PSYCHOLOGY AND EDUCATION (2021) 58(4): 1853-1859
Article Received: 08th October, 2020; Article Revised: 15th February, 2021; Article Accepted: 20th March, 2021

Factors influencing intention to use STEM Project-based learning: peer-to-peer in Thailand

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ABSTRACT

The objective of this study was to examine the influencing factors in user's intention to use STEM project-based learning: peer-to-peer in Thailand. Four hundred and five people participated in this study. All participants completed a survey including general information and forty-four items which examined using an exploratory factor analysis (EFA). Multiple regression analysis was used to examined relationships among variables associated with the influencing factors. The results showed that all of the factors of web-based collaborative learning, perceived usefulness, and perceived ease of use, lead to a positive effect on the intention to use the system with a standardized co-efficient (b = 0.151, 0.326 and 0.400, p-value < 0.05). Perceived ease of use was confirmed as the most important contribution to the intention to use the system. In addition, when users had perceived ease of use in the system, their intention to use was increased. Finally, the research was applied to the influencing factors in the system. Based on the results, we recommend that the usage of STEM project-based learning: peer-to-peer system should be closely monitored by teachers to ensure the usage frequency. Moreover, to ensure that this system can be used easily, instructional designers must focus on user-friendliness design and provide a training session for both teachers and students. Collaboration with professors and experts in the system is necessary because they have an important role for supporting STEM project-based learning: peer-to-peer in Thailand

Keywords
STEM, Project-based learning, peer-to-peer, Thailand

Article Received: 10 August 2020, Revised: 25 October 2020, Accepted: 18 November 2020

Introduction

In 2018, Thai government proposed Thailand 4.0 policy in pursuit of changing industry-based economy to innovation-, technology-, and creativity-based [1]. However, current education model inadequately equip graduates with important skills for the plan which require problem-solving, critical thinking, collaboration and communication skills [2]. The education policy then utilizes STEM education and project-based learning to nurture critical thinking and problem-solving skills to all learners in Thailand.

One of the challenges of the STEM educational process is that education is shifting from the traditional teaching methods towards the use of new technology. New generations are demanding for more interactive education and learning via their personal communication devices such as mobile phones, tablets and personal computer. These challenges demand educators in adopting new collaborative model, with direction towards openness, access and sharing of knowledge. Being able to learn anywhere anytime could promote the success of education [3]. Since the platform must engage new-generation students, it must employ many tools and technology.

One possible solution to such problem is to have a learning platform for training students with these skills while engaging students and encouraging effective group collaboration simultaneously. In obtaining students communication and collaboration skills, the platform should provide social interaction among learners.

E-learning system is being utilized in creating an effectively collaborative learning through peer-supportive and environmental exchange. Students may "work together" asynchronously; they can do mutual projects or cooperate despite mismatched schedules. Nevertheless, it should be reminded that e-learning systems may be accepted in one situation. For example, many researchers have found that asynchronous communication tools are seldom used [4].

To understand the usefulness and justify the improvement this platform needs, the Technology Acceptance Model (TAM) framework can be used. TAM is used to examine the acceptance of educational technology by stakeholders such as students and teachers. Technology acceptance can be examined via user's intention to engage technology for the tasks it is planned to assist.

Lee, M. K., Cheung, C. M., & Chen, Z. (2005) pointed out that users' motivation for the acceptance of an internet-based learning medium (ILM) can help academic institutions and instructional designers to emerge tactic for system design and implementation. Internet-based educational enhances geographical reach and boosts up learner control in substantially cost-effective way. Technology-supported activities can be used for different purposes in a different environment [5]. Groves & Zemel (2000) suggest the using of technologies in various contexts and different perceptions. It has significations for how to integrate technology intended to support student learning dealt with specific practices and worth in education [6].

A STEM project-based learning: peer-to-peer in Thailand was a platform designed under the principles that support project-based learning and collaborative learning process. The system had tools supporting a STEM learning process and activity. It also had a database and provide users'

supporting resources such as web board and peer guidance. The researcher plan to implement this web-based collaborative learning system as problem-solving tools and support students in STEM project-based learning.

The research aims of this study are: 1) To identify variables that contribute to intention to use STEM project-based learning: peer-to-peer in Thailand system. 2) To analyze factors influencing intention to use STEM Project-based learning: peer-to-peer in Thailand.

We expect in this study that all factors will be determined by the intention to use. Understanding target groups' attitudes are a great important because this may guide instructional designers to provide appropriate web-based collaborative learning to enhance the effectiveness of learning processes and learning innovation system; a STEM project-based learning: peer-to-peer in Thailand.

Literature Review

Technology acceptance model (tam)

Technology Acceptance Model (TAM) is the acceptance of technological innovation. TAM has three measures including perceived usefulness, perceived ease of use, and behavioral intentions, which will derive from two factors of PU and PEU [7]. Perceived usefulness (PU) is described as how much one's task performance, as believed by his or her, increased from adopting such technology. Perceived ease of use (PEU) is explained as how free of effort is while using such technology, as understood by the person [8]. Both are the rudimentary beliefs of TAM framework [9].

Previous researchers who used TAM as a framework also expanded their variable factors that may alter the user's acceptance. For example, Groves and Zemel (2000) found that facilitating support (skills training, materials available or information, and administrative support) are influenced factors that use of instructional technologies [6]. Some studies have introduced product factors, for example, system functions, system satisfaction, collaborative activities [10]. Hasan (2006) studied user factors, for example, computer self-efficacy [11]. Ngai et al. (2007) examined environmental factors, for example, organizational support or technical [12].

STEM project-based learning

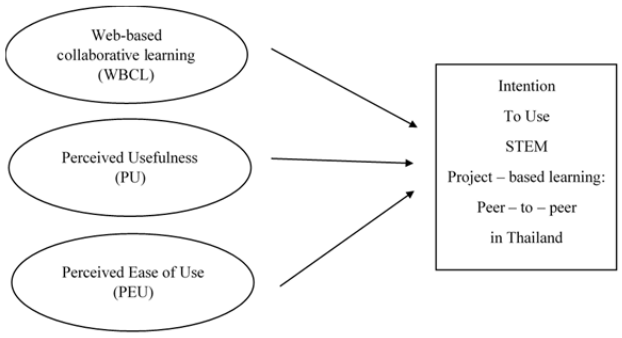
STEM education is a learning and teaching techniques, which are the integration of four fields of study: science, technology, engineering, and mathematics. It can be used in all levels from pre-school to post-doctorate in both formal and informal settings. Integrative STEM education is known as general education with intention to cultivate science and technology proficiency among citizens. Moreover, STEM education enhances creativity and imagination. Students can reflect their processes in problem-solving then retain new knowledge and skill [13].

Project-based learning provides opportunities for students to practice, study, and research according to their personal abilities, aptitudes, and interests. Students can use scientific processes to find answers. A project can be applied to any educational level and group, depending on the difficulty. A group project allows students to participate and coordinate in systematically creation of effective keys to complex problems [14].

Peer-to-Peer

"peer-to-peer" (P2P) refers to system that collect and share resources through direct communication among peer community to perform a function in a decentralized and cost-effective manner [15]. According to Vygotsky, collaboration is key to develop knowledge and understanding. Social interaction in any forms help facilitate learning. Bandura (1971) attributed that influences from others affect learning behaviors and outcomes. A learning platform allowing synchronous input and influences from multiple users creates a learning environment where modeling and reinforcement exist. Ideally, stronger students can be a model for performing correct processes while weaker students observe and interact with the entire equation solving. If a weaker student does not fully understand all steps, then he or she will be provided with examples and guidance from peers which ultimately lead to correct solution. All members of the cohort can potentially succeed because each of them contributes in one way or another in the process. Collaboration is essential in developing a shared understanding by working together. [16][17].

Research's conceptual framework



Methods

Population and Sample

The population sample of this study were Thai people between the aged of 13 to 60. A sampling group was calculated using 5-10 times to the variables. A total of four hundred and five people were selected by purposive sampling from schools and universities. The sampling group consisted of 1) professor teachers and students in schools and universities, who have experienced STEM project-based learning 2) Experts in innovation or any field in Thailand.

Materials

The question items were adopted from previous research, and some items were removed or reworded to fit the context of the current study. The questionnaire was translated into

the Thai language. All question items were measured on a five-point Likert-type scale, ranging from ‘‘disagree strongly’’ (1) to ‘‘agree strongly’’ (5). Content validity was examined by 5 experts.

Thirty respondents were used to validate the instrument. The reliability for all items was obtained at 0.94 by means of Cronbach’s alpha coefficient (above 0.80). The items were developed for problem solving and supporting students in STEM project-based learning by studying and exploring information from literature research and interviewing teachers and students. The concept is to develop items of project-based learning, collaborative learning processes and Technology acceptance model (tam)**.**

There were thirty-seven items that influenced variables and seven items for intention to use which included 1) Require login to access the system 2) Confidentiality of personal data 3) Notification of STEM contests in the system 4) Useful STEM information provided in the system (search) 5) Shared folder provided for upload 6) Shared folder provided for download 7) Chat function 8) Private web board (with friends in group or classroom) 9) Public web board (with peers) 10) Reinforce participation with rewards 11) Expert members facilitating STEM project-based learning 12) Going with the flow 13) Matching peers 14) Funding provided 15) Recommended co-working space (free of charge) 16) Recommended co-working space (with some charges) 17) Reserved co-working space 18) Course web page provided 19) Project web page provided 20) Rating feedback and comment 21) Searching for useful data 22) Accessing useful data 23) Sharing useful data 24) Peer-to-peer (person to person) 25) Networking (person with others) 26) Networking with friends (members) 27) Cloud funding 28) Education funding support is tax-deductible 29) Solving problem for lack of workplace 30) Idea gathering from peers 31) Help designing methodology 32) Project template provided 33) Guideline and advice for creative presentation 34) User-friendly system 35) Knowledge sharing (joyful as a giver) 36) Receiving advice from expert (glad as a receiver) 37) Easy learning by STEM project-based learning

There were seven items for intention to use which included 1) Safety (authenticated system and confidentiality of data provided) 2) Happiness from getting support from peers 3) Having a chance to help others 4) Self-development 5) Proud to be a lead user of the system 6) Intend to use the system in the future 7) Recommending the system to others

Data Analyze

The data was collected from June 2019 to August 2019. The quantitative data was analyzed by using frequency, percentage, mean, and standard deviation. An Exploratory Factor Analysis (EFA) was conducted to test the construct validity of the scale. Based on the result, researchers omitted four question items, comprising of two question items which were influencing variables and two question items which were intention to use from the scale due to higher item-total correlations. Thus, the remaining thirty-five question items were subject to factor analysis. There were nineteen question items which were web-based collaborative learning, thirteen question items which were perceived usefulness, three question items which were perceived ease of use and five question items which were intention to use. The Bartlett's test of sphericity (Homogeneity of covariance) was 9930.5 and statistically significant at p-value < 0.05 [18]. The KMO measure of sample adequacy was well above the minimally accepted level of .50 [19]. This indicated a significant relationship among the variables of the study as well as the scale and show it had good validity. The thirty-eight item-total correlation coefficients ranged from .69 to .86, showing acceptable to high homogeneity of the items.

The Statistical Package for Social Science (SPSS) 22.0 software was used to analyze the data. Multiple regression analysis or correlation analysis (MRC) was used to analyze the data and it is a very flexible data analytical system. MRC was used to forecast an outcome based on data that were collected earlier. Multiple regression analysis of data for which manipulation variables was impossible while correlation analysis is explained the relationship between variables [20].

Results

Table 1 Descriptive statistics of sample demographics (n=405)

Measure	Item	Frequency	Percentage (%)
Gender	Male	177	43.7
	Female	228	56.3
Occupation	Professor	25	6.2
	Teacher	26	6.4
	Expert	53	13.1
	Student	301	74.3
Education	Grade 7-9	93	23.0
	Grade 10-12	200	49.4
	Vocational student	10	5.2
	University student	6	1.5
	Bachelor’s Degree	35	8.6
	Master’s Degree	52	12.8
	Doctor of Philosophy	9	2.2

The participants included four hundred and five Thai people who were the target groups of this STEM project-based learning. There were 43.7% male respondents and 56.3% female respondents. There were 74.3% students, 13.1% experts, 6.4% teachers and 6.2% professors. Educational levels of the respondents were Grade 10-12 (49.4%), Grade 7-9 (23%), Master’s Degree (12.8%), Bachelor’s Degree (8.6%), Vocational students (5.2%), Doctor of Philosophy (2.2%) and University students (1.5%). Table 1 shows the detailed sample demographics.

Variable	Item	Mean	SD	Cronbach's alpha
Web-based collaborative learning (WBCL)	Require login to access the system	3.80	0.61	
	Confidentiality of personal data	4.18	0.63	
	Notification of STEM contents in the system	3.79	0.56	
	Useful STEM information provided in the system (search)	4.11	0.71	
	Shared folder provided for download	3.99	1.00	
	Chat function	3.77	1.01	
	Private webboard (with friend in group or classroom)	3.82	0.67	
	Public webboard (with peers)	3.71	0.66	
	Reinforcing participation with rewards	3.73	0.59	
	Expert members facilitating STEM project-based learning	3.89	0.68	
	Going with the flow	3.85	0.65	
	Matching peers	3.99	0.65	
	Funding provided	3.92	0.64	
	Recommended co- working space (free of charge)	4.00	0.67	
	Recommended co- working space (some expenses)	3.75	0.59	
	Reserved co-working space	3.89	0.65	
	Course web page provided	3.90	0.58	
	Project web page provided	3.90	0.65	
	Rating given for feedback and comment	3.91	0.56	
		3.89	**0.75**	**0.954**
Perceived Usefulness (PU)	Searching for useful data	3.95	0.98	
	Accessing to useful data	3.88	0.98	
	Sharing useful data	3.92	1.00	
	Peer-to-peer (person to person)	3.85	0.95	
	Networking (person with others)	3.81	0.95	
	Networking with friends (members)	3.83	0.98	
	Cloud funding	3.85	0.97	
	Education funding support is a tax-deductible item	3.82	1.01	
	Solving problem for lack of workplace	3.87	0.99	
	Idea gathering from peers	3.87	0.98	
	Help designing methodology	3.86	0.96	
	Project template provided	3.86	0.99	
	Guideline and advice for creative presentation	3.81	1.03	
		3.86	**0.76**	**0.946**
Perceived Ease of Use (PEU)	User-friendly system	3.91	1.01	
	Get advice from expert(s) as a guest	3.90	0.96	
	Easy learning of STEM project-based learning	3.99	0.97	
		3.94	**0.85**	**0.881**
Intention To Use (ITU)	Stable (authenticated system and confidentiality of data provided)	3.82	0.97	
	Sharing achievements to help others	3.87	0.92	
	Proud to be a lead user of the system	3.81	0.96	
	Intend to use the system in the future	3.90	0.96	
	Recommending the system to others	3.82	1.05	
		3.84	**0.78**	**0.847**

The descriptive statistics for each variable are showed in Table 2. The average of items were 3.71-4.18 which show that all variables were important. The most important item was confidentiality of personal data by a mean of 4.18 followed by useful STEM information provided in the system by a mean of 4.11 and recommended co-working space (free of charge) by a mean of 4.00, respectively.

The most important variable perceived ease of use by a mean of 3.94 followed by web-based collaborative learning by a mean of 3.89 and perceived usefulness by a mean of 3.86, respectively. Mean of intention to use (dependent variable) was 3.84. The Cronbach's alpha value is ranging from 0.847 to 0.954, indicating good scale reliability.

Table 3 Correlations matrix

	ITU	WBCL	PU	PEU
ITU	1.000			
WBCL	0.713	1.000		
PU	0.774	0.860	1.000	
PEU	0.765	0.704	0.794	1.000

Pearson correlation displayed the relationship between variables. The relationship of variables was between 0.713-0.860 showing that all variables were of high positive correlation. The correlation between independent variables and dependent variable was 0.713-0.774, showing quite a bit higher. The highest positive correlation between web-based collaborative learning and perceived usefulness (PU) was 0.860. The correlation of variables at the significance level of alpha 0.05 is showed on Table3.

Table 4 Multiple regression analysis

Model	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	.414	.126		3.270	.001		
WBCL	.161	.060	.151	2.665	.008	.259	3.855
PU	.340	.069	.326	4.926	.000	.190	5.273
PEU	.378	.045	.400	8.407	.000	.367	2.722

R = .816; R^2 = .666; Adj. R^2 = 0.664; Std. Error .46191; F = 266.994; Sig = 0.00

The enter method used was in multiple regression analysis. The model shows a good fit with a p-value of 0.01 (not greater than 0.05). The collinearity adjustment R2 is 66.40%. The results were listed below:

Web-based collaborative learning has a significant positive influencing factor on intention to use STEM project-based learning problem: peer-to-peer (· = .151; t = 2.665; p < 0.05). The result showed that the intention to use STEM project-based learning: peer-to-peer is supported.

Perceived usefulness in this study revealed a relationship exists between perceived usefulness and the intention to use STEM project-based learning: peer-to-peer (p = 0.000). The p-value is under 0.05. The result of the test revealed (· = .326; t = 4.926; p < 0.05) that the intention to use STEM project-based learning: peer-to-peer is strong supported.

Perceived ease of use in this study displayed a relationship between perceived ease of use and the intention to use STEM project-based learning: peer-to-peer (p = 0.000). The p-value is under 0.05. The result of the test display (· = .400; t = 8.407; p < .005) that perceived ease of use is a major determinant.

Discussions

The findings concluded that factors influencing intention to use a STEM project-based learning: peer-to-peer in Thailand consisted of three factors and thirty-five variables. Web-based collaborative learning factor consisted of nineteen variables. Perceived usefulness consisted of thirteen variables. Perceived ease of use consisted of three variables. The most important item was confidentiality of personal data, followed by useful STEM information provided in the system and recommended co-working space (free of charge), respectively. The three factors and thirty-five variables are showed in Table 2.

Perceived ease of use, perceived usefulness and web-based collaborative learning were positive effect on the intention to use the system with a standardized co-efficient of 0.400, 0.326 and 0.151, respectively. In addition, perceived ease of use was confirmed to have the highest contribution to the intention to use the system.

Perceived ease of use was the most important factor and had positive effects on the intention to use the system. This confirms previous researches. We will develop user-friendly system and easy learning of STEM project-based learning. If users already have positive feelings in regard to use of technology, they were more probably to continue to use it more frequently. This system must be relatively simple to use, the learning process, in which perceived ease of use was confirmed to have a significant influence on behavioral intention (BI) [21].

Perceived usefulness was positively related to web-based collaborative learning. It is also a second rank factors influencing intention to use STEM project-based learning: peer-to-peer. Users can access, search, upload and download materials anywhere and anytime. They use discussion boards to discusses and communicate with their friends and peers. Kim et al. (2007) pointed out that perceived usefulness affected the individual's use of information technology [22].

Web-based collaborative learning has a positive effect on the intention to use the system. Lorenzo et al. (2007) stated that it engaged users, particularly students, in Web 2.0 activities [23]. Bennett, S., et al. (2011) suggested that technology was considered a valuable factor supporting two mains sorts of activities – communicating and accessing information with social networking [24]. The findings also were argued that facilitating conditions affected intention to use indirectly, but it was the greatest direct effect on PEU (perceived ease of use). If a technology is tough to use and learn, it is probably to be time-consuming [25].

This research provided a critical concept on how to design functions of STEM project-based learning to support students' interaction and resources by peers. It is found that motivating and engaging students, teachers, experts and professors to use the system was an issue. STEM project-based learning: peer-to-peer will be used as a resource to assist users to construct knowledge, and exchange STEM educational information in Thailand. Nevertheless, as highlighted by Sugar, Crawley and Fine (2004), the technology integration and support must be continued after the beginning of students' technology adoption. Therefore, school administrators need to plan a strategy and give supports to insure the long-term effective use of technology for teaching and learning. Collaboration with professors and experts is of utmost importance due to their supporting roles in system usage [26].

Conclusion

STEM project-based learning: peer-to-peer in Thailand is designed to use a web-based learning system as a tool to solve and support students in STEM project-based learning problem. The development was made under the principles of supporting project-based learning and collaborative learning. It is a synthesis of extant technology acceptance models. This research used web-based collaborative learning, perceived usefulness, and perceived ease of use to explore the intention to use a STEM project-based learning: peer-to-peer in Thailand. The variables based on TAM were applied to STEM project-based learning: peer-to-peer in Thailand.

Limitations and Future Studies

First, Researchers defined and discovered the problem of STEM project-based learning in Thailand as it measured only relationships between functions of web-based collaborative learning for solving and supporting STEM project-based learning (the independent variables) and intention to use (the dependent variable). Second, the samples' data were collected by purposive sampling in Thailand. The research's findings may not be totally applicable to people in different cultures. Third, it was important to argue about the variables that did not show significance in the studies as they may exhibit important effects in other groups or areas. These limitations pointed to future research directions worthy of our investigative attention. We should consider other indicators, factors and learning outcomes as well.

Future research maybe to test the system of STEM project-based learning: peer-to-peer in Thailand. Structural Equation Model (SEM) can be use in the future for valid cause-effect influences. EFA, Factor analysis and multiple regression are the first step toward the overall design of project-based learning: peer-to-peer in Thailand. It would also be interesting to examine the user's behavior in the future.

Acknowledgement

The research was funded by Chulalongkorn University (Grant No. GCUGR1225622033D). We gratefully acknowledge support from Technopreneurship and Innovation Management Program, faculty of Graduate School, Chulalongkorn University (CUTIP).

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