at a mean 87.69%. All variables were then presented in the focus group discussion for sequential confirmation analysis in phase 2.

B. *The Result of Phase 2*

The following result of phase 2 demonstrates the final product of the necessary ICT competency domains derived from the focus group discussion of the nine experts:

The conceptual framework of the ICT competency domains covers seven of the following areas: 1) Fundamental of Computers and Information Technology; 2) Accessing Information; 3) Integrating Information; 4) Creating Information; 5) Communicating Information; 6) Managing Information; and 7) Evaluating Information. Each area emphasizes both cognitive and psychomotor domain because the development of ICT competency mainly utilizes training which is a result-oriented process that, in a limited period time, can produce specific results tailored to specific performances or activities required to be fulfilled to certain achieve effective performance standards. All variables can be classified into three competency levels: basic, intermediate, and advanced. The experts agreed that the variables under the intermediate and advanced level should be the necessary ICT competency domains for undergraduate students enrolled in Information and Communication Technology, Computer Technology, Computer Education, Computer Science, and Computer Engineering at both public and private higher education institutions. In terms of basic variables, the experts agreed that they should be the necessary ICT competency domains for undergraduate students of all fields. Based on the criteria, 56 variables in the basic competency level were selected for all undergraduate students. The selection process was conducted through various measures from all competency factors covering all necessary details that fit the context of undergraduate students as shown in Table II and III.

TABLE II
THE RESULT OF THE FOCUS GROUP DISCUSSION OF THE EXPERTS TO SELECT
AND CONFIRM THE NECESSARY ICT COMPETENCY DOMAINS
FOR THE UNDERGRADUATE STUDENTS

Domains of ICT Competencies	Components of ICT Competencies	variables	Frequency (F)	Percent (%)
1. Fundamental of Computers and Information Technology	1.1 Cognitive domains	5	9	100
	1.2 Psychomotor domains	3	9	100
2. Accessing Information	2.1 Cognitive domains	3	9	100
	2.2 Psychomotor domains	5	9	100
3. Integrating Information	3.1 Cognitive domains	3	9	100
	3.2 Psychomotor domains	5	9	100
4. Creating Information	4.1 Cognitive domains	4	9	100
	4.2 Psychomotor domains	4	9	100
5. Communicating Information	5.1 Cognitive domains	4	9	100
	5.2 Psychomotor domains	4	9	100
6. Managing Information	6.1 Cognitive domains	4	9	100
	6.2 Psychomotor domains	4	9	100
7. Evaluating Information	7.1 Cognitive domains	5	9	100
	7.2 Psychomotor domains	3	9	100
A total		**56**	**9**	**100**

From Table II, the nine experts, through a unanimous resolution-100% agreement rating, selected 56 basic competency variables from 14 total competency domains, a composition of seven core competency domains in two components. The result was used to construct a Model Framework for presenting the ICT Competencies of Undergraduate Students in Thailand as shown in Table III.

C. Model Framework for Presenting the ICT Competency Domains for Undergraduate Students in Thailand

TABLE III
MODEL FRAMEWORK FOR PRESENTING THE ICT COMPETENCY DOMAINS
FOR UNDERGRADUATE STUDENTS IN THAILAND

Domains and Components of ICT Competencies	Variables of ICT Competencies
1. Fundamental of Computers and Information Technology	
1.1 Cognitive domains	(1) Knowledge of computer background and evolution.
	(2) Knowledge of computer use and capability.
	(3) Knowledge of basic computer components and computer system.
	(4) Knowledge of basic computer system (hardware and software).
	(5) Knowledge of basic information technology system.
1.2 Psychomotor domains	(1) Ability to install a basic operating system in a computer system.
	(2) Ability to install basic utility programs and application programs such as word processors for document printing and programs for spreadsheets, graphs, and calculation in a computer system.
	(3) Ability to set up computer connector devices and peripherals with respective device drivers e.g. Printer and scanner.
2. Accessing Information	
2.1 Cognitive domains	(1) Knowledge of appropriate information selection e.g. a utilization of domestic and international research databases.
	(2) Knowledge of keyword searches for information through online electronic media.
	(3) Knowledge of benefits in accessing information and having media and information literacy.
2.2 Psychomotor domains	(1) Ability to use a computer via search engines and browsers to access information.
	(2) Ability to use a smartphone and tablet via search engines and browsers to access information.
	(3) Ability to look up information from online electronic media.
	(4) Ability to use the internet to access information and be literate in media and information.

	(5) Ability to record and store information.
3. Integrating Information	
3.1 Cognitive domains	(1) Knowledge of benefits in using the information.
	(2) Knowledge of the use of new media.
	(3) Knowledge of the use of information and new media with efficiency and media literacy.
3.2 Psychomotor domains	(1) Ability to look up the information and new media for professional purposes.
	(2) Ability to benefit from information and new media for professional purposes.
	(3) Ability to be literate and considerate in media usage.
	(4) Ability to use a computer, smartphone, and tablet, via cloud technology e.g. Google Drive, to store information and new media.
	(5) Ability to use a computer, smartphone, and tablet to store information on a new-generation workspace e.g. Dropbox.
4. Creating Information	
4.1 Cognitive domains	(1) Knowledge of principles of appropriate design and creation of media, information, and new media.
	(2) Knowledge of media, information, and new media production and creation via word processing programs for professional printing.
	(3) Knowledge of media, information, and new media production and creation via presentation programs for professional presenting.
	(4) Knowledge of media, information, and new media production and creation via spreadsheet programs for professional spreadsheets, tables, graphs, and mathematic calculation.
4.2 Psychomotor domains	(1) Ability to produce and create media, information, and new media using word processing programs for professional documents.
	(2) Ability to produce and create media, information, and new media using presentation programs for professional presenting.
	(3) Ability to produce and create media, information, and new media using spreadsheet programs for professional spreadsheets, tables, graphs, and mathematic calculation.
	(4) Ability to use a computer, smartphone, and tablet to produce and create media, information, and new media.
5. Communicating Information	
5.1 Cognitive domains	(1) Knowledge of basic computer network communication. (2) Knowledge of tools and programs to facilitate communication (send and receive information) through a computer network.
	(3) Knowledge of principles of social media usage and literacy in professional exchange of information.
	(4) Knowledge of benefits, usage trend, and evolution of information and communication technology.
5.2 Psychomotor domains	(1) Ability to correctly employ tools and programs in a computer to facilitate communication (send and receive information) through a computer network.
	(2) Ability to correctly employ tools and programs in a smartphone to facilitate communication (send and receive information) through a computer network.
	(3) Ability to correctly employ tools and programs in a tablet to facilitate communication (send and receive information) through a computer network.
	(4) Ability to use social media in knowledge exchange or communication for professional information exchanges.
6. Managing Information	
6.1 Cognitive domains	(1) Knowledge of basic usage of a computer, smartphone, tablet both in an online and offline environment
	(2) Knowledge of information management in data collection and verification.
	(3) Knowledge of information management in data processing.
	(4) Knowledge of information management in data maintenance.
6.2 Psychomotor domains	(1) Ability to use a computer, smartphone, tablet for data collection and verification.
	(2) Ability to use a computer for data processing.
	(3) Ability to use a computer for data maintenance.
	(4) Ability to use a computer, smartphone, tablet to connect to an internet network to use a cloud technology online service such as

	Google Drive to management the information.
7. Evaluating Information	
7.1 Cognitive domains	(1) Knowledge of good information characteristics.
	(2) Knowledge of principles to determine good information.
	(3) Knowledge of information evaluation.
	(4) Knowledge of principles of information evaluation.
	(5) Knowledge of steps to evaluate the information.
7.2 Psychomotor domains	(1) Ability to verify the searched information.
	(2) Ability to analyze the searched information.
	(3) Ability to synthesize the searched information.
14 domains and 2 components of ICT Competencies	**A total of 56 variables**

According to Table III, all 56 variables of the ICT competency domains produced by the nine experts can be used to construct a Model Framework for presenting the ICT Competencies of Undergraduate Students in Thailand covering seven domains two components totaling 14 domains.

V. CONCLUSION

The development of the ICT competency domains by the experts through the focus group discussion produced seven core competency domains including: 1) Fundamental of Computers and Information Technology; 2) Accessing Information; 3) Integrating Information; 4) Creating Information; 5) Communicating Information; 6) Managing Information; and 7) Evaluating Information which can be broken down into two components each with a total of 56 variables. The findings will further be employed in the confirmatory factor analysis of the ICT competencies in the subsequent study.

VI. DISCUSSION

The development result of the ICT competency domains by the experts through the focus group discussion produced seven core competency domains including: 1) Fundamental of Computers and Information Technology; 2) Accessing Information; 3) Integrating Information; 4) Creating Information; 5) Communicating Information; 6) Managing Information; and 7) Evaluating Information. When determining the discovery of the seven core competency domains, it was found that the discovery is consistent with the aim of the study on the ICT competency domains which is congruent the existing concepts suggested by Ahmad, M., Karim, A.A., Din, R., Albakri, I.S.M.A., Archibong, I.A., Ogbiji, J., Anijaobi-Idem, F., Danner, R.B., Pessu, C.O.A., Fong, S.F., Ch'ng, P.E., Por, F.P., Thamasan, S., Punnee, L., and Paitoon, P. [2, 3, 5, 6, 17] Such consistency justify the idea that these core competency domains can be practically developed into the ICT Competency domains for each spatial context of Thailand. The competency training can be provided in a form short-term training covering the two components: cognitive and psychomotor. The idea is in concert with Fong, S.F., Ch'ng, P.E., Por, F.P., Kamba, M.A., Tasir, Z., Abour, K.M.E.A., Halim, N.D.A., Harun, J., Thamasan, S., Punnee, L., and Paitoon, P. [6, 8, 9, 17] which examined and developed the supplementary courses to enhance the ICT competency of the undergraduate students. In addition, it was also congruent with the results of Voogt, J., Pelgrum, H., Youssef, A.B., Dahmani, M., Ng, W.K., Miao, F., and Lee, M. [11, 13, 16] which employed the experts through focus group discussions to examine and develop the ICT competency domains. The results also produced seven core ICT competency domains with two components i.e. cognitive and psychomotor which share the same nature with the findings of this study.

VII. RECOMMENDATIONS

The research results of this study can be adapted and applied to all competencies and variables, such as improving training programs or activities to strengthen various competencies of students. In relation to further studies should be conducted on the components of relevant ICT competencies for university students through other forms of research, such as focus group discussions and Confirmatory Factor

Analysis (CFA).

VIII. ACKNOWLEDGEMENTS

REFERENCES

(Arranged in the order of citation in the same fashion as the case of Footnotes.)

[1] Akarawang, C., Kidrakran, P., and Nuangchalerm, P. (2015). "Enhancing ICT Competency for Teachers in the Thailand Basic Education System". International Education Studies, Vol. 8, pp. 1-8.

[2] Ahmad, M., Karim, A.A., Din, R., and Albakri, I.S.M.A. (2013). "Assessing ICT competencies among postgraduate students based on the 21st Century ICT Competency Model". Asian Social Science, Vol. 9, pp. 32.

[3] Archibong, I.A., Ogbiji, J., and Anijaobi-Idem, F. (2010). "ICT competence among academic staff in universities in Cross Rivers State, Nigeria". Computer and Information Science, Vol. 3, pp. 109.

[4] Leekitchwatana, P. (2017). "Development of Competency Factors for Information Technology Teachers at Lower Secondary Education Level". Asia-Pacific Journal of Science and Technology, Vol. 15, pp. 1101-1114.

[5] Danner, R.B. and Pessu, C.O.A. (2013). "A Survey of ICT Competencies among Students in Teacher Preparation Programmes at the University of Benin, Benin City, Nigeria". Journal of Information Technology Education: Research, Vol. 12, pp. 33-49.

[6] Fong, S.F., Ch'ng, P.E., and Por, F.P. (2013). "Development of ICT competency standard using the Delphi technique". Procedia-Social and Behavioral Sciences, Vol. 103, pp. 299-314.

[7] Dincer, S. and Sahinkayasi, Y. (2011). "A cross-cultural study of ICT competency, attitude and satisfaction of Turkish, Polish and Czech university students". TOJET: The Turkish Online Journal of Educational Technology, Vol. 10.

[8] Kamba, M.A. (2011). "ICT competency framework for library and information science schools in Nigeria: The need for model curriculum". International Journal of Library and Information Science, Vol. 3, pp. 68-80.

[9] Tasir, Z., Abour, K.M.E.A., Halim, N.D.A., and Harun, J. (2012). "Relationship between teachers' ICT competency, confidence level, and satisfaction toward ICT training programmes: A case study among postgraduate students". TOJET: The Turkish Online Journal of Educational Technology, Vol. 11.

[10] United Nations Educational, S. and Organization, C. (2011). "UNESCO ICT competency framework for teachers".

[11] Voogt, J. and Pelgrum, H. (2005). "ICT and curriculum change". Human Technology: An Interdisciplinary Journal on Humans in ICT Environments.

[12] Pineida, F.O. (2011). "Competencies for the 21st century: integrating ICT to life, school and economical development". Procedia-Social and Behavioral Sciences, Vol. 28, pp. 54-57.

[13] Youssef, A.B. and Dahmani, M. (2008). "The impact of ICT on students performance in higher education: Direct effects, indirect effects and organisational change". RUSC, Universities and Knowledge Society Journal, Vol. 5, pp. 45-56.

[14] Teck, S.H. and Lai, Y.L. (2011). "An empirical analysis of Malaysian pre-university students' ICT competency gender differences". International Journal of Network and Mobile Technologies, Vol. 2.

[15] Sysoyev, P.V. and Evstigneev, M.N. (2014). "Foreign language teachers' competency and competence in using information and communication technologies". Procedia-Social and Behavioral Sciences, Vol. 154, pp. 82-86.

[16] Ng, W.K., Miao, F., and Lee, M. (2006). "Capacity-building for ICT integration in education". Digital Review of Asia Pacific 2009-2010, pp. 67-76.

[17] Thamasan, S., Punnee, L., and Paitoon, P. (2017). "Investigating ICT Competencies for Undergraduate Students at Nakhon Sithammarat Rajabhat University". DRLE, The 15th International Conference on Developing Real-Life Learning Experience Smart, Education for Sustainable Development, Faculty of Industrial Education and Technology King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand, pp. 11-19.

[18] Guo, R.X., Dobson, T., and Petrina, S. (2008). "Digital natives, digital immigrants: An analysis of age and ICT competency in teacher education". Journal of educational computing research, Vol. 38, pp. 235-254.