

Development Of The Team-Based Ubiquitous Learning Model On Cloud Platform To Enhance Creative Problem-Solving Abilities

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Abstract

Technology is changing rapidly. People who live in highly complex societies face a variety of issues every day and must find answers. One will succeed in surviving in society if they have the capacity to creative problem-solving abilities. Using team-based learning serves as the cornerstone for instruction and learning to practice problem solving through ubiquitous learning, which enables learning at any time and anywhere while utilizing a range of technologies. This study aimed to develop the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities. This model was created by combining Team-based learning (TBL) and Ubiquitous learning (UL) properly. The respondents were five experts in educational technology and in curriculum and pedagogy. The instruments used were the team-based ubiquitous learning model on cloud platform and an assessment on model suitability. Data were collected through an interview and a focus group and then analyzed via content analysis, mean (\bar{x}), and standard deviation (SD). The study results revealed that the team-based ubiquitous learning model on cloud platform consists of five steps of team-based learning: 1) pre-class preparation, 2) individual readiness-assurance test, 3) team-readiness-assurance test, 4) team application, and 5) appeals and feedback. The model is presented in the form of a diagram with clear arrows. In another circle, five components of ubiquitous learning and their abbreviations are presented, namely, interactivity (In), permanency (Pe), accessibility (Ac), connectivity (Co), and adaptability (Ad).

The overall result of the model suitability was at the high level (\bar{x} = 4.20, SD.= 0.51).

Keywords: team-based ubiquitous learning model, cloud platform, creative problem-solving abilities

1. INTRODUCTION

The trend of new social change needs to be improved and changed. The most noticeable change is the arrival of information technology (IT), which can rapidly distribute information in all directions with quick response. The advancement of IT results in important changes in various aspects. According to Section 9 in Thailand the National Education Act B.E. 2542 (1999), the emphasis is on educational technology, with the focus for academic institutions in graduate production to be aware of educational technology literacy and for teacher development to be capable of effectively producing media or technology. Although no technology can replace a teacher, the teacher can be replaced by a technology knower (Ronghuai et al., 2019). Therefore, IT skill is one important skill in 21st-century education with the focus on students to gain technology literacy that is useful for study and knowledge seeking from various sources outside classes (Jedaman et al., 2016). This focus points out that 21st-century education conforms to Thailand's "Thailand 4.0 to Education 4.0" program, in which learners can learn from everywhere to create and integrate knowledge for creating different innovations for societies. Therefore, teaching and learning at present are not confined only in the classroom because students can seek knowledge from their surroundings and online platforms.

Currently, a learning society that uses advanced technology is referred to as a "ubiquitous society," that is, a society where communication is possible anywhere and anytime (i.e., "all over the place"). This is a current conceptual framework in applying information and communication technology (ICT) in daily life anywhere and anytime. In the past, ICT started from using an effective, large-sized computer. Later, the device was developed to possess higher effectiveness in a smaller size, from a desktop to a mobile device. The development continued until humans no longer had to rely on any device to access specific information useful for learning anywhere and anytime, called U-learning = E-learning + M-learning (Anukool & Petsangsri, 2019). This is an integration of E-learning and a mobile phone used as an

instrument to learn quickly and save considerable resources. Therefore, the ubiquitous learning environment (ULE) can respond to learning at present to open educational chances for learners at all levels as well as reduce the learning gaps of learners in rural areas to access knowledge.

In the master plan of ICT for education in Issue 3 B.E. 2557–2561 (2014–2018) of the Ministry of Education Thailand, the target is to create ubiquitous learning to access learning resources anywhere and anytime in order to continuously increase learning experience by using a modern personal device. Accordingly, studying and researching potential increase the free access to online learning resources, leading to various models of future classrooms (Ministry of Education, 2014). One essential component is the use of cloud processing technology, called “cloud computing,” which is defined differently according to the perspectives and situations in each organization. Gartner Company defines cloud computing to be “a powerful way to process data of an enormous IT structure which is expandable. It is presented to massive number of users around the world in the form of service.” Therefore, researchers from different institutions collaborate to develop such technology to support consumer demand and reduce incurred expense. In an educational perspective, cloud computing is very beneficial for managing different data, and it is technology suitable for supporting ubiquitous learning to gain its full pedagogical benefits and effectiveness.

According to the rapid change of technology mentioned above, people living in societies with more complexity have to face a lot of problems and try to solve these problems every day. Creative thinking to solve problems can enable people to achieve better success living in societies. Therefore, problem-solving ability is very important for the livelihood of people in the current competitive world. Thus, enhancing students’ opportunity to gain problem-solving ability is regarded as an important goal in educational management because such ability is a cognitive skill that occurs from a person’s practice and experience, until such time that getting skillful becomes a useful life skill. However, to gain creative problem-solving skill, a person needs to be trained on how to think about problem-solving and how they need to accumulate experience in regularly practicing problem-solving. This experience can be obtained from a practical part in academic institutions (Russell, 1956; Tegano, Sawyers, & Moran, 1989).

From the national academic conference "Elevating the quality of basic science education Thailand in 2012" jointly

analyzed the results of the PISA test of Thai children that the score was low because of the lack of analysis and problem solving. According to the ranking of competitiveness and education by IMD in 2011, Thailand was ranked 51st out of 57 countries around the world from the former that used to be ranked 46 in 2007, In addition, the scores of the International Student Assessment Examination or the Program for International Students Assessment (PISA) in science and mathematics Thailand continues to rank at the bottom, while other Asian countries are still at the top. Conclusion regarding these issues It is clear that the PISA assessment results can provide insight into the caliber of Thai children's education. Reflecting the still-lagging instructional process in the classroom. Instructional that enable creative problem solving should be prioritized because the PISA evaluation places a strong emphasis on critical thinking and problem solving. (Bangkok Business Online, 2021)

The team-based learning model manages learning according to 21st-century education management through a learning process to change existing behaviors to new permanent behaviors. The new behaviors result from training or experience, not from natural response, instinct, or coincidence. Such changed behaviors must be quite permanent to be regarded as learning occurrence. If the changed behaviors are temporary, then they will not be considered as learning because people change when they learn something (Bloom, 1971). This positive change is called "development." As a result, when learning management is considered as a change for better learning, technological innovation in pedagogy plays more important roles in education management in the 21st century. Therefore, it is necessary to study about the readiness of teaching and learning, the learning media suitable for managing team-based learning, and problems, obstacles, and suggestions of the current learning management to develop educational management in the 21st century by using the team-based learning model for undergraduate students at Banditpatanasilpa Institute. The study aims to gain understanding about the model and inquire about the possibility and students' opinions and understanding about 21st-century educational management because the foundation of this educational management needs to prepare students to be ready (Soodchalerm, 2017). Accordingly, guidelines can be obtained to develop team-based learning management in order to achieve effective learning and make

classrooms places for true learning. Moreover, participation in thinking and seeking knowledge by themselves enable students to effectively apply knowledge in societies and be high-quality people with good practices beneficial for the country.

As a result, researchers are interested in developing the team-based ubiquitous learning model on cloud platform to enhance the creative problem-solving abilities of undergraduate students in order to upgrade education in Thai societies at present, eventually expanding in world societies in the future. The study also aims to answer the following questions: (1) What is the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities? (2) How does the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities affect the students?

2. RESEARCH OBJECTIVE

To develop the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities.

3. LITERATURE REVIEW

3.1 Team-based Learning

Team-based learning is a process to manage learning by building interaction within a group/team or among groups/teams of students or team members to encourage active learning, in-depth learning, critical thinking, building adapting skills in working with other people, assertion, and better communication (Michaelsen & Mennenga, 2012). Team-based learning is a process to develop students' learning while doing group activities in small groups, and it is helpful for developing thinking, mind, and acceptance of others (Beatty & Mcauley, 2012). In general, a team-based learning course is divided into five to seven main units, each of which starts from assigning tasks before classes (e.g., reading, watching presentation videos, etc.) designed for students to understand the main concepts of that learning unit. The class activities in each unit are part of the Readiness Assurance Process (RAP), which consists of individual readiness-assurance test (iRAT), team readiness-assurance test (tRAT), immediate feedback assessment technique (IF-AT), and team application (tAPP). After assignments are given prior to class, iRAT is used to test each student. After that, tRAT is used to test the teams by using their agreement in answers via the IF-AT, in which the students

immediately receive feedback about their decision each time after checking the tRAT. Each team can defend their answers and have a chance to appeal with evidence. Finally, the teacher explains and corrects some misunderstanding. The effectiveness of the team test, appeal of each learning unit, and arrangement of course contents are helpful for team application (Michaelsen et al., 2014). To summarize, team-based learning management is synthesized into five steps: 1) pre-class preparation, 2) individual readiness-assurance test, 3) team readiness-assurance test, 4) team application, and 5) appeals and feedback (Michaelsen et al., 2014; Larry K. Michaelsen & Michael Sweet, 2008; Sunay Palsole & Carolyn Awalt, 2008; Rungkarn et al., 2016; Iyarit Thaipisuttikul, 2016).

3.2 Ubiquitous Learning

Ubiquitous learning is a learning process in a ubiquitous computing environment, leading to learning correct matters in proper places, time, and methods (Leonor et al., 2018). The term “ubiquitous” refers to ubiquitous computing in a Ubiquitous learning Environment (ULE), that is, the environment in which learning can occur in students’ surroundings. Lesson contents are embedded into learning objects that the students are interested to learn. When students are interested in different learning objects, the lesson contents they are interested in are automatically sent to them through portable devices, such as iPad or smartphones, via wireless communication technology. The students can interact with other students. A learning theory suitable for the ULE is constructivism, which conforms to the current learning model focusing on self-constructive learning (Yong Xiong et al., 2021). Ubiquitous learning combines the processes of e-learning and m-learning (mobile learning), leading to u-learning (ubiquitous learning) with five structures: 1) learning objectives including lesson contents, teaching and learning, teaching/learning methods, and graphic/audio media; 2) learning tasks helpful for students to understand lesson contents; 3) learning management by using a process to explain lesson contents for students to understand well; 4) learning communication in real time such as via the Internet or VDO call; and 5) function management such as in using different applications to connect with the Internet (Pimmer et al., 2016). The five main components of ubiquitous learning are 1) permanency, 2) interactivity, 3) accessibility, 4) connectivity, and 5) adaptability (Mark Weiser, 1993; Yong Xiong et al., 2021; Cope & Kalantzis, 2009; Pimmer et al., 2016.; T-Y Liu, 2009; Chris

Dede, 2010; Leonor et al., 2018; Intarapanit et al., 2021; Anukool & Petsangsri, 2019; Xinli, Yuchen, Lailin, Youmei, 2022; Virtanen Mari et al., 2018; Bertram C. Bruce, 2009).

3.3 Creative Problem-solving Ability

Problem-solving and creative thinking are results of a similar concept. However, creative thinking inserts in every thinking moment, whereas problem-solving is at the end of thinking, that is, a product of creative thinking in order to solve a particular problem (Guilford, 1976). Problem-solving and creative thinking occur in connection by starting when a person faces a problem and needs ideas and imagination to find ways to solve that problem. When the problem is solved, such ideas are accumulated as experience to solve subsequent problems by selecting the best ideas from experience to solve problems. If any problem cannot be solved, then creative thinking is used to find new ideas (Anderson, 1975). Creative problem-solving ability is the ability of humans to seek answers and find problem-solving methods. It is a systematic intuitive thinking process that includes various skills that can be developed until becoming skillful is gained, such as the development of sports skills by relying on individual ability and regular practice (Olson, 1996). The creative problem-solving ability involves finding answers and novel ideas that are useful and valuable. It consists of convergent and divergent thinking in a suitably complementary form and method as a complete thinking process to find answers (Malakul Na Ayudhya, 1994). In the creative problem-solving process, the starting problem called mess is solved in five steps: 1) fact finding, 2) problem finding, 3) idea finding, 4) solution finding, and 5) acceptance finding. In Step 1 fact finding, as a problem causes anxiety, an attempt is made to find details of what the problem is. In Step 2 problem finding, after getting details about the problems in Step 1, various causes are compared to find the main cause of the point and thus find the solutions. In Step 3 idea finding, the finding in Step 2 is brainstormed to find the best solution but without a suitability assessment. In Step 4 solution finding, the best alternative solution obtained from Step 3 is considered by starting from setting selection criteria, such as saving, fast, and so forth, to select the best solution. Finally, in Step 5 acceptance finding, the best solution selected in Step 4 is applied; its usability is verified, and the ideas are disseminated for other people to try to get acceptance (Davis, 1983). To conclude, the creative problem-solving process is divided into five steps, namely, 1) fact finding, 2) problem finding, 3) idea

finding, 4) solution finding, and 5) acceptance finding, which lead to new idea finding called new challenge (Torrance, 1962).

4. RESEARCH METHODOLOGY

Design and Development Research (DDR) was employed. The instructional design used is Dick, Carey & Carey's (1990) Instructional Development Model DDR is a research discipline focusing on the establishing of either products, courses, or programs which are beneficial to education. The stages of the DDR model are as follows. 1) Identify the problems motivating the research 2) Describe the objectives 3) Design and develop the artifact 4) Subject the artifact to testing 5) Evaluate the results of testing 6) Communicate those results

4.1 Identify the problems motivating the research.

Step 1: Study the conditions, problems and learning needs with a team-based learning combined with ubiquitous learning. 15 people with experience teaching general education courses were interviewed for this project. The interview performed was regarding the current problems of learning management for the undergraduate students and the students' need to study with the team-based ubiquitous learning model.

Step 2: Study concepts and theories about the Team-based ubiquitous learning model methods from relevant domestic and international articles, documents, and research; context information, such as Components of the team-based learning, Components of Ubiquitous learning

Step 3: Synthesize model of Team-based Learning, Ubiquitous Learning methods and Creative Problem-solving Ability arising from Team-based Learning with Ubiquitous Learning methods.

Step 4: Draft of the team-based ubiquitous learning model on cloud platform to enhance problem-solving abilities.

4.2 Describe the objectives.

For the develop the team-based ubiquitous learning model on cloud platform to enhance problem-solving abilities, the researchers studied details about ubiquitous learning management, cloud platform technology, team-based learning theory, and problem-solving ability in local and international papers to synthesize the details for developing the model suitable for undergraduate students. The procedure of model development is described below.

4.3 Design and develop the artifact.

Draft of the team-based ubiquitous learning model on cloud platform to enhance problem-solving abilities.

The interview performed was regarding the current problems of learning management for the undergraduate students and the students' need to study with the team-based ubiquitous learning model. It was found that most students were reluctant to make a decision as they did not have much idea about creative problem-solving, and they have little flexibility and outside-the-box thinking. In addition, the researchers studied the needs of the students to learn with the team-based ubiquitous learning model. It was found that the students preferred team-based learning to individual learning and group assignments to individual assignments. They wanted to share knowledge with their peers in groups, and they possess good learning abilities to study through online devices. Afterwards, the researchers synthesized the components of ubiquitous learning and teaching as well as team-based learning procedure to develop the model appropriate for enhancing creative problem-solving abilities. The model was also prepared in terms of lesson plans, online media, contents, design of data arrangement and display, and learning evaluation suitable for the contexts of team-based learning with ubiquitous learning on cloud platform. The model was validated by experts in educational technology (ubiquitous learning and cloud platform) and pedagogy (team-based learning and creative problem-solving) through a focus group (Krueger, 2002).

1. Respondents: The respondents in the study were five experts in educational technology (ubiquitous learning and cloud platform) and pedagogy (team-based learning and creative problem-solving) who have at least five years of relevant experience.

2. Development of research instruments: The research instruments were a semi-structured interview and assessment of the model suitability.

- Semi-structured interview combined the structure of an interview with question items and pre-set questions. These questions items were validated by the research advisor and the co-adviser. The semi-structured interview form, it is divided into 3 parts as follows: part 1 Status and general information of the interviewees total 6 item. Part 2: Opinions and guidelines for developing a team-based learning model with Ubiquitous learning on cloud platform to enhance creative problem-solving abilities total 4 item about step of model, Activities of model, appropriate media of model and the ingredients for model success. Part 3: Additional recommendations for the development of

the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities it allows for open comment.

- Assessment of the model suitability was in a five-level rating scale. The assessment items were in three parts. Part 1 included the components of team-based learning with ubiquitous learning on cloud platform to enhance creative problem-solving abilities. total 32 items, divided according to the 5 steps of the team-based learning. Part 2 consisted of the components of ubiquitous learning in the team-based learning model on cloud platform to enhance creative problem-solving abilities. total 5 item, divided according to the composition of ubiquitous learning. Part 3 involved learning activities and technology to support learning activities according to the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities. total 24 items, divided according to the 5 steps of the team-based learning.

3. Data collection: Data were collected through the interview and the assessment of model suitability from five experts in educational technology (ubiquitous learning and cloud platform) and pedagogy (team-based learning and creative problem-solving) with relevant experience of at least five years. The validation was performed in three steps as follows.

(1) Preparation

The synthesis was performed on the principles, concepts, and theories on ubiquitous learning, team-based learning, and creative problem-solving. Then the team-based model with ubiquitous learning on cloud platform to enhance problem-solving activities was drafted. Afterwards, the synthesized data on principles, concepts, and theories were used to design the components suitable for developing the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities in the following steps.

(1.1) Research instruments: The instruments were semi-structured interview and assessment of the model suitability.

(1.2) Data collection: The data were collected through a focus group from five experts in educational technology (ubiquitous learning and cloud platform) and pedagogy (team-based learning and creative problem-solving) who have at least five years of relevant experience.

(1.3) Data analysis: The data on opinions and suggestions were collected through the semi-structured interview and the assessment of model suitability from the experts in the focus group. The data were then analyzed to improve the model suitability.

The researcher drafted the team-based ubiquitous learning model. The main team-based learning components are 1) pre-class preparation, 2) individual readiness-assurance test, 3) team readiness-assurance test, 4) team application, and 5) appeals and feedback. On the other hand, the main ubiquitous learning components are 1) interactivity, 2) permanency, 3) accessibility, 4) connectivity, and 5) adaptability. The first initial letters of all steps were combined to entitle the model as the PITTA Model with the component relationship presented in the Figure 1.

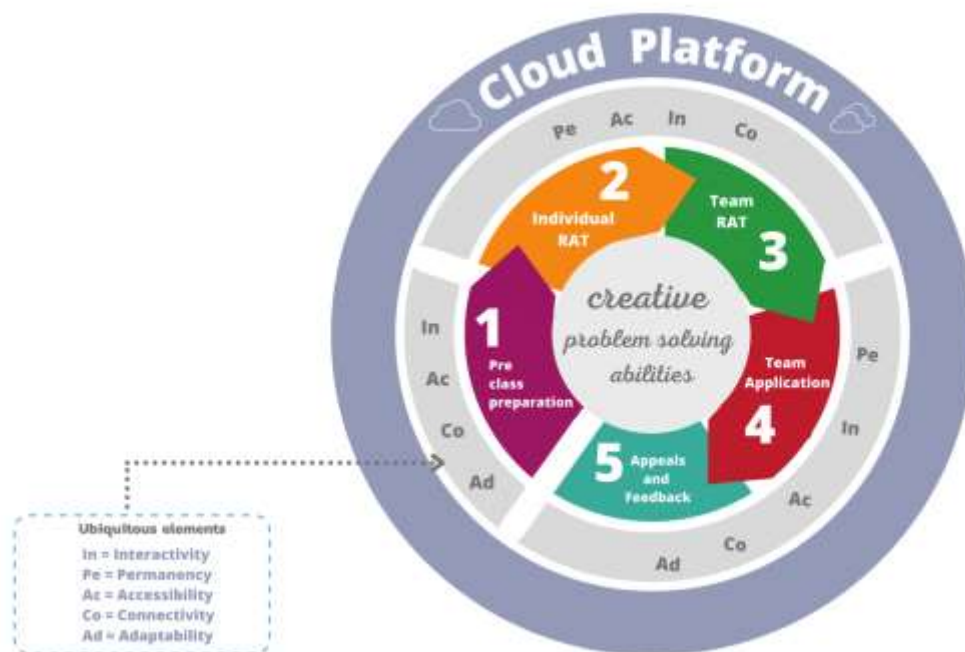


Figure 1. Draft of the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities in the PITTA model.

(2) Focus Group

In the focus group, the researchers were moderators to inform the objective of the focus group according to the framework and relevant issues. The participants gave their opinions and discussed reasonably according to the framework and given issues. The data about their opinions were collected.

(3) Conclusion

After the focus group was completed, the moderators concluded the issues from the discussion and requested the participants to check and confirm the accuracy or add the missing points. Next, the researchers checked the data and concluded the main basic data from the interview and the assessment of the model suitability for further analysis in order to develop the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities.

4.4 Subject the artifact to testing.

Regarding Table 1 (6.1) Results from the focus group about the suitability of the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving activities in the PITTA model. The analysis of results that the component connection of the team-based learning model is suitable at the high level.

4.5 Evaluate the results of testing.

Regarding Figure 2 (6.1) The results of the experts' opinions according to the team-based model with ubiquitous learning on cloud platform to enhance creative problem-solving abilities in the PITTA model.

4.6 Communicate those results.

Regarding PITTA Model (6.1) There are 5 steps in total Step 1: Pre-class preparation, Step 2: Individual readiness-assurance test, Step 3: Team readiness-assurance test, Step 4: Team application and Step 5: Appeals and feedback.

5. DATA ANALYSIS

The data on opinions and suggestions were collected from five experts through the semi-structures interview and the focus group to improve the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities. The collected data were analyzed with content analysis and the model suitability was assessed in mean (\bar{x}) and standard deviation with the weighing criteria to assess the model suitability in five levels.

6. ANALYSIS OF RESULTS

6.1 Team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities.

The content analysis results from semi-structured interview with experts consisted of 4 steps (Pope & Mays, 2002) Follow as:

Step 1 Interviews and record; Conducted individual expert interviews by semi-structured interviews with sound recording and data recording, it takes an average of 15 minutes per person for a total of 5 people.

Step 2 Paraphrase; Transcripts and paraphrase of the interview by audio-to-text converting by recording the interview, then typing the voice from the recording into a word file.

Step 3 Coding; data coding by searching for key word, similar words, or phrases among respondents, data can be coded. Then, encrypt the data and code-categorize it organized as follows:

Table 1. Coding the content analysis results from semi-structured interview.

Keyword	Descriptive record
Appropriate steps	the model should be 5 steps. Step 1: Pre-class preparation Step 2: Individual readiness-assurance test Step 3: Team readiness-assurance test Step 4: Team application and Step 5: Appeals and feedback. Activities of model, it should be offered in an online setting that may be used with onsite learning. and must be able to study anywhere any time and any device. Whether it's a tablet, smartphone, computer, or computer notebook have to the ability to obtain information in this model. Appropriate media of model, learning materials in the model must be an interesting media, it ought to be an engaging medium that can impart knowledge in practically everywhere. All the components of the media used will be recognizable to the students and, most crucially media must be online. The ingredients for model success, the participation of learners who purposefully use the model is one factor that will contribute to the effectiveness of model learning. Additionally, the models are intriguing enough to hold students' interest and make good use of educational material. Every stage of the PITTA model is carefully designed with the learner's goals in mind.
Activities of model	
Appropriate media	
The ingredients for model success	

Step 4 Comprehending the concept; Interpretation was made after data analysis as follows; PITTA model has 5 steps (Figure 2) Step 1: Pre-class preparation Step 2: Individual readiness-assurance test Step 3: Team readiness-assurance test Step 4: Team application and Step 5: Appeals and feedback. Activities of model, PITTA model was designed to be used on any device, at any time, and in anywhere, the importance of all online communications. Appropriate media of model, the PITTA model approach combines relevant and contemporary material in an online manner. such as assignment board online or distributing knowledge via online systems including discussion boards where students can communicate students to students or students with teacher.

The ingredients for model success, every stage of the PITTA model is carefully designed with the learner's goals in mind.

The results of the experts' opinions according to the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities in the PITTA model are shown below.

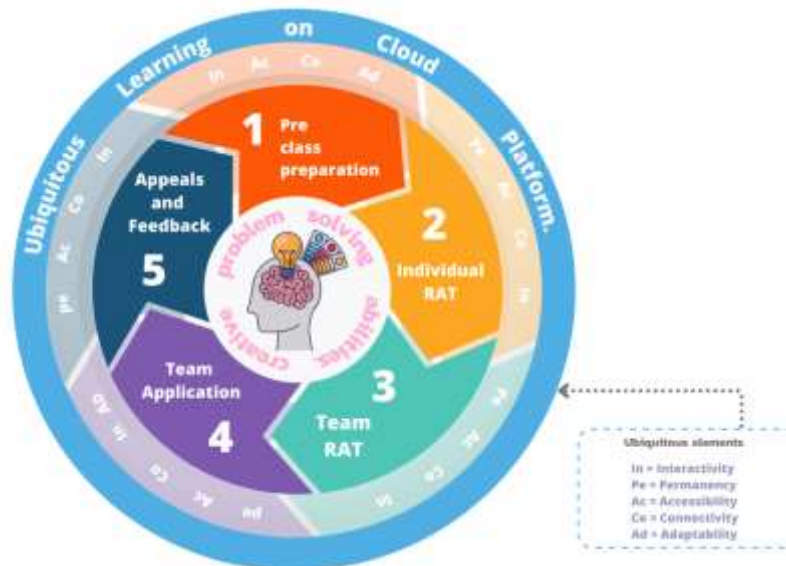


Figure 2. Team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities in the PITTA model improved according to suggestions.

Step 1: Pre-class preparation

Pre-class preparation is a step to prepare students before class through self-study. In this step, the teacher arranged a channel for the students to access the contents of online media and study the assigned contents before class. This step enhances the interactivity, accessibility, connectivity, and adaptability of students.

Step 2: Individual readiness-assurance test

In this step, the students took a test in class to assess their understanding about the assignment for them to study the contents of the online media. Each student individually took the test in multiple choices, and the teacher announced the test results through a private e-mail. The test also assessed their creative problem-solving abilities. This step enhances the permanency, accessibility, interactivity, and connectivity of students.

Step 3: Team readiness-assurance test

The students took the same test again but in groups. In this step, the test was meant to assess their creative problem-solving abilities by brainstorming on the case studies to solve the problem in a creative way as much as possible and discussing knowledge together in teams. After taking the TRAT, the test answers were given for the groups to discuss the answer one by one in order to build consensus on that answer. During the discussion, each group of students was allowed to search information from online sources. This step enhances the permanency, accessibility, interactivity, and connectivity of students.

Step 4: Team application

In this step, each student group applied the principles, concepts, and theories of the course contents to expand workpiece creation. The teacher assigned group work to promote both learning and team development. Each group started from making scripts and story boards and were allowed to search information from online sources. The students submitted their work through an online assignment board. This step enhances the permanency, accessibility, interactivity, connectivity, and adaptability of students.

Step 5: Appeals and feedback.

In this step, the teacher gave suggestions and assessed and reflected the results of group work by assigning each student group to present their scripts and story boards. The teacher gave comments and suggestions to each group until the group work was satisfied. Each group could access online learning sources. They improved their work and submitted the work assignment through an online assignment board. Then the students were assigned to produce workpieces. This step enhances the permanency, accessibility, interactivity, connectivity, and adaptability of students.

Results from the focus group about the suitability of the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving activities in the PITTA model. The analysis of results in Table 2 shows that the component connection of the team-based learning model is suitable at the high level ($\bar{x} = 4.23$, $SD = 0.51$) and the components of the ubiquitous learning in the PITTA model are suitable at the high level ($\bar{x} = 4.28$, $SD = 0.46$). Learning activities and technology to support the learning activities according to the team-based ubiquitous learning model on

cloud platform to enhance creative problem-solving activities are suitable at the high level ($\bar{x} = 4.10$, $SD = 0.53$).

The overall analysis result of the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving activities by five experts is suitable at the high level ($\bar{x} = 4.20$, $SD = 0.51$).

Table 2. Results from the focus group about the suitability of the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving activities in the PITTA model.

Items	Description	\bar{x}	SD	Suitability
1	Components of the team-based learning model	4.23	0.51	High
2	Components of ubiquitous learning	4.28	0.46	High
3	Learning activities and technology to support the learning activities according to the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving activities	4.10	0.53	High
	Total	4.20	0.51	High

7. Discussion and Conclusion

7.1 Discussion

Team-based learning management consists of five steps. Step 1 pre-class preparation is to prepare students to gradually absorb knowledge from media in a way that does not involve reading passages. The teacher does not explain or teach principles clearly but uses visual and music media through communication channels for students to study by themselves at their selected places and time without a requirement to study in the classroom. This way stimulates the students to be interested and curious about learning and searching knowledge without any limits. It is an implicit teaching method for students to learn by themselves in various ways to access knowledge, such as by speaking, listening, doing, watching, or writing. For example, some students prefer learning by listening to reading, while others prefer learning from images or cartoons to reading. This finding conforms to Page & Marshall (1980), who state that a learning style refers to the characteristic action or behavior in which each student prefers to learn, think, solve problems, and respond to learning issues. In this stage, the students combine existing knowledge with new knowledge to gain more understanding about the studied issues. This is consistent with the schema theory of Carrell (1983) that state students use existing knowledge or

experience (schema) to predict new learning things, depending on their ability to connect existing and new knowledge together. Regarding Step 4 team application, this step is a period of practice and receiving immediate feedback to achieve understanding about contents and accomplish tasks according to the team target. The students collaborate to plan work, share clear duties in teams, and accept and trust team members. In the application step, students work together in teams both inside and outside classes, and so they need skills in communication, interpersonal relationship, opinion expression, collaborative thinking, decision-making, group skills, and self-study skills. The team members share their ideas and experience from inside and outside classes. This step relies on teamwork process, problem-solving skills, and mutual decision-making to achieve the group target. This result is consistent with the study of Latif & Sleem (2018), who believe that team-based learning management can enhance problem-solving skills and creative thinking skills. While team members collaborate to think and make decisions to find the best solutions or methods to create tasks, they likewise help one another share opinions, give suggestions, and make arguments to find answers for decision making. In fact, creative problem-solving refers to thinking about finding ways to make a decision without conforming to various ideas but rather occurring from raising questions or arguments to seek reasonable solutions with clear sources of answers. It is a thought to find answers or methods that are different from existing ones. These answers or methods are valuable and useful. They consist of convergent and divergent thinking in a suitably complementary way. Creative problem-solving ability is a complete process to find a solution, and this process occurs at the steps of team-based learning. In addition, regularly receiving immediate feedback can enhance team-based learning to be successful, as immediate feedback on collaborative learning can encourage students to express opinions for making decision to find the best solutions or methods for the team. This outcome is consistent with the study of Lefebvre (2016), which supports that students who pass the RAP or team test through feedback can develop communicative skills, apply knowledge learned from teamwork to do the test, and perform tasks with better understanding. It can be seen that team-based learning can enhance students who do not receive knowledge from pre-class preparation to have a learning process as well.

The researchers apply team-based learning with ubiquitous learning for learning management as it is the

process suitable for students at the present era to learn by doing or access learning anywhere and anytime through communication devices. This approach is consistent with Anukool & Petsangsri (2019), who summarize the ubiquitous learning model in three main components: learning at any time, supporting wireless devices, and communication for sharing knowledge. The researchers use five ubiquitous learning components: permanency, accessibility, interactivity, connectivity, and adaptability. Similarly, according to Virtanen et al. (2018) ubiquitous learning consists of six components: permanency with a daily record of learning; accessibility to access documents, information, or videos at anywhere; immediacy to immediately receive information; interactivity to interact with experts, teachers, or classmates; situating of instructional activities that are helpful for solving problems in real situation; and adaptability to receive accurate information. Research on ubiquitous learning focuses on enhancing creative problem-solving abilities. Similarly, Phumeechanya (2014) studied the development of the ubiquitous learning system by using problem-based learning to enhance problem-solving skills and context awareness. According to that study, 1) the developed learning system consists of four main input components: ULE, learning objectives, characteristics of learners and teachers, and course contents; and 2) ubiquitous learning by using problem-based learning consists of three main steps: pre-teaching, teaching, and assessment. Problem-based learning consists of seven steps: notifying the problem, understanding, and identifying the problem, building, and prioritizing hypotheses, setting learning objectives, studying for additional details, synthesizing, and testing data, and summarizing study results. The students can learn anywhere through mobile devices and wireless communication. The result can be led to Education for sustainable development (ESD) that's allows every human being to acquire the knowledge, skills, attitudes, and values necessary to shape a sustainable future.

7.2 Conclusion

The team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities was developed and validated by the experts. The experts' opinions were as follows. (1) The experts suggested managing the team-based learning in five steps every week. (2) The experts suggested that the model be connected with the dependent variable, that is, creative problem-solving abilities, by promoting students to

practice solving problems creatively in every learning step. The analysis of results on the experts' opinions shows that the experts suggested using technology to support every step of the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities.

Therefore, the researchers improved the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities according to the experts' suggestions in five steps: 1) pre-class preparation, 2) individual readiness-assurance test, 3) team readiness-assurance test, 4) team application, and 5) appeals and feedback. These steps are presented in a pie chart with clear arrows. In another circle, five components of ubiquitous learning with their abbreviations are presented, namely interactivity (In), permanency (Pe), accessibility (Ac), connectivity (Co), and adaptability (Ad), as shown in Figure 2. In conclusion, the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities is suitable at the high level (\bar{x} = 4.20, SD.= 0.51).

Future Research

This research is phase 1 to development of the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities. Future research phase 2 research will be carried out to study the effect of using the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities. The final phase is to certify the team-based ubiquitous learning model on cloud platform to enhance creative problem-solving abilities.

Ethical approval

conducting procedural research involving human subjects; It complies with international norms for ethical research involving human subjects, such as Declaration of Helsinki, The Belmont Report, CMOS Guideline, International Conference on Harmonization in Good Clinical Practice or ICH-GCP and is approved by the King Mongkut's Institute of Technology Ladkrabang's Human Research Ethics Committee. The authorization is EC-KMITL_66_011

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