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Certifying the Team-Based Ubiquitous Learning Model on Cloud Platform to Enhance Creative Problem-Solving Abilities (PITTA Model)

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Abstract

This research aimed to certify the team-based Ubiquitous learning model on Cloud Platform to enhance creative problem-solving abilities (PITTA Model). The research informants were specialists in Educational Technology (EdTech) and specialists in curriculum and instruction, the total number of which was 5. The instrument was an assessment form to certify the team-based ubiquitous learning model on Cloud Platform. The data collection method was the Focus Group discussion. Content Analysis was utilized to analyze the data, which were rendered using mean ($\bar{x}$) and standard deviation (SD.). The findings were obtained from the Focus Group discussion, based on the assessment of the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities with regard to its efficiency. It was found that the 5 specialists marked the model's suitability to be the highest level ($\bar{x} = 4.76$, $SD = 0.38$). In terms of clarity and feasibility, the specialists also marked the model to be the highest level ($\bar{x} = 4.83$, $SD = 0.27$).

Keywords: *Team-based Ubiquitous Learning, Cloud Platform, Creative Problem-Solving Abilities, Model Certification*

1. Introduction

Due to the rapid growth of society in the realm of information technology, distribution of information becomes within reach. Meanwhile, development of the country need be fulfilled by the consistent progress of education that fosters creativity of learners who successfully integrate obtained knowledge with technology. This could bring about the enhanced quality of Thailand's education and learners equipped with the industry-required potential. With full access to corpora of knowledge and a digitalized learning environment, learners shall be provided with more opportunities to initiate on technology-assisted innovations. Instructors in the 21st century simply serve as learning facilitators, unlike the past in which an instructor-centered learning model was preferred. This scenario underlies why new-generation instructors are supposed to design and create learning activities that allow learners to seek, explore, discover, and establish knowledge on their own. Ubiquitous Learning is an approach based on ubiquitous computing, believed to encourage learners to grasp desired lessons at an effective

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manner (Yahya et al., 2010). In the ubiquitous learning environment (ULE), learners are granted full access to knowledge tailored to their interests and preferences. In other words, particular lessons can be wirelessly delivered to interested learners via such portable devices as an iPad or a smartphone. With wireless communication technology, learners can interact with one another. To conduct a ULE, the theory of constructivism is applied to align with today's learning models by which learners are encouraged to establish knowledge on their own (Jones & Jo, 2004). However, today's world is instantly developing at such a rapid speed that some technological advances may induce problems. It is therefore essential for education to keep pace by promoting creative problem-solving abilities. Such abilities feature both creativity and problem-solving skills. While one can make use of their creativity under certain circumstances, problem-solving emerges at the end of each creativity-driven circumstance resulting in the final solution to a problem (Guilford,1967). Theoretically, problem-solving and creativity are interrelated. When an individual faces a problem, he/she will contemplate on the most effective solutions possible and memorize them for future use. Only when none of the preceding solutions work, would he/she come up with creativity to figure out a new one (Anderson, 1975). Human beings are of creative problem-solving abilities allowing for systematic thinking and intuition. These cognitive and intuitive procedures require consistent practice of a comprehensive set of skills, like athletes do. Both personal competencies and regular practices are even deemed an effective combination for achievement (Olson, 1996). Creative thinking seeks practical answers and expects new, valuable, and effective solutions. There are two main feasible processes of creative thinking: convergent thinking and divergent thinking. It is an ability with comprehensive procedures leading to an effective solution (ประสาร มาลากุล ณ อยุธยา, 2537).

Brainstorming plays a significant role in conducting an effective team-based learning environment. Exposed to team-based learning, learners can solidate relationships and interactions with one another within a group or team. Not only could this encourage learning motivations, in-depth pursuits, and critical thinking, but learners will be given an opportunity to grow their adaptability, self-confidence, and communicative skills (Michaelsen & Mennenga, 2012). Team-based learning is a developmental procedure by which learners are involved in group activities and encouraged to enhance cognition and acceptance (Beatty & Mcauley, 2012). Typically, team-based courses are comprised of 5-7 units, each of which begins with a pre-class assignment (e.g. reading or watching presentation videos). Such assignment is well-designed to assist learners in grasping an understanding of concepts lying under each particular unit. Each unit provides learners with the Readiness Assurance Process (RAP), including the Individual Readiness Assurance Test (iRAT) and Team Readiness Assurance Test (tRAT). Learners take the iRAT during the session of pre-class preparation and then take the tRAT subsequently. Based on answers produced on the answer sheet, IF-AT (Immediate Feedback Assessment Technique) will be employed to give learners immediate feedback on the reasoning they gave. With regard to tRAT, each team is eligible to raise an argument against the feedback and may lodge an appeal for further explication. At the end, instructors shall review the instructions and correct misunderstandings that might have occurred and resulted in unexpected outcomes. Following that, the instructors should assess efficiency of the tRAT, appeals, lesson units, and course content, which can further benefit the team Application (tAPP) (Michaelsen et al., 2014).

In previous research, the researchers have developed the Team-based ubiquitous Learning

Model on Cloud Platform to enhance creative problem-solving abilities of undergraduate students. It was primarily aimed to improve the quality of Thai education in alignment with the needs of the world society. A comparison was drawn on learning achievement and creative problem-solving abilities using PITTA model. The cluster random sampling technique was employed to recruit undergraduate students from Bunditpatanasilpa Institute of Fine Arts, who were enrolled in the Innovation Information Technology and Communication in Education course in Semester 2, Academic Year 2022. Students from 2 sections of the course were recruited with the total number of 50. The samples were divided into two groups: 25 were exposed to the PITTA model and the other 25 to the traditional learning approach. The research instruments included a learning achievement test and a creative problem-solving abilities assessment form. The collected data were the results of learning achievement and creative problem-solving abilities. The statistics used for data analysis included $\bar{x}$, SD., and One-way MANOVA. The findings indicated that the PITTA model-exposed group outperformed and demonstrated better learning achievements than their traditional approach counterparts with statistical significance at .05. As for creative problem-solving abilities, the PITTA model-exposed group outperformed their traditional approach counterparts with statistical significance at .05 (Wadtan, R. et al, 2023).

PITTA Model features 5 team-based learning 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 clearly directed to the subsequent using an arrow. In the outer ring, 5 Ubiquitous elements are illustrated with the following abbreviations: In = Interactivity, Pe = Permanency, Ac = Accessibility, Co = Connectivity, and Ad = Adaptability.

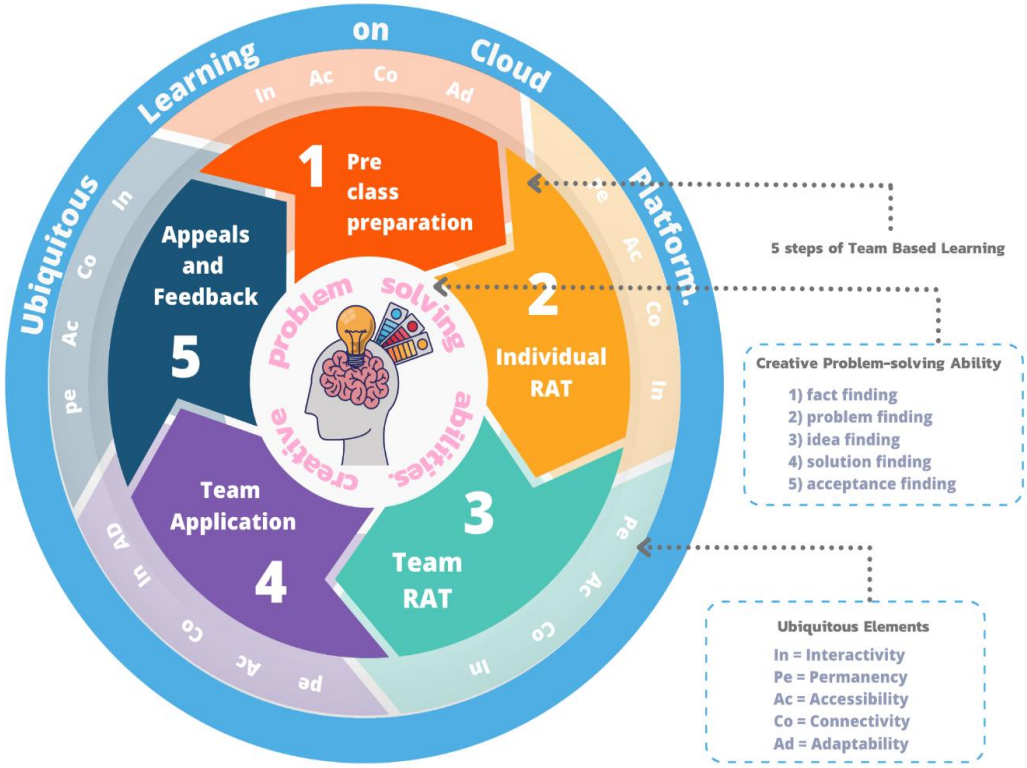

Figure 1: PITTA Model (Wadtan, R. et al, 2023).

2. Research Objective

To certify the team-based ubiquitous learning model on Cloud Platform to enhance creative problem-solving abilities**.**

3. Research Methods

To develop an assessment form to certify the team-based ubiquitous learning model on Cloud Platform to enhance creative problem-solving abilities (PITTA Model), the researchers reviewed relevant literature including research in both Thai and international settings. Concepts were compiled and synthesized to develop an effective model. The processes of assessment form development are as follows.

3.1 Developing an Assessment Form to Certify the Team-Based Ubiquitous Learning Model on Cloud Platform to Enhance Creative Problem-Solving Abilities

Adopting the results of previous research on management of the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities, the researchers sought to develop an assessment form to certify the team-based ubiquitous learning model on Cloud Platform. The said form was to assess 4 main components, namely 1) content, 2) design and organization of Ubiquitous, 3) accessibility and connectivity, and 4) learning management. Such assessment form was verified by the thesis supervisor for revision before the implementation.

3.1.1. Informants were 5 specialists in Educational Technology (Ubiquitous and cloud platforms) and specialists in curriculum and instruction (team-based learning and creative problem-solving), who had at least 5 years of relevant experience.

3.1.2. The developed research instrument was a 5-point Likert scale assessment form to certify the team-based ubiquitous learning model on Cloud Platform. Assessing criteria and results interpretation are as follows.

5	means the team-based ubiquitous learning model is	most suitable
4	means the team-based ubiquitous learning model is	highly suitable
3	means the team-based ubiquitous learning model is	moderately suitable
2	means the team-based ubiquitous learning model is	marginally suitable
1	means the team-based ubiquitous learning model is	least suitable

3.1.3 After having the research instrument verified by the thesis supervisor, the researchers revised the assessment form and had it validated by 3 experts. For content validity, the experts were inquired to find the Index of Congruency (IOC) of the form's content.

3.2 Data Collection

For data collection, the researchers used the assessment form to certify the team-based ubiquitous learning model on Cloud Platform. Following that, the data were scrutinized and rendered in the forms of mean and standard deviation. The 5-point Likert scale criteria were employed for data interpretation, as follows.

4.50 – 5.00 refers to most suitable.

3.50 – 4.49 refers to highly suitable.

2.50 – 3.49 refers to moderately suitable.

1.50 – 2.49 refers to marginally suitable.

1.00 – 1.49 refers to least suitable.

Afterwards, the researchers implemented the validated assessment form to retrieve data from the 5 specialists in Educational Technology (Ubiquitous and cloud platforms) and specialists in curriculum and instruction (team-based learning and creative problem-solving), who had at least 5 years of relevant experience. The Focus Group technique was employed to settle a Focus Group discussion, which was divided into 3 phases as follows.

3.2.1 Preparation

In the preparation phase, the researchers anticipated conclusion to and discussion on the potential of the Team-based Ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities. After that, the researchers processed the anticipated results to prepare information for the following phase in which efficacy of the learning model shall be assessed and certified.

3.2.2 Focus Group Discussion

In the Focus Group discussion phase, the researcher served as the moderator, informing the attendees (specialists) about the purpose in order of frameworks and topics. The discussion allowed the specialists to voice their opinions under the topics given and discuss their reasonings with one another.

3.2.3 Conclusion

In the conclusion session, the discussion's moderator restated the ideas gathered within the group. The attendees were inquired to reaffirm their reasonings on certification of the learning model. At the end, the researchers verified and summarized the significant results so as to proceed with further development of the model.

4. Data Analysis

For data analysis, the researchers performed Content Analysis on results of the assessment form and reasonings provided by the specialists in the Focus Group discussion. To certify the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities, the assessment results were calculated using mean ($\bar{x}$) and standard deviation (SD). The 5-point Likert scale criteria were employed to interpret suitability levels of the said learning model.

5. Findings

5.1 Assessing Results of Efficacy of the Team-Based Ubiquitous Learning Model on Cloud Platform to Enhance Creative Problem-Solving Abilities (PITTA Model)

Table 1: Assessing Results of Efficacy of the Team-based Ubiquitous Learning Model on Cloud Platform to Enhance Creative Problem-solving Abilities (PITTA Model).

Item	Description	$\bar{x}$	SD	Interpretation

1	Content	4.72	0.44	Most Suitable
2	Design and Organization of Ubiquitous	4.70	0.41	Most Suitable
3	Accessibility and Connectivity	4.80	0.40	Most Suitable
4	Learning Management	4.83	0.28	Most Suitable
	Total	4.76	0.38	Most Suitable

According to Table 1, the analysis results indicated that *Learning Management* was marked to be most suitable ($\bar{x}$ = 4.83, SD = 0.28); so were *Accessibility and Connectivity* ($\bar{x}$ = 4.80, SD = 0.40), *Content* ($\bar{x}$ = 4.72, SD = 0.44), and *Design and Organization of Ubiquitous* ($\bar{x}$ = 4.70, SD = 0.41). Based on the Focus Group discussion to assess efficacy of the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities, the specialists had consensus that the model was "Most Suitable" on average ($\bar{x}$ = 4.76, SD = 0.38).

5.2 Certifying Results of Efficacy of the Team-based ubiquitous Learning Model on Cloud Platform to Enhance Creative Problem-solving Abilities (PITTA Model)

Table 2: Certifying Results of Efficacy of the Team-Based Ubiquitous Learning Model on Cloud Platform to Enhance Creative Problem-Solving Abilities (PITTA Model).

Item	Description	$\bar{x}$	SD	Interpretation
1.	Pre-class Preparation	4.80	0.22	Most Suitable
2.	Individual Readiness Assurance Test	4.75	0.42	Most Suitable
3.	Team Readiness Assurance Test	4.85	0.30	Most Suitable
4.	Team Application	4.84	0.26	Most Suitable
5.	Appeals and Feedback	4.92	0.16	Most Suitable
	Total	4.83	0.27	Most Suitable

According to Table 1, the analysis results indicated that *Appeals and Feedback* was marked to be most suitable ($\bar{x}$ = 4.92, SD = 0.16); so were Team Readiness Assurance Test ($\bar{x}$ = 4.85, SD = 0.30), Team Application ($\bar{x}$ = 4.84, SD = 0.26), Pre-class Preparation ($\bar{x}$ = 4.80, SD = 0.22), and Individual Readiness Assurance Test ($\bar{x}$ = 4.75, SD = 0.42).

Based on the Focus Group discussion to certify the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities, the specialists had consensus that the model was "Most Suitable" on average ($\bar{x}$ = 4.83, SD = 0.27).

Based on the results of Content Analysis, the specialists suggested that the letter C in Creative need be capitalized and the entire word had better be relocated to the upper part to for ease of clockwise reading. As for the font style, it need be shadowed rather than whitened for ease of reading, especially with the abbreviations

In, Ac, Co, and Ad.

The following illustrates the revised version of the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities (Figure 2).

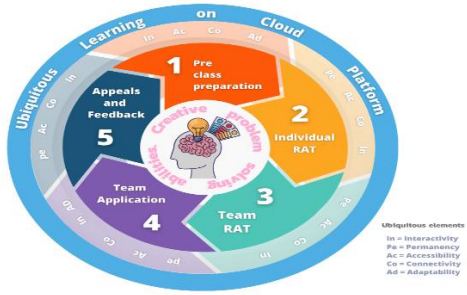

Figure 2: Revised Version of the Team-based ubiquitous Learning Model on Cloud Platform to Enhance Creative Problem-solving Abilities (PITTA Model)

6. Conclusion and Discussion

6.1 Conclusion

1. For congruence of the certifying form, 3 experts were inquired to voice opinions on clarity and feasibility of integrating Ubiquitous-driven team-based learning with creative problem-solving abilities. The IOC score of the form was at the range of 0.67-1.00. This indicated congruence of the form to certify the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities.

2. According to the results of the assessment form of the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities, the 5 specialists marked clarity and feasibility of the model to be "Highest". As for efficacy, the specialists had consensus that the model was "Most Suitable" on average. Furthermore, it was suggested that the letter C in Creative need be capitalized and the entire word had better be relocated to the upper part to for ease of clockwise reading; and the fonts need be shadowed rather than whitened for ease of reading.

6.2 Discussion

Attributed to compliance of the researchers with the specialists' constructive suggestions, certifying results of the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities indicated that the model's clarity and feasibility were at the "Highest" level. This was also complemented by results of previous research on team-based learning, Ubiquitous-driven learning, and creative problem-solving abilities. In Phase 2 of the implementation, the PITTA Model was revised according to the specialists' feedback. They suggested that the Individual Readiness Assurance Test had better be more related to the Ubiquitous elements. In consideration of learner's interaction with and access to the model, permanency should not be regarded during this test session because in Phase 2, the iRAT shall be taken individually, not in team. It could be more appropriate taking into account Permanency in Phase 3 where learners shall take the Team Readiness Assurance Test. This suggestion is in alignment with the study of Lefebvre (2016, p.192-207) proposing that learners having undergone the RAP or Team Test and provided with constructive feedback outdo in holding learning permanency and applying knowledge to the Team Test, and they also successfully achieve tasks resulting from their enhanced reading comprehensibility. Typically, team members do share personal experiences and ideas gained from inside and outside classrooms. To maximize the advantage of sharing and achieve the team's goal requires team

work skills, problem-solving abilities, and group decision-making. This aligns with the study of Dana (2007), who implemented the team-based learning model in a law course. In Dana's study, 36 students were divided into 6 teams with 6 members in each. Throughout the semester, 75-minute classes were delivered twice a week under the following conditions. 1) Pre-class reading was required. 2) Multiple-choice pre-tests were taken to provide fundamental concepts of each reading. 3) Members of each team took the same test as taken individually earlier. 4) Students may write down questions of concern on a separate piece of paper. 5) Class discussions were conducted to clarify questions of concern. 6) Based on the concepts provided, more complicated exercises were assigned to each team. 7) Each team discussed adaptability of one another as demonstrated during each assignment. 8) Grading rubrics were encouraging to both individual students and teams. The findings indicated higher learning achievements, improved reasoning and critical thinking skills, strengthened relationships with friends and the instructor, and more positive attitudes towards course content and classes. As for the PITTA Model being certified, it was disclosed that the model was marked Most Suitable with respect to Learning Management and Accessibility and Connectivity. This could imply that the Ubiquitous-driven learning model is effective whether in learning management or accessibility to and connectivity with abundant sources of information, enabling learning experience to take place anywhere and anytime. This implication aligns with the study of G.D. Chen et al. (2008), the title of which is Ubiquitous Learning Website: Scaffold Learners by Mobile Devices with Information-aware Techniques, highlighting the significant influence of mobile device's portability and immediate communication on learning processes, for example, interacting with peers and transferring data. Such properties of mobile devices were said to allow for instant access to sources of information and have potential to enhance learning experience either on websites or mobile devices. Hence, the present study sought to create a Ubiquitous-driven website to convenience learning experience regardless of time and physical classrooms. Implementing the Team-based ubiquitous Learning Model on Cloud Platform to enhance creative problem-solving abilities (PITTA Model), any organization can benefit, and learners may foster their lifelong learning relying on timely access to sources of information so they can be playing a pivotal role in development of workforce, organizations, communities, and the country. In the circumstance that today's world is rife with waves of rapid changes, learners are encouraged to pursue lifelong learning, and it is imperative that they be provided with fundamental skills such as information searching and literacy skill. This also applies to adult learners, who should be more exposed to a variety of resources that encourage a team-based learning environment (Knowles, 1980).

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