

Students' Beliefs Regarding the Use of E-portfolio to Enhance Cognitive Skills in a Blended Learning Environment

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Abstract—This paper reports on a quantitative study on ICT readiness among undergraduate students in Thailand, students' beliefs about use of e-portfolios in the Blended Learning Environment (BLE), and students' beliefs about using e-portfolios to enhance their cognitive skills in the BLE. The sample group comprised 360 undergraduate students, divided by study fields. The data collection tool was a questionnaire of students' beliefs. The reliability value of the questionnaire was 0.889. Data was analyzed using statistical analysis and f-test. The beliefs and needs were ranked by PNI modified. The research found that every student had a computer connected to the Internet. The analysis results of students' beliefs about the use of e-portfolios in the BLE were positive and the top five results were: (1) learning by creating work, (2) enhancing creativity, (3) enhancing the problem solving skill, (4) enhancing critical thinking, and (5) enhancing authentic assessment. The current state of using e-portfolios to enhance cognitive skills in the BLE was at average level, while the needs were at the high level.

Keywords—Belief, Blended Learning, E-portfolio, Cognitive skills

1 Introduction

Global society in the 21st century is fast changing. The advancement of Information and Communication Technology (ICT) has greatly connected the world and sped up communication. As a result, the lifestyles and learning styles of students have changed. The modern learning style requires learners to establish a network of learning, without any boundaries, and which is fully supported by the use of ICT in different study fields in Higher Education Institutions (HEIs), whether education, engineering, linguistics, or any other area [1][2]. Concurrently, cognitive skill is now considered one of the most important skills among the four skills for learning and teaching in the 21st century [3]. According to the literature, several educators focused on using ICT to enhance cognitive skills. For example, Laux and Stoten [4], Barrot [5], and Bleasel et al., [6] all studied the use of technology to improve critical thinking, problem solving, and creative thinking skills. Porter, Kleve and Palermo [7] emphasized the use of technology in enhancing creative thinking skill. Much research also studied

the learning achievement results of technology skills and positive attitudes toward learning through use of the e-portfolio and BLE [4][5][8][9][10][11][12][13].

Additionally, research studies have addressed belief in teaching and the use of technology. A positive relationship has been established between teaching and the use of technology [14][15][16]. Thus, beliefs, values, feelings, and attitudes comprise the student's affective domain important to learning [17]. Jaimun [18] and Sophonhiranrak [19] proposed that attitude variables and students' experience can lead to self-directed learning and promote online and blended learning effectively. Phomaneer [20] studied the factors affecting learning via website, such as e-learning, BLE, online learning, etc. The research found that the student's attitude and beliefs as well as technological skill affected online learning at relatively high and high levels, respectively. In addition, these student factors accounted for the cognitive skill at a relatively high level, and that the learning environment, achievement motivation, attitude, personality, and teaching strategies influence critical thinking at the high level. However, there exists a gap in research on students' beliefs about the use of technology that enhances cognitive skills and how e-portfolio and blended learning can develop these skills, especially in the BLE in terms of its benefit on the flexibility and expansion of their knowledge via the online learning community. Such research could ascertain how valuable classroom time could be used for learners to practice these skills and build the necessary learning attitudes. This can enhance learning capacity, especially cognitive skills, for learners [21][22]. E-portfolio can be used for the Blended Learning Environment (BLE) and effective online learning since it has been widely used to develop learning achievement and cognitive skills [7][4][5][6][23][24].

A variety of research identifies students' beliefs as possibly having influenced the use of ICT in learning over the past ten years [14][16][15][25][26][27][28][29]. Despite belief in using ICT having been studied extensively in HEIs, belief in using ICT to develop e-portfolios to enhance cognitive skills has found to be limited. The aforementioned literature and related research identifies the importance of studying students' beliefs about the use of e-portfolios in BLEs to enhance cognitive skills. The findings from this study will contribute to the field of educational technology in extending the understanding of the adoption of e-portfolios in the BLE to enhance the cognitive skills of students in many countries.

2 Literature Review

2.1 Students' beliefs

From the review of the literature on belief, the research was found to focus on belief in teaching and the use of technology. A positive relationship has been established between teaching and the use of technology [14][16][15][25][26][27][28][29]. Beliefs, values, feelings, and attitudes comprise the student's affective domain and the importance for learning [17]. Jaimun [18] and Sophonhiranrak [19] proposed that attitude variables and student's experience can lead to self-directed learning and promote

online and blended learning effectively. Phommancee[20] studied the factors affecting learning via web-based instruction. The research found that the student's attitude and belief as well as technological skill affected online learning at relatively high and high levels, respectively. In addition, these student factors accounted for cognitive skill at a relatively high level and that learning environment, achievement motivation, attitude, personality, and teaching strategies influence critical thinking and creative thinking at a high level.

2.2 Electronic portfolio

The roles of electronic portfolio (e-portfolio) in higher education to enhance learning have been addressed in different parts of the world, including Europe, Asia, Australia, and America [30][31][32][4][5][6][7][33]. The theoretical frameworks used in the study are authentic assessments and constructivist which are based on student assessments from learning evidence concerning, both assignments and processes. This is relevant to the abovementioned research on student ability in developing and presenting with the e-portfolio which will help to promote the learning result, practice result, and learning from reflection. Also, it promotes learning analysis which enhances quality and ability in assessing real situations. In addition, it develops knowledge and thinking skills, including critical thinking and problem solving skills [4][5][6][7][33].

Barrett [30] and Koraneekij [33] provided similar definitions of e-portfolio as the systematic collection of works using computer technology and the Internet. It allows learners to store and collect different types of media such as text, audio, photos, and animations. Students can take part in determining and choosing the content and assessment as well as self-assessment, which focuses on reflecting upon the development and learning outcome of students. Research has investigated the effectiveness of e-portfolio used in higher education. In Australia, Porter et al. [7] conducted a comparison study of blended learning with two types of e-portfolio – in the Moodle e-portfolio and Mahara e-portfolio. It was found that the learning result and creativity can be developed and presented using e-portfolio. Hallam and Creagh [24] studied the current conditions of the uses of e-portfolio of higher education students in Australia. They discovered that the e-portfolio was widely used and it employed a number of technologies. Bleasel et al. [6] gathered feedback on the use of the e-portfolio in medical long cases in a graduate medical program. The e-portfolio was deemed a valuable tool, with recommendations that it should be user friendly and easy to access. In the U.S., Laux and Stoten[4] studied e-portfolios and nurse students. They discovered that the e-portfolio was a tool that showed the learning results of nurse students. Studying the development and use of e-portfolios in a large medical school in the U.S., O'Brien et al. [23] found that most students passed the criteria. In sum, the above literature review indicates that most e-portfolios can be used in the BLE and online learning effectively by using learning achievement results, positive attitudes, and creative thinking.

Studies on e-portfolios in enhancing cognitive skills and higher order thinking skills have also been addressed. It was found that the e-portfolio helped enhance criti-

cal thinking skills, problem-solving skills, technology skills, learning achievement, and creative thinking. In Asia, Barrot[5] studied the use of the e-portfolio with and Facebook for students who studied English as a second language on a writing course in the Philippines. The study garnered positive feedback toward the writing practice of students. Koraneekij [33] studied the development of the e-portfolio by self-assessment to enhance the critical thinking skills of student teachers. The study revealed that student teachers developed greater critical thinking skills after the experiment at a statistically significant level. Shuyan[8] studied the learning processes used in the development of the e-portfolio of graduate students in the educational technology field. They concluded that the e-portfolio helped students to develop their knowledge and technology skills as well as critical and problem-solving skills. In Europe, Van der Schaaf et al. [34] studied the role of e-portfolios in enhancing learning analysis which improved the quality and ability of assessing the real situation and expert assessments in education institutes in a sample comprising 121 students and 30 instructors from 5 institutes in Netherlands. They surmised that e-portfolios and student analysis were successful when developed and used in real situations. Koraneekij [33] studied the development of the e-portfolio by self-assessment to promote the critical thinking of student teachers. Shuyan [8] studied the learning process occurring during the development of the e-portfolio and found that the e-portfolio helped students develop critical thinking and problem-solving skills. Porter et al. [7] found that learning outcome and creativity can be developed and presented using e-portfolio. Thus, this research focuses on cognitive skills particularly critical thinking and problem solving skills. According to the literature, these skills can be measured by the use of e-portfolios from the records and evidence which then present the learning outcomes of these cognitive skills. This is because it allows learners to enhance their knowledge and understanding, and develop analysis and synthesis skills and apply knowledge and critical thinking [31][32]. Instructors and peers can send feedback on the assessments via the e-portfolio which enables learners to improve their work and cognitive skills. To introduce a new tool or innovation for learners, the most important thing is the learners' beliefs and attitudes.

2.3 Blended learning environment

Several research works have investigated the different types of Blended Learning Environment (BLE) that influence the various types of learning outcomes including knowledge creation, cognitive skills, as well as other types of competencies related to the students' desired learning outcomes [11][12][13][35][9]. Khlaisang [35] developed a constructivist BLE with cognitive tools to enhance the learning of higher education learners. Further research by Khlaisang & Koraneekij [9] developed the BLE using an Online Interactive Reflective Learning Log (OIRL) that enhanced the knowledge pursuit and retention of students in Thailand.

Kintu, Zhu, and Kagambe[11] studied BLE to analyze the relationship between the characteristics and background of students and the design of the features and learning results. The sample comprised 238 students from Uganda, Africa. The research found that the characteristics and backgrounds of some students and the designed features

can determine the learning results of students in BLE at a statically significant level. Nakayama, Mutsuura, and Yamamoto [12] studied the learning ability and learning attitude of students by writing a journal on BLE. The researchers analyzed the contents of the journals to estimate the scores from the final exam and to develop the learning ability of higher education students in Japan. They discovered that the activities and learning method of writing a journal correlated and predicted the test scores. In Europe, Vo, Zhu and Diep[13] studied the effect of BLE on the learning results of higher education students by comparing these results with traditional learning by reviewing 122 research articles. Their research concluded that BLE was more related to the learning improvement of students in STEM fields compared to traditional learning. This is consistent with the research by Thorne et al. [36] which studied the creation of variables related to the curriculum evaluation of Advanced Life Support (ALS) that improved the learning outcome of students participating in e-Learning Advanced Life Support (e-ALS) in the UK. They found that time spent accessing e-learning did not have any effect on learning result. However, the BLE helped students adjust their learning experience via e-learning to match their needs. Aydin[37] studied learning environment via Facebook in Turkey. The results of the research are not conclusive because of the lack of research on educational environments using Facebook as an educational resource. However, current research shows that Facebook should be more useful as an educational tool. The work of Pilgrim et al. [38] studied the perspectives of recent graduates from the Blended Learning Curriculum for teachers specializing in children with learning and behavioral problems in New Zealand. The results indicated that program performance was recognized by participants as important for working with children with such difficulties. They also saw that they could develop the capacity to develop their teaching competencies well. In addition, to address the effectiveness of BLE it is important to explore the existing pedagogy used in BLE to enhance cognitive skills. For example, Bonk and Graham [39] studied the types of online learning in higher education that were well known among 544 online instructors. The first three were group problem solving and collaborative tasks (65.4%), problem-based learning (58.1%), and discussion (43.6%). The above section has highlighted the benefits and pedagogy used in BLE in general. In sum, the need to explore particular pedagogies to be used in BLE to enhance cognitive skills is necessary.

2.4 Pedagogy used in BLE to enhance cognitive skills

As for the pedagogy used in the BLE to enhance cognitive skills, research has applied various learning theories, methods, and tools. For example, Khlaisang [35] took a constructivist approach with cognitive tools, and Khlaisang and Koraneekij [9] used reflective journal for interactive learning. Research by Bonk and Graham [39] found that the three most widely used teaching methods among instructors were: (1) group problem solving and collaborative tasks, (2) problem-based learning, and (3) discussion. One study on pedagogy found that problem-based learning and project-based learning also helped enhance cognitive skills [40][41][42][43][44][45][46].

Pedagogy is knowledge in instruction that helps learners develop knowledge in accordance with the objectives. It is derived from the widely accepted concepts, princi-

ples, philosophies, and theories of educators which have been scientifically tested and researched [47][17]. This research focuses on two types of pedagogy to develop cognitive skills, namely, problem-based learning (PBL) and project-based learning (PjBL). PBL is student-centered learning using problems from real contexts. Students are given the problem and find solutions by working together and using existing knowledge as well as acquiring extra knowledge [48]. Some research has centered on the use of PBL to improve learning outcomes and positive attitudes within learning. [40] studied mind maps and PBL and enhancing the creativity and learning motivation of students. Hallinger and Bridges [49] studied the result of the use of PBL in developing the leadership skills of educational staff. Smith and Hung [42] indicated that PBL helps students better improve their computer skills than learners learning by lecture. This concurs with Hou et al. [50], who by looking at the development and evaluation of the use of web-based mind map tools in teaching by PBL, found that learners had positive attitudes towards learning when using this learning method.

Based on the literature review, PjBL is defined as the instructional model which allows students to study problems and perform research, collect data, and perform tasks. The learning process is systematic from start to finish. Then knowledge is applied to maximize the benefits [51]. Research has investigated the role of PjBL in improving learning outcomes and positive attitudes in learning. Chu et al. [52] conducted a comparative study of perception and action on using wikis in PjBL through the use of the triangulation methodology. It was found that most students had positive attitudes toward the use of wikis, most effectively in the areas of "motivation" and "knowledge management". Han [53] studied student's attitudes toward STEM learning using PjBL in South Korea. This work showed that student attitudes towards PjBL comprised elements such as learning with technology, self-directed learning, and activity-based learning which helped direct students with good attitudes to more intentional and engaged learning. Wu [44] studied mind map collaborative learning to promote creative learning activities and strengthen student capacity to create innovation in Taiwan. The results showed that this learning method can improve learning effectiveness, enhance innovative thinking skill, and promote the creative side. In the U.S. Davis, Pauls, and Dick [45] studied PjBL in environmental chemistry labs for undergraduate students to develop a method for evaluating pesticides. The result showed that PjBL improved the students' learning ability in various areas. Ludwig, Tongen and Walton [46] conducted a comparative study of teaching methods by using PjBL that enhanced students' abilities in mathematics and biology in the U.S. The research concluded that the first approach allowed students to select projects based on individual interests, which enabled them to apply mathematical and biological models. The second approach helped students select projects that focused on the most common biological patterns that motivated unity among students. Biasutti and El-Deghaidy[54] also studied the use of wikis as an online teaching tool in PjBL for university instructors. The researcher divided trainees into small groups in a wiki-based environment within the Moodle platform in Italy. They found that collaborative activities and online activities could develop work learning effectiveness and the ability of instructors in designing projects within the interdisciplinary context. Ruggiero and Boehm [55] investigated the relationships between intern students, clients, and mentors which led to the suc-

successful completion of an internship program in a virtual environment in designing the PjBL in the UK. The research found that the success of the project related to the understanding between intern students, mentors, and clients. It also led to the design, development, and research methodology.

2.5 Cognitive skills

As mentioned, the most immediate cognitive skills for the 21st century learning are critical thinking, problem-solving, and creativity [56]. Critical thinking skill is the capacity to consider an issue reasonably, using information, situation, and experience to decide what to believe or what should be done and make a reasonable conclusion [57][58][56]. Problem-solving skill can be defined as the understanding of situation by using behavior patterns, methods, and procedures to study the problems to achieve the desired goals. It is the thinking process that requires intelligence to solve problems and achieve the expected goals. [59][60][61][56]. Creativity is the ability to imagine, think outside the box, and think of new possibilities to create things or solve problems [62][63][56]. In the Thai context, the Thai Qualifications Framework for Higher Education (TQF: HED) recognizes the need for cognitive skills by requiring learners to gain experience during higher education in the five most significant and urgent cognitive skill areas as the minimum [35].

3 Aim of the Study

From the aforementioned literature and related research, the aim of the current study was to examine students' beliefs about the use of e-portfolio in a BLE to enhance cognitive skills. The following research questions were used to guide this study:

- What is the ICT readiness among undergraduate students in Thailand?
- What are the students' beliefs about the use of e-portfolios in BLE in Thailand?
- What are the students' beliefs about using e-portfolios to enhance their cognitive skills in BLE?

4 Method

4.1 Participants

The sample group comprised 360 undergraduate students at the Faculty of Education, Chulalongkorn University in Thailand who were selected and invited to participate in the study. The size of the sample group was calculated using the G* Power program with the confidence level at 95%, error at $\pm 5\%$, power of test at 0.95, moderate effect size (.25), and 8 analysis groups [64]. Stratified random sampling was based on students' majors, including Secondary Education (Science Education), Secondary Education (Humanities and Social Sciences), Early Childhood Education and

Elementary Education, Non-formal Education, Art and Music Education, Business Education, Health and Physical Education, and Educational Technology.

4.2 Instrument

The instrument used in the study was a questionnaire on the student's beliefs. It consists of 3 major parts: (1) demographic information about the use of ICT, (2) students' beliefs about learning in a BLE, and (3) students' beliefs about using e-portfolios to enhance their cognitive skills in a BLE. The process of creating the survey included first studying the concepts, theories, and related research to define the conceptual framework and determine the scope of questions. Then, the draft questionnaire was reviewed by three experts to check the content and language as well as the completeness and coverage of questions. The questionnaire was pilot tested on 30 students with the same characteristics as the sample group. Finally, the questionnaire was validated with Cronbach's alpha coefficient with a reliability value of 0.889.

4.3 Data collection and analysis

The questionnaire data was collected by sending a request letter and coordinating with the dean of the faculty in which the sample group was studying. Then, the researcher sent the questionnaire to the sample group, collected and counted the returned questionnaires. The complete questionnaires were collected to analyze the data using statistical analysis (F-test). In addition, PNI_{modified} was applied with the aim of comparing the current states, expected states, and prioritizing the need value from the highest to the lowest. Wongwanich[65] used PNI_{modified} for needs assessment research based on the two grounded concepts of discrepancy and importance. Discrepancy was defined as the comparison between the current states and expected states, while importance was defined as needs prioritization. The results were presented in the number form of 1 to n, from the highest to the lowest, representing the most important to the least important respectively.

5 Results

In the following section, the research findings are aligned with the research questions as follows.

5.1 Demographic information of the use of ICT in the BLE

The respondents were 360 undergraduate students. Most were female, accounting for 66.4%, and studying in the third year (26.9%). Most of them (18.9%) were studying the Secondary Education major (Humanities - Social Sciences). As for the use of computer and Internet, it was found that all respondents had their own computer and could connect to the Internet. Most of them had between 1 and 10 years of experience in using a computer, accounting for 62.5%, and between 1 and 10 years of experience

using the Internet, accounting for 78.9%. Most respondents used the Internet from 1 to 20 times per week (93.3%). The number of hours spent on the Internet was between 1 and 10 hours, accounting for 98.9%.

As for the readiness of computer (hardware), it was found that most respondents had their own computers or notebooks (99.2%). All respondents have used ICT for learning. Most respondents used a computer for doing reports, accounting for 98.6%. All respondents had knowledge in word processing programs. The details about the readiness for using technology for learning and developing an e-portfolio are shown in figures 1-3.

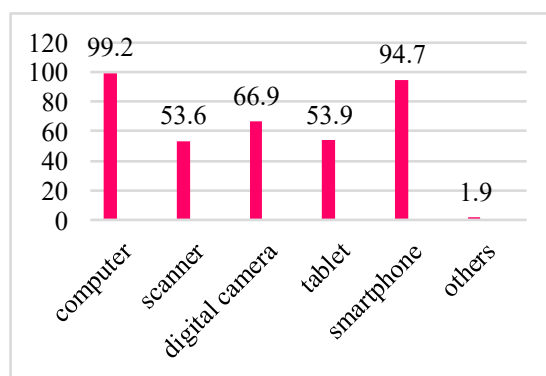


Fig. 1. Technological readiness to develop an e-portfolio (Percentage)

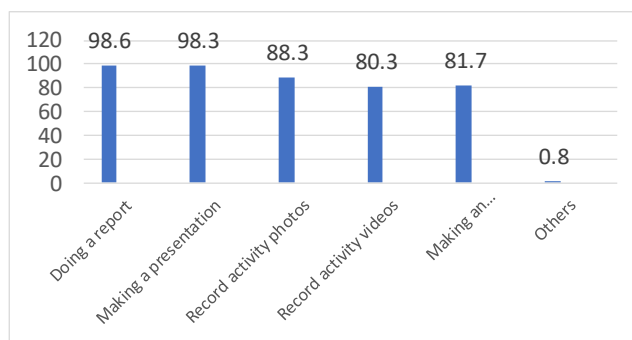


Fig. 2. The use of technology in learning and developing an e-portfolio (Percentage)

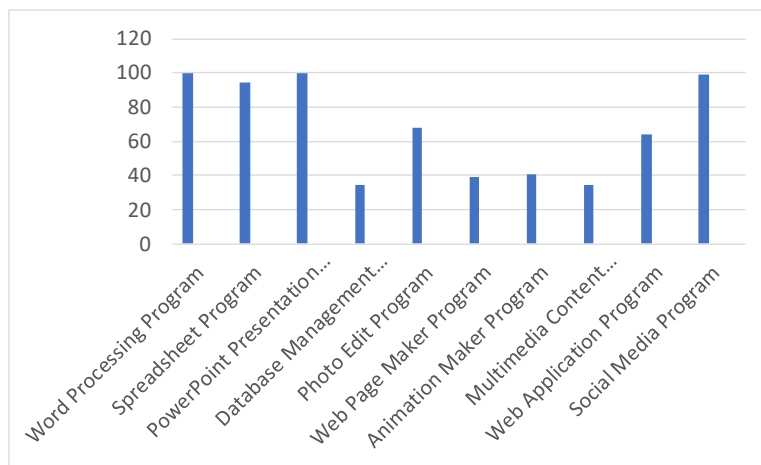


Fig. 3. Competency in using computer software in learning and developing an e-portfolio (Percentage)

5.2 Students’ beliefs about the use of e-portfolios in the BLE in Thailand

Analysis of the results of students’ beliefs about the use of e-portfolios in the BLE to enhance their learning covered the five top areas as follows: (1) learning by creating work, (2) enhancing creativity, (3) enhancing problem solving skills, (4) enhancing critical thinking, and (5) enhancing authentic assessment.

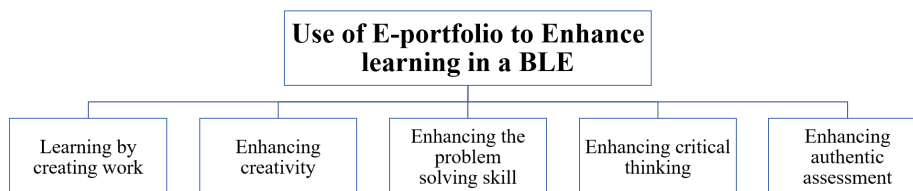


Fig. 4. Students’ beliefs about the use of e-portfolios in the BLE in enhancing learning in the five top areas

The analysis of the differences of means in the use of e-portfolios in the BLE classified by independent variables found that the mean for the use of e-portfolio in BLE for student gender had statistically significant difference at the 0.05 level. Females had a higher mean than males. As for the study year, the mean of the second year students was higher than that of third-year students. When comparing study fields, it was found that Elementary and Primary Education had higher means than Non-formal Education, Secondary Education (Sciences), and Arts and Music Education. Educational Technology had a higher mean than Secondary Education (Sciences) and Arts and Music Education as detailed in table 1.

Table 1. Analysis of the results of the differences of mean in the use of e-portfolios in the BLE classified by independent variables

Variables	Details		SD	Levene's test	sig	F	sig	Results
Gender	Male (M)	3.58	.636	.194	.660	6.442	.012	F > M
	Female (F)	3.75	.556					
Year	First year	3.67	.600	2.332	.056	2.978	.019	2 > 3
	Second year	3.84	.605					
	Third year	3.55	.752					
	Fourth year	3.68	.440					
	Fifth year	3.77	.425					
Study field	Secondary Education (Sciences) (M1)	3.53	.374	2.132	.040	4.296	.000	1. M3 > M1, M4, M5 2. M8 > M1, M5
	Secondary Education (Social Sciences) (M2)	3.71	.499					
	Elementary Education (M3)	3.98	.509					
	Non-formal Education (M4)	3.63	.410					
	Arts & Music Education (M5)	3.52	.555					
	Business Education (M6)	3.81	.758					
	Health & Physical Education (M7)	3.50	.981					
	Educational Technology (M8)	3.93	.559					

5.3 Students' beliefs about using e portfolios to enhance their cognitive skills in the BLE

To answer the third research question on students' beliefs about using e-portfolios to enhance their cognitive skills in the BLE. This section is divided into 3 parts: (1) experience and beliefs in using e-portfolios, (2) current states and needs in using e-portfolios to enhance cognitive skills in the BLE, and (3) current states in using e-portfolios to enhance cognitive skills in the BLE. The details are as follows:

Experiences and beliefs in using e-portfolios: Regarding the experience and beliefs regarding use of e-portfolios in the BLE, it was found that most respondents have experience using portfolios (94.2%). The number students who had never used e-portfolio stood at 55.0%, but most were interested in and of the belief that the e-portfolio was one of the important ICT tools used in the BLE, at 73.6%, because the e-portfolio can gather the work online, facilitate the storing of information, and back up work and thereby prevent the risk of data loss.

Current states and needs in using e-portfolios to enhance cognitive skills in the BLE: As for the differences in the means of the current states and expected states in using e-portfolios to enhance cognitive skills in the BLE, based on respondents' opinions all items had statistically significant difference at the 0.05 level. When analyzing

the needs using PNI modified, the analysis results of the current states and expected states in using e-portfolios to enhance cognitive skills in BLE found that the top five needs were: (1) students can develop an e-portfolio for authentic assessment, (2) students develop an e-portfolio to evaluate their learning outcome in cognitive skill, (3) students have developed in their critical thinking skill from the instructor’s teaching management, (4) students have developed their problem solving skill from the learning process, and (5) students learn from the BLE as shown in table 2. It can be seen that students need to use the e-portfolio to develop cognitive skill in two areas: critical thinking and problem solving, which were ranked in 4th and 5th place. Also, it was revealed that students need to use the e-portfolio to develop creative thinking skill (ranked 11th).

Table 2. Comparison of current states, expectation states, and prioritized needs in using an e-portfolio to enhance cognitive skills in the BLE

Question	Current states		Expected states		t	sig	Needs	
		<i>SD</i>		<i>SD</i>			<i>PNI</i>	<i>Rank</i>
Students can develop the e-portfolio for authentic assessment.	2.24	1.476	4.10	.852	23.403	.000	0.83	1
Students develop the e-portfolio to evaluate their learning outcome in cognitive skill	2.51	1.474	4.27	.784	21.848	.000	0.70	2
Students have developed their critical thinking skill from the instructor’s teaching management.	2.80	1.235	4.36	.706	22.786	.000	0.56	3
Students have developed their problem solving skill from the learning process.	2.95	1.101	4.26	.753	20.568	.000	0.44	4
Students effectively learn in the BLE.	2.96	1.189	4.19	.787	19.038	.000	0.42	5

* $PNI_{modified} = (I-D) / D$, When I is needs and D is current states. Items with higher $PNI_{modified}$ value are items with higher needs than those with lesser $PNI_{modified}$

The mentioned results, element and learning processes of the use of e-portfolio to enhance cognitive skills, and relationship among students’ beliefs about the use of e-portfolios in the BLE to enhance their cognitive skills and their needs are presented in table 3.

Table 3. Summary of the proposed learning processes and elements, students’ beliefs, and their needs about the use of e-portfolios in the BLE to enhance their cognitive skills

Proposed learning process and elements	Students’ beliefs in using e-portfolios to enhance cognitive skills	Students’ needs in using e-portfolios to enhance cognitive skills in the BLE
State objectives, content, and e-port criteria Elements: (1) (2)	Enhancing authentic assessment	Students can develop the e-portfolio for authentic assessment. Students effectively learn in the BLE.
Create artifacts congruent with cognitive skills in the BLE. Elements: (3) (5)	Learning by creating work	Students develop the e-portfolio to evaluate their learning outcome in cognitive skill. Students effectively learn in the BLE.
Collect artifacts or evidence for working in the e-portfolio. Elements: (2) (3)	Enhancing problem solving skill	Students have developed their problem solving skill from the learning process. Students effectively learn in the BLE.
Self-reflect upon and assess artifacts. Elements: (3) (4)	Enhancing problem solving skill	Students have developed their problem solving skill from the learning process. Students effectively learn in the BLE.
Feedback by individuals involved. Elements: (3) (4)	Enhancing critical thinking	Students have developed their critical thinking skill from the instructor’s teaching management. Students effectively learn in the BLE.
Select artifacts for presentation in the e-portfolio. Elements: (4) (6)	Enhancing creativity	Students have developed their critical thinking skill from the instructor’s teaching management. Students effectively learn in the BLE.
Make the presentation e-portfolio public. Elements: (4) (6)	Enhancing creativity	Students have developed their critical thinking skill from the instructor’s teaching management.
Assess the potential impact of the presentation portfolio. Elements: (1) (4) (6)	Enhancing authentic assessment	Students can develop the e-portfolio for authentic assessment. Students effectively learn in the BLE.

Remark: The 6 elements include: (1) E-Port Objectives, (2) E-Port Artifacts, (3) Roles of Individuals, (4) E-port Tools, (5) BLE Pedagogy, and (6) E-Port Assessment

6 Discussion

The survey results of the use of ICT found that all undergraduate students had their own computer and could connect to the Internet. Likewise, for the readiness for computer use it was found that most students had their own computers or notebooks. All students were able to use Microsoft Word and PowerPoint presentation software as

well as social media. It was found that most students have used an e-portfolio, accounting for 94.2%, and 73.6% of respondents were interested in using e-portfolios because they can collect their work there online, facilitate the storing of data, and back up work which prevents the risk of data loss. This concurs with Hallam and Creagh[24], Bleasel et al. [66], and Laux and Stoten[4] who found there were several technologies used for the e-portfolio. It was recommended that the e-portfolio be user friendly and easy to access as well as facilitate data storage and present learning results.

The result analysis of the students' beliefs toward using e-portfolios to enhance cognitive skills in BLE was found to be positive. Students believe that the use of an e-portfolio in the BLE enhances their creativity, critical thinking, and problem solving skills. This relates to the research of Koraneekij [33] which found that the e-portfolio helped improve critical thinking skill. The sample group in this study also believed that the e-portfolio was appropriate for use in the BLE to enhance not only ICT skills but also cognitive skills. This is similar to Shuyan[8] who found that the e-portfolio helped students to improve technological knowledge and skills as well as critical thinking and problem-solving skills. As for the differences in the mean of the current states and needs in using the e-portfolio to enhance cognitive skills in the BLE, based on respondents' opinions, all items had statistically significant difference at the level of 0.05. It can be seen that the needs had higher mean than the current states. When analyzing the needs using $PNI_{modified}$, the top five needs in using an e-portfolio to enhance cognitive skills were to develop an e-portfolio for authentic assessment, to develop an e-portfolio to evaluate their cognitive skill, to develop the critical thinking skill, to develop the problem solving skill from the learning process, and to effectively learn from BL, respectively. This concurs with Van der Schaaf et al. [34] who found that the e-portfolio was successful when it was developed and used in a real situation.

7 Conclusion

This research aimed to investigate ICT readiness among undergraduate students in Thailand, to examine students' beliefs about the use of the e-portfolio in the BLE in Thailand, and to evaluate students' beliefs about using the e-portfolio to enhance their cognitive skills in the BLE. Regarding students' use of computer and Internet, it was found that everyone had their own computer connected to the Internet. Most students also had between 1 and 10 years experience in using a computer. Everyone used ICT in learning and was able to use Microsoft Word. The result analysis of the current state of using e-portfolios to enhance cognitive skills in the BLE found that, overall, the respondents' opinion was at the average level and the needs were at the high level. As for the differences in the mean of the current states and needs in using the e-portfolio to enhance cognitive skills in the BLE, based on the respondents' beliefs, all items had statistically significant difference at the level of 0.05. When analyzing the needs using $PNI_{modified}$, it was found that the students believe that developing an e-portfolio for assessment and to enhance experience in using an e-portfolio in the BLE are necessary. This information is helpful for higher education institutes and instruc-

tors who provide a BLE and are interested in assessing learning outcomes using e-portfolios and need to develop students' cognitive skills. Future research could include an investigation into the development of an e-portfolio that supports application of the research results. Higher education students need to use an e-portfolio because of readiness in terms of tools and technology. Also, at present, MOOCs have also become popular. E-portfolios can certainly be developed to support this type of learning as well.

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