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Development of Learning Outcome Based E-Portfolio Model Emphasizing on Cognitive Skills in Pedagogical Blended E-Learning Environment for Undergraduate Students at Faculty of Education, Chulalongkorn University

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Abstract

This research aims to develop the learning outcome based e-portfolio model that emphasizes cognitive skills in pedagogical blended e-learning environment. The model was developed based on the survey of 360 students, and the interview from 3 administrators and 12 instructors at Faculty of Education, Chulalongkorn University, Thailand. Then, it was tested by 36 undergraduate students at Faculty of Education. Analysis of repeated measures ANOVA indicated that there was statistical difference at .05 level of significant. Then, the model was approved by the experts. Accordingly, the results showed that the model should consist of 6 elements along with 8 steps.

1. Introduction

The use of electronic portfolios is one of the methods to evaluate the actual condition by using computer and network technology. It enables the portfolio owner to accumulate and store their works in various forms, including audios, videos, images, and text. It uses database and hypertext to link the works that were selected based on the criteria to reflect the achievement and development of learners (Barrett, 2000). In addition, the portfolio can also be used to evaluate the works of learners including formative progress and summative evaluation. The process of

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portfolio also provides opportunities for learners to develop knowledge, understanding, analysis, synthesis, application of knowledge, and critical thinking under the cooperation of many parties (Klenowski, 1998).

According to the resolution of the Council of Chulalongkorn University, there are nine desirable qualities of the graduates. One of the qualities was thinking skills, including critical thinking, creative thinking, and problem solving (Chulalongkorn University, 2010), which are cognitive skills based on the Qualifications Framework for Higher Education (The Office of Higher Education Commission, 2009). Also, the university has a policy focusing on providing learning activities via electronic media that allows students to access learning easily and study with the potential of each individual without the limitation of time and place. Computers and network were used as the main tool to access the content of the lesson and be a channel for interaction in the learning process. (Centre for Learning Innovation, Chulalongkorn University, nd)

E-Learning system in blended learning environment combines the benefit of classroom and online learning in content delivery, activities, and measurement and evaluation. Blended e-Learning has become widespread in higher education because of its flexibility for instructors to integrate educational technology in teaching. Also, instructors can offer more effective teaching by implementing student-centered method. Students can access and study contents anywhere and anytime. They can participate and exchange ideas in classroom and learning social media. Therefore, instructors can improve learner's cognitive skills and necessary learning attitudes in the classroom period. It can be seen that e-Learning system in blended learning environment will help improve learning potential, especially cognitive skills. There are four important elements for the designing of this teaching method: electronic contents, learning management system, communication, and evaluation. All elements focus on teaching method that the students have more proactive role as a learner in a process of e-Learning system in blended learning environment (Khlaisang, 2011; Khlaisang, 2010; Khlaisang and Koraneekij, 2009; Bonk & Graham, 2006).

Based on the rational and importance of the above mentioned problem and to respond to the policy of Chulalongkorn University that encourages instructors to provide learning activities focusing on learning outcomes which the university identifies as desirable qualities of the graduates, the management of learning environment based on blended e-Learning system, and the evaluation focusing on actual condition using electronic portfolios, the researchers conducted the research on Development of Learning Outcome Based E-Portfolio Model Emphasizing on Cognitive Skills in Pedagogical Blended e-Learning Environment for Undergraduate Students at Faculty of Education, Chulalongkorn University.

2. The Research Study and The Findings

The research objectives of this study were: (1) to study the condition and need of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University; (2) to develop E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University; (3) to study the use of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University; and (4) to evaluate of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University.

Accordingly, the research methods used in this study comprised of 4 phases; Phase 1: study the condition and need of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University, Phase 2: develop and test E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University, Phase 3: study the use of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University, and Phase 4: evaluate E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University. The details are described as follows

Phase 1: Study the condition and need of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University.

The report from phase 1 of the study included the survey of 360 students to identify the needs from the target users. Then, the interviews from the 3 administrators and 12 instructors were conducted in order to find the need

solution based on the need identification and analysis of the survey results. Details are described as follows.

The sample group consisted of 360 undergraduate students. G* Power program with the confidence level at 95%, error at ± 5%, power of the test at 0.95, medium effect size at 0.25, and eight groups for analysis were used to determine the sample group (Faul F. et.al., 2009). The random sampling was classified by the department. Research instrument was a questionnaire for students about the condition and need of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment. The questionnaire was verified for content validity by 3 experts and had the reliability at 0.889. The data was collected and analyzed using descriptive statistics. The results showed that most students have used portfolio before at 94.2 percent as shown in Figure 1. There were 55.0 percent of students who have never used electronic portfolio as shown in Figure 2. Most students were interested in using electronic portfolio at 73.6 percent, as shown in Figure 3, because electronic portfolios helped store the works online, facilitate in storage, and can back up the works, reducing the risk of data loss.
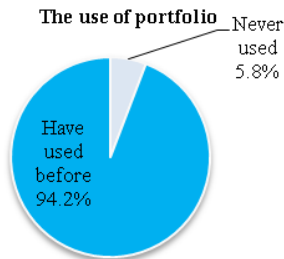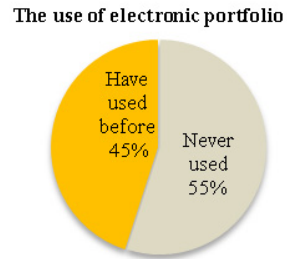

Fig. 1. The use of portfolio

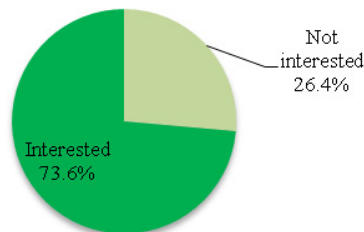**Fig. 2.** The use of electronic portfolio

Fig. 3. The interest of using electronic portfolio

The analysis of the condition of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment found that the overall opinions of the respondents was at medium level ($\bar{x}$ = 2.78, SD = 1.229). Students have seen other people's electronic portfolio before, have experiences in using electronic portfolio, and was able to develop electronic portfolio to evaluate an actual condition at low level ($\bar{x}$ = 2.13, 2.24, 2.24; SD = 1.379, 1.440, 1.476, respectively). The analysis of the need to use E-Portfolio emphasizing on cognitive skills in pedagogical blended e-Learning environment found that the overall opinions of the respondents was at high level ($\bar{x}$ = 4.20, SD = .794). Students' need to develop creative thinking, critical thinking, and problem solving skill from teaching and learning management was at high level ($\bar{x}$ = 4.40, 4.36, 4.32; SD = .712, .706, .727, respectively).

Correspondingly, the interviews from the 3 administrators and 12 instructors were conducted in order to find the need solution based on the need identification from the survey. The administrators strongly supported the survey result showing the readiness of students in using e-portfolio. Also, they all agreed to the design of e-portfolio in integrating the cognitive skills' learning outcomes, since it has been promising not only from the university but also from the Office of Higher Education Commission. While the results from the interviewing 12 instructors found that they gave more emphasis on the design of e-learning in blended learning environment. The proportion of the face to face and online activities needed to be clear. Also, the pedagogy integrated into the design needed to be suitable, such as the use of project-based learning, and problem-based learning. Since the evidences of cognitive skills should be able to collect and evaluate, the learning design should be focused on the authentic type of activities showing both students' work and the process of learning.

Phase 2: Develop and test E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning

environment for undergraduate students at Faculty of Education, Chulalongkorn University

The researchers studied, analyzed, and synthesized concepts, theories, and researches related to electronic portfolio for students, cognitive skill Learning outcomes, rubric assessment, e-Learning in blended environment, and the results from opinion analysis of administrators, instructors, and students from research phase 1. Then, the draft of E-Portfolio model was developed. The draft was examined by the interview with 7 experts and improved according to the suggestions. The model was later approved by 5 experts using evaluation form of electronic portfolio model.

E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University consisted of 6 elements and 8 steps. Elements included (1) E-Port Objectives, (2) E-Port Artifacts, (3) Roles of Individuals, (4) E-port Tools, (5) Pedagogy BLE, (6) E-Port Assessment.

Eight steps included (1) State objectives, contents, and e-port criteria, (2) Create artifacts congruence with cognitive skills in pedagogical blended e-learning environment, (3) Collect artifacts or evidences for working e-portfolio, (4) Self-reflect and assess of the artifacts, (5) Feedback by individuals involved, (6) Select artifacts for presentation e-portfolio, (7) Make the presentation e-portfolio public, and (8) Assess potential impact of the presentation portfolio. The result of model development was showed in Figure 4.
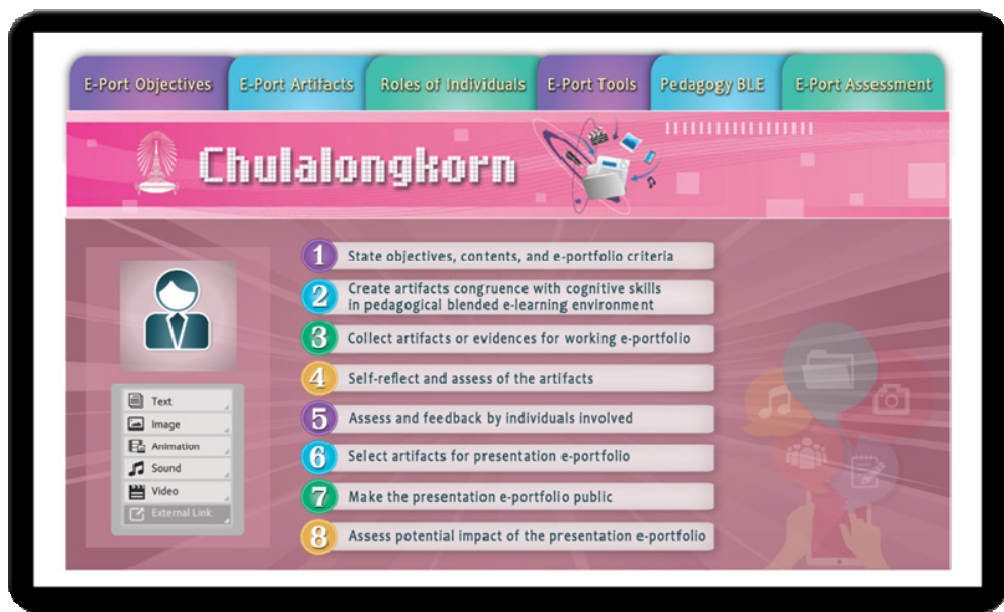

Fig. 4. Elements and steps of Learning Outcome Based E-Portfolio Model Emphasizing on Cognitive Skills in Pedagogical Blended e-Learning Environment for Undergraduate Students at Faculty of Education, Chulalongkorn University

Phase 3: Study the use of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University

The sample group in the study of the use of E-Portfolio was undergraduate students at Faculty of Education, Chulalongkorn University. It was divided into 2 groups: 1) 17 students using of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment with project-based learning and 2) 19 students using of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment with problem-based learning. The study time was 6 weeks. The tools used in this study included the plan for blended e-Learning pedagogy, E-Portfolio manual for students, evaluation criteria or evidences of the learning outcomes of cognitive skills which included (1) problem solving, (2) creative thinking, and (3) critical thinking, and evaluation criteria for E-Portfolio. The qualities of all tools were assessed by 3 experts. The examples of plan for blended e-Learning pedagogy, tools, and outcomes can be summarized in Table 1.

Table 1. Overall activities plan by integrating project-based learning pedagogy

Overall activities plan Module 1			
E-learning in blended learning environment by integrating Project-Based Learning pedagogy		**Learning outcomes of cognitive skills of undergraduate students, measured by the trace on E-Portfolio**	
E-learning in blended learning environment E-Learning system in blended BLE combines the benefit of classroom and online learning. Leaning tools includes: 1. Learning Management System 2. Social Web Application, including Google Drive (group planning tool, research tool, presentation tool, and comment tool), Social Sticky Note: Lino (brainstorming tool), and Social Inspiration Board: Pinterest (collecting tool) 3. Outcome Based E-Portfolio	**Pedagogy** This module focuses on project-based learning. The steps are as follows. 1. Preparing by clarifying the objectives of the activity. 2. Each group decides the topic. 3. Each group plans the project. 4. Research and prepare the presentation using methods. 5. Each group presents the work and exchange the work with other group. 6. Students take an assessment to check the understanding of the activity. 7. Students reviews and apply knowledge by discussing the results in learning reflection record together.	**Creative thinking** Evaluation form for creative thinking has elements that cover 4 creative thinking dimension including; 1. Readiness in competency – Originality dimension 2. Courage to encounter problems and challenges - Fluency dimension 3. Ability to presents various solutions to the problem - Flexibility dimension 4. Ability to present creatively and applicably - Elaboration dimension	**Problem solving** Evaluation form for problem solving has elements focusing on problem solving process rather than the work. It contains 4 steps including; 1. Identifying problem. 2. Interpreting the problem to identify various solutions (Analysis). 3. Developing hypothesis / determining the best solution (Synthesis). 4. Testing hypothesis / best solution. Applying the solution and evaluating (Assessment)

Data was analyzed using frequency, percent, mean, standard deviation, t-test and repeated measures ANOVA. The research results indicated as follows.

1. The results of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment with *Project-Based Learning*

1.1 The analysis of the differences of the average scores of problem solving found that there was statistical difference at .05 level of significant (t = -12.813, sig = .000). The scores from the 2nd test ($\bar{x}$= 12.177, SD = .951) was higher than the scores of the 1st test ($\bar{x}$= 9.294, SD = .470) as detailed in Table 2.

1.2 The analysis of the difference of the average scores of creative thinking found that there was statistical difference at .05 level of significant (t = -14.741, sig = .000). The scores from the 2nd test ($\bar{x}$ = 13.294, SD = 1.213) was higher than the scores of the 1st test ($\bar{x}$ = 9.706, SD = .470) as detailed in Table 2.

Table 2. The analysis of the difference of the average scores of problem solving and creative thinking

Problem solving	N	$\bar{x}$	SD	t	sig	Result
1st Test	17	9.294	.470	-12.813	.000	2nd Test > 1st Test
2nd Test	17	12.177	.951			
Creative thinking						
1st Test	17	9.706	.470	-14.741	.000	2nd Test > 1st Test
2nd Test	17	13.294	1.213			

2. The results of E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment with *Problem-Based Learning*

2.1 The analysis of the differences of the average scores of problem solving found that the average scores of problem solving in repeated measures was statistical difference at .05 level of significant (Wilks' Lambda = 111.866, sig = .000; Sphericity Assumed = 120.407, sig = .000). The errors of measures in variables was equal in all groups (Mauchly's W = .992, Approx. Chi-Square = .143, sig = .931) as detailed in Table 3. The result of the average score comparison of the two tests found that the repeated measures of the 1st and 2nd test (F = 96.983, sig = .000) and the 2nd and 3rd test (F = 34.517, sig = .000) was statistical difference at .05 level of significant. The scores from the 2nd test ($\bar{x}$= 11.737, SD = 1.759) was higher than the scores of the 1st test ($\bar{x}$= 9.105, SD = 1.941). However, the scores from the 2nd test ($\bar{x}$= 11.737, SD = 1.759) was lower than the 3rd test ($\bar{x}$= 13.421, SD = 2.063). It can be concluded that the 3rd test had the highest average scores, followed by the 2nd and 1st test.

2.2 The analysis of the differences of the average scores of critical thinking found that the average scores of critical thinking in repeated measures was statistical difference at .05 level of significant (Wilks' Lambda = 120.748, sig = .000; Sphericity Assumed = 94.597, sig = .000) .The errors of measures in variables was equal in all

groups (Mauchly's W = .931, Approx. Chi-Square = 1.209, sig = .546) as detailed in Table 3. The result of the average score comparison of the two tests found that the repeated measures of the 1st and 2nd test (F = 96.728, sig = .000) and the 2nd and 3rd test (F = 10.782, sig = .004) was statistical difference at .05 level of significant. The scores from the 2nd test ($\bar{x}$ = 11.105, SD = 1.449) was higher than the scores of the 1st test ($\bar{x}$ = 8.053, SD = 1.545). However, the scores from the 2nd test ($\bar{x}$ = 11.105, SD = 1.449) was lower than the 3rd test ($\bar{x}$ = 12.263, SD = 1.939). It can be concluded that the 3rd test had the highest average scores, followed by the 2nd and 1st test. The details are shows in Table 3.

Table 3. The analysis of differences of average scores in problem solving and critical thinking

Learning Outcomes	N	$\bar{x}$	SD	Wilks' Lambda		Mauchly's Test of Sphericity			Sphericity Assumed	
				F	sig	Mauchly's W	Approx. Chi-Square	sig	F	sig
Problem solving										
1st test	19	9.105	1.941	111.866	.000	.992	.143	.931	120.407	.000
2nd test	19	11.737	1.759							
3rd test	19	13.421	2.063							
Critical thinking										
1st test	19	8.053	1.545	120.748	.000	.931	1.209	.546	94.597	.000
2nd test	19	11.105	1.449							
3rd test	19	12.263	1.939							

Phase 4: Evaluate E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University.

The E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University is presented in the following figures.
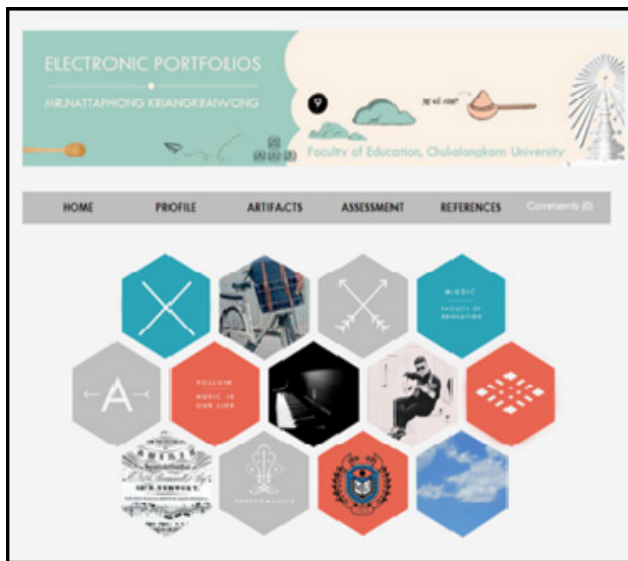

Fig. 5. Homepage of E-Portfolio model emphasizing on cognitive skills

Fig.6 Page of artifacts of E-Portfolio model emphasizing on cognitive skills

The model was approved by 7 experts. It was confirmed that the appropriate model should consist of 6 elements and 8 steps. The scores of the appropriateness of the model were mean = 4.64 and SD = 0.10 which was at the highest level. The scores of the elements of electronic portfolio were mean = 4.60 and S.D. = 0.17 which was at the highest level. The scores of the process in developing electronic portfolio were mean = 4.63 and S.D. = 0.19 which was at the highest level. The scores of the model and explanation was mean = 4.50 and S.D. = 0.10 which was at the highest level. The experts had additional suggestions that the model can be used as a guideline in developing the appropriate model of teaching in every course. Details of cognitive skill should be included by adding a definition

and identifying the guideline of choosing problem-based learning or project-based learning. Also, information about which pedagogy will develop which cognitive skills should be added. From the suggestions, the researchers have added operating terms for more effective use.

3. Discussion and Conclusions

According to the student need analysis and the model testing, discussion and conclusions of the report are described as follows. E-Portfolio model emphasizing on cognitive skills in pedagogical blended e-Learning environment for undergraduate students at Faculty of Education, Chulalongkorn University consists of 6 elements and 8 steps. The study shows that the Project-Based Learning model helps develop problem solving and creative thinking skill and the Problem-Based Learning model helps develop problem solving and critical thinking skill. The development process of student electronic portfolios starts from Step 1 which is stating objectives, contents, and e-port criteria. This process allows the students to participate and make them know what they were expected to be (Koraneekij, 2009). Step 2 is to create artifacts that reflect cognitive skills by Problem-Based Learning or Project-Based Learning. Problem-based learning is the learning that uses a problem as a basis to achieve learning objectives. Instructors would present a situation and allows students to search for solutions or knowledge. It emphasizes on encouraging students to seek knowledge to solve problems and work together as a team with instructors as a facilitator of learning (Khlaisang & Koraneekij, 2009). The instructors help students to understand learning objectives, identify the problem, present and analyze the problem, plan, research, or study more information using different methods. Students will create, synthesize, and test the hypothesis and make a conclusion. They would take assessment to test the understanding of the activities and review and apply knowledge by discussing the results in learning reflection record together. This will enhance the ability to identify problems, interpret problems to identify various solutions, research and assess the credibility of the source, develop the hypothesis, make an assessment to find the best solution, test the hypothesis, and apply the best solution to trial and evaluate it.

Project-based learning is the learning that encourages students to study and practice according to their interest, skills, and abilities under the supervision and guidance of instructors. The learning starts by making the students understand learning objectives, identify the project topic, plan the project, research and prepare the presentation using appropriate methods. Then the students present their project, exchange learning with other groups, take an assessment to test the understanding of the activities, and reviews and apply knowledge by discussing the results in learning reflection record together. This will enhance the ability to identify problems, interpret problems to identify various solutions, research information, develop the hypothesis and assess to find the best solution, test the hypothesis, and apply the best solution to trial and evaluate it. In addition, the learning process will help develop the dimensions of originality, fluency, flexibility, and elaboration.

This is also consistent with the research of Khlaisang and Likhitdamrongkiat (2012) on e-Learning system in Blended Learning Environment (BLE) to enhance cognitive skills for learners in higher education. The research concluded that e-Learning system in BLE to enhance cognitive skills should focus on teaching methods which were different in three major disciplines. Teaching method suitable for Health Sciences is problem-based learning, including inductive and group discussions teaching method. Teaching techniques are brainstorming and conversation. Teaching method suitable for Science and Technology is project-based learning, including scientific process and lecture teaching method. Teaching techniques are mind map and systematic thinking. Teaching method suitable for Humanities and Social Sciences is collaborative learning, including game-based learning and group discussions teaching method. Teaching techniques are brainstorming and mind map. The research has suggested that the feedback which was the evaluation should be divided into formative assessment and summative assessment. Formative assessment or sub assessment is the assessment during the study period by observing learning in free-to-free context and evidences of behaviors in online context that is relevant to thinking process of each discipline. Formative assessment is important to support summative assessment or overall assessment which is cognitive skills assessment of e-Learning of three disciplines.

This research can respond to the collecting of evidences that shows thinking process according to nine desirable qualities of the graduates. One of the qualities was thinking skills, including critical thinking, creative thinking, and problem solving (Chulalongkorn University, 2010), which are cognitive skills based on the Qualifications Framework for Higher Education (The Office of Higher Education Commission, 2009). Also, the results of this research are consistent with the research of Khlaisang (2012) on pedagogical blended e-Learning model using cognitive tools based upon constructivist approach for knowledge construction in higher education. Based on the

research finding, the top three pedagogical blended e-Learning models included (1) Collaborative Discussion-Based Learning (CDBL), (2) Collaborative Project-Based Learning (CPjBL), and (3) Collaborative Problem-Based Learning (CPBL). Based on the research findings, it can be concluded that all three pedagogical blended e-Learning model are effective. However, when compared among the three modules, module 3 (CPBL) showed the highest scores of knowledge creation, followed by module 3 (CPjBL), though the scores are slightly different. Further suggestions based on the research findings are the effectiveness of the cognitive tools used in such models should be further examined for the most appropriate tools in constructing cognitive knowledge, especially the higher level of knowledge including analyzing, evaluating, and creation, as well as the cognitive skills including problem solving skills, Creative thinking skills, and critical thinking skills which are considered the ultimate goals of 21st century skills in higher education.

This is also consistent with the research of Khlaisang and Koraneekij (2012) on the developing of Blended E-Learning Model by Online Interactive Reflective Learning Logs (OIRL). Based on the finding, it can be concluded that the OIRL can help the process of self-study and practice according to students' interest, skills, and abilities. Also, it helps support the process of reviewing and applying by the discussion of refection record which develops the ability to identifying the problem, interpreting the problem to identify various solutions. According to the model procedures, it was found that the use of blended e-Learning can enhance opportunities for learners to experience, review for in-depth understanding from both in class and online activities, such as class demonstration, brainstorming activities, practice, and presentation, then shift from in class to online further discussion, and presentation of projects through blog. Such activities presenting the fine transition from face to face to online activities. In addition, with the use of OIRLs, it would help learners to present whether they really understand the concept of the course content, as well as learning process. To support such implication, based on the learners' survey of their satisfaction, they expressed that in class lecture and demonstration from the lecturers helped them to understand concept of the course content, and by reviewing learning courseware, it has enhanced their understanding. When writing OIRLs, it helped learners to review both course content, as well as learning process. Then, in the step of reading, giving feedback, and revising OIRLs, it was found that learners in both groups really enjoyed receiving the comments and supports which could turn out to be positive reinforcement for their learning. Learners also expressed informative feedback was helpful in drawing conclusion. The conclusion and discussion of this work are also congruence with this research regarding the effectiveness of OIRL to develop the ability to identifying the problem, interpreting the problem to identify various solutions.

In addition, the development process of E-Port will help students to reflect on their own works and evaluate themselves. It enabled students to think and review the works, their strength and weakness and to seek ways to improve their works. The process of portfolios also provided opportunities for students to develop knowledge, understanding, analysis, synthesis, application of knowledge and critical thinking under the cooperation of many parties (Forker & Mcdonald, 1996; Klenowski, 1998). This was consistent with the research of Barbera (2009) and Luchoomun, McLuckie, and Van (2010) which found that the evaluation will help promote learning experience of the students. Evaluating and using electronic portfolios will help develop collaborative working skills and student's learning process.

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