The Development of System and Collaborative Learning Activities in Ubiquitious Learning Environments Using Computer Tablet with QR Code

การพัฒนาระบบและกิจกรรมการเรียนรู้ร่วมกันในสภาพแวดล้อมการเรียนแบบยูบิควิตัสโดยใช้คอมพิวเตอร์แท็บเล็ตร่วมกับคิวอาร์โค้ด

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Abstract

The purposes of this research study were 1) to develop system and collaborative learning activities in ubiquitous learning environment using computer tablet with QR code 2) to compare pretest and posttest of the experiment, and 3) to study the satisfaction of the samples learning with the system and collaborative learning activities in u-Learning. The samples studies are undergraduate students of computer education during the first semester of 2017 and twenty-nine students were recruited. Research tools include a system and collaborative learning activities in ubiquitous learning environment using tablet and QR code and questionnaires measuring students' ability in learning achievement tests and satisfactions. Statistics for data analysis are percentage, arithmetic mean, standard deviation and t-test dependent.

The results were as follows:

1) The developed system and collaborative learning activities in ubiquitous learning environment using tablet and QR code. The system consists of four parts, as follows: (1) computer tablet , (2) wireless communication, (3) ubiquitous learning environment, and

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(4) sensor technology. The learning activities composed of five steps, as follows: (1) assigning work, (2) planning, (3) action, (4) presentation, and (5) discussion and conclusion

2) Posttest of the samples learning achievement through system and activities was higher than pretest at the .05 level of significance.

3) The students are satisfied with the system and collaborative learning activities in ubiquitous learning environment using computer tablet with QR code at high level.

Keywords: Ubiquitous Learning, Collaborative Learning, QR code

บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อ 1) เพื่อพัฒนาระบบและกิจกรรมการเรียนรู้ร่วมกันในสภาพแวดล้อมการเรียนแบบยูบิควิตัสโดยใช้คอมพิวเตอร์แท็บเล็ตร่วมกับคิวอาร์โค้ด 2) เพื่อศึกษาผลของระบบและกิจกรรมการเรียนรู้ร่วมกันในสภาพแวดล้อมการเรียนแบบยูบิควิตัส ฯ และ 3) เพื่อศึกษาความคิดเห็นของผู้เรียนต่อระบบและกิจกรรมการเรียนรู้ร่วมกันในสภาพแวดล้อมการเรียนแบบยูบิควิตัส ฯ กลุ่มตัวอย่างที่ใช้ในการวิจัย คือ นักศึกษาระดับปริญญาบัณฑิต สาขาวิชาคอมพิวเตอร์ศึกษา มหาวิทยาลัยราชภัฏนครปฐม ภาคเรียนที่ 1 ปีการศึกษา 2560 จำนวน 29 คน เครื่องมือที่ใช้ในการวิจัย คือ ระบบและกิจกรรมการเรียนรู้ร่วมกันในสภาพแวดล้อมการเรียนแบบยูบิควิตัสฯ แบบทดสอบวัดผลสัมฤทธิ์ทางการเรียน และแบบสอบถามความคิดเห็นของนักศึกษา สถิติที่ใช้ในการวิจัย คือ ร้อยละ ค่าเฉลี่ยเลขคณิต ส่วนเบี่ยงเบนมาตรฐาน และ t-test dependent

ผลการวิจัย พบว่า

1) ระบบและกิจกรรมการเรียนรู้ร่วมกันในสภาพแวดล้อมการเรียนแบบยูบิควิตัสโดยใช้คอมพิวเตอร์แท็บเล็ตร่วมกันคิวอาร์โค้ด ซึ่งองค์ประกอบของระบบ ประกอบด้วย 4 ส่วน ดังนี้ 1) คอมพิวเตอร์แท็บเล็ต 2) ระบบเครือข่ายไร้สาย 3) สภาพแวดล้อมการเรียนแบบยูบิควิตัส และ 4) ระบบเซนเซอร์ และขั้นตอนของกิจกรรมการเรียนรู้ ประกอบด้วย 5 ขั้นตอน ดังนี้ 1) การกำหนดงาน 2) วางแผนการสร้างงาน 3) ดำเนินการสร้างงาน 4) การนำเสนอผลงาน และ 5) อภิปรายและสรุปผล

2) นักศึกษาระดับปริญญาบัณฑิตที่เรียนด้วยระบบและกิจกรรมการเรียนรู้ร่วมกันในสภาพแวดล้อมการเรียนแบบยูบิควิตัสฯ มีผลสัมฤทธิ์ทางการเรียนหลังเรียนสูงกว่าก่อนเรียนอย่างมีนัยสำคัญทางสถิติที่ระดับ .05

3) นักศึกษาระดับปริญญาบัณฑิตที่เรียนด้วยระบบและกิจกรรมการเรียนรู้ร่วมกันในสภาพแวดล้อมการเรียนแบบยูบิควิตัส ฯ มีความคิดเห็นต่อระบบและกิจกรรมการเรียนรู้อยู่ในระดับมาก

คำสำคัญ : การเรียนแบบยูบิควิตัส การเรียนรู้ร่วมกัน คิวอาร์โค้ด

Introduction

In Article 22 of the National Education Act of B.C. 2542 as amended in B.C. 2545 (the 2nd issue), the principle which states that all learners should be able to learn and also to develop themselves is considered to be of the utmost importance. The learning management process must encourage learners to develop themselves naturally to their full potential. Therefore, the learning management process must involve learning activities which support learners according to their abilities. In addition, Article 24 states that learning management can happen anytime and anywhere. Therefore, it requires the application of information and communications technology to education to allow learners to learn anywhere and anytime in order to help them develop themselves to their full potential.

Within the National ICT Policy Framework 2011 – 2020 of Thailand (ICT 2020), Strategy 6 states that the development and application of ICT can reduce economic and social disparities by creating equality of opportunity in terms of access to resources and public services for all citizens, especially basic services that are essential to good living, including education services and health services (Ministry of Information and Communication Technology, B.C. 2554), as well as promoting the creation and application of innovation and digital media for learning at all levels. This policy framework focuses on applying information and communication technology in learning management.

From the teaching experiences related to the subject of Information Technology (IT) which is a basic subject for undergraduates, it has been found that most undergraduates learn based on their individual characteristics with no communication necessary. As a result, the undergraduates do not cooperate in the class and do not use group processes in learning. This contributes to their low levels of achievement in learning. In addition, the subject requires students to be enrolled in both theory and practice classes. In the theory classes, the undergraduates lacked interest in learning due to the fact that the learning process did not present them with, or allow them to experiment with, real equipment. Therefore, it is essential to manage the learning process so that undergraduates can have experience of using real equipment as well as using the technology as part of learning management in order to interest undergraduates and to stimulate their motivation to learn. According to Sakulwichitsintu (2017) who designed framework of knowledge for using information technology as a tool for effective online collaborative learning.

Veridian E-Journal, Silpakorn University
ISSN 1906 – 3431

Ubiquitous Learning is a learning management process that uses information technology and media in as part of the management process due to the fact that it has been developed on the basis of a ubiquitous technology and the creation of learning environments according to the contexts of the learners (Liyytinen & Yoo, 2002). This allows learners to learn anywhere and anytime as their needs demand by using any portable devices without the need for a computer. As a result, it contributes to flexibility in learning and quick access to information. Also, it is a learning management system that is learner-centered and focuses on the work of the learner. This form of learning will help learners build and obtain knowledge by themselves (Junqi et al., 2010).

Furthermore, constructivism learning theory can be applied to u-Learning (Jones & Jo, 2004). The use of learning theory to design learning will help link the effective development of the knowledge of learners to the learning environment (Jacobs, 1999). The researchers were interested in collaborative learning - a learning method that allows students to participate in group work with members who have different abilities to work and present the knowledge gained as a result of cooperation. Learners in each group will learn and build knowledge together by using technology as part of the learning process. The presentation of information arising from this kind of learning will build internal relationships which develop as a result of work creation that requires the assistance of a range of people to accomplish a task. Moreover, with regard to the process of information and knowledge management, creating work as a result of mutual efforts between learners will require discussions. These are a feature of collaboration associated with joint action and understanding each other (Dissakul, 2000). In addition, collaborative learning also allows learners to work more effectively by linking the knowledge each individual has gained in the past, and allowing it to be synthesized as new knowledge (Garlach, 1994; Koschman, 1997).

U-Learning is a learning management process that uses technology in the process. It involves the development of learning through the use of digital media which can be accessed anywhere and at anytime, based on the demand of learners by using portable devices without the need for a computer. As a result it contributes to flexibility in learning and quick access to information. Also, it is a learning management process that is learner-centered and focuses on the work of learners (Junqi et al., 2010). This research has chosen to consider the use of computer tablet in learning management so that learners can learn content from their environment. Computer tablet is an information technology device suitable for use in learning activities. It make students understand the content of the course more. (Somjaiwang and

Ruangrit, 2016). Also, the features of u-Learning management requires context awareness and environments that can adapt to real situations or to the contexts of learners. An instructor must provide adequate information to learners (Yahya et al., 2010).

Quick Response code (QR code), have great potential to improve learning because it enable learning across multiple contexts and content interactions (Crompton, 2013). Chin, Lee and Chen (2015) developed a QR-based U-Learning Material Production System (QR-ULMPS) that provides teachers with an education tool to motivate college level students enrolled in a liberal arts course by using QR code. Therefore, the researchers have chosen quick response code technology to be used as a sensor to detect and link to contents as needed by learners. This will act as a guideline for the development of collaborative learning activities in u-Learning environments by using computer tablet with QR code.

Objectives

This research has the following objectives:

1) To develop the system and collaborative learning activities in ubiquitous learning environments by using computer tablet with QR code.

2) To study the results of the system and collaborative learning activities in ubiquitous learning environments by using computer tablet with QR code.

3) To study the opinions of undergraduates toward the system and collaborative learning activities in ubiquitous learning environments by using computer tablet with QR code.

Research Hypothesis

The undergraduates who learned with the system and collaborative learning activities in u-Learning environments by using computer tablet with QR code had higher learning achievements than when using previous learning methods with a statistical significance at the .05 level.

Scope of the Research

1) The variables used in the research:

1.1) The independent variables were the system and collaborative learning activities in u-Learning environments by using computer tablet with QR code.

1.2) The dependent variables were the learning achievement and the opinions of undergraduates.

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2) Populations in this study were undergraduates at Nakhon Pathom Rajabhat University, 1st semester, academic year 2017.

3) Sample was undergraduates at Nakhon Pathom Rajabhat University, 1st semester, academic year 2017, with a total of 29 undergraduates being selected by purposive sampling.

Research Methodology

Phase 1 - The development of the system and collaborative learning activities for undergraduates in u-Learning environments using computer tablet with QR code.

The system and collaborative learning activities in u-Learning environments by using computer tablet with QR code has the following steps:

1) Analyze the problems and needs associated with collaborative learning activities in u-Learning environments by using computer tablet with QR code, appropriate contents for the collaborative learning activities in u-Learning environments, undergraduates, the characteristics of undergraduates, and contexts related to the collaborative learning activities in u-Learning environments by using tablet computer with QR code.

2) Design the system and collaborative learning activities in u-Learning environments by using computer tablet with QR code, learning objectives, measurement, and evaluation.

3) Develop the research instruments as follows;

3.1) Develop the system and collaborative learning activities in u-Learning environments by using computer tablet with QR code. Presenting the system and collaborative learning activities to experts in order to evaluate the quality. Analyze the results of evaluation of the system and collaborative learning activities by mean ($\bar{x}$) and standard deviation (S.D.) consisting of five criteria for evaluation follows;

4.50 - 5.00	Highest
3.50 - 4.49	High
2.50 - 3.49	Moderate
1.50 - 2.49	Low
1.00 - 1.49	Lowest

As approved by experts, system and collaborative learning activities has high level quality.

3.2) Develop the learning achievement test with reliability at 0.89.

3.3) Develop the students' satisfactions survey. To analyze the results of students' satisfactions survey by mean ($\bar{x}$) and standard deviation (S.D.) consisting of five criteria for evaluation; that is, highest, high, moderate, low and lowest.

4) Implement the formative evaluation processes of the system and collaborative learning activities in u-Learning environments by using computer tablet with QR code by one-to-one testing with 3 undergraduates and small group testing with 6 undergraduates. Observe, interview, solve errors associated with the collaborative learning activities, and conduct field trial with 15 undergraduates. The group learning was conducted in terms of collaborative learning activities that were improved as a result of small group testing. The qualitative data was collected through observation and interview in order to obtain the opinions of trial learners with regard to collaborative learning activities. This data related to applications, problems, and suggestions with regard to learning resulting from the activities under consideration.

Phase 2 – The study of the results of system and collaborative learning activities in u-Learning environments by using computer tablet with QR code.

The research in phase 2 used a research methodology in the form of One Group Pre-test – Post-test Design and was implemented in the form of the following processes:

O_1	X	O_2

O_1 represents the pretest

X represents the learning activities

O_2 represents the posttest

1) Describing to the undergraduates methods of collaborative learning activities in a u-Learning environment using computer tablet with QR code, the measurement, evaluation and practice using such equipment according to the associated learning activities.

2) Measuring and evaluating learning achievements before the trial learning, as well as informing the undergraduates of the results of the evaluation.

3) Conducting the trial learning by assigning undergraduates to learn about the subject of Information Technology through the use of collaborative learning activities in u-Learning environments by using computer tablet with QR code.

4) Measuring and evaluating the learning achievements after the trial learning and informing the undergraduates of the results of the evaluation.

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5) Interviewing undergraduates about their opinions with regard to the system and the collaborative learning activities in u-Learning environments by using computer tablet with QR code.

The statistics used in the research were Percentages, Arithmetic Means, Standard Deviation, and T-Test Dependent.

Results

1) The system and collaborative learning activities in u-Learning environments by using computer tablet with QR code.

1.1) The collaborative learning system in u-Learning environments by using computer tablet with QR code consisting of 4 parts as follows: computer tablet, wireless communication, u-Learning environments, and sensor technology.

1.2) The collaborative learning activities in u-Learning environments by using computer tablet with QR code consists of 5 steps as follows:

Step 1: Assigning work – An instructor will assign work to learners to be performed using a tablet computer. When the learners have been assigned their work, they will be divided into groups with 4-6 people in each, to study the content and to create pieces of work according to their interests. Assigning works will be done by letting learners log onto the system by using the computer tablet that connect to a wireless network, and connecting to a host computer that stores the learning materials.

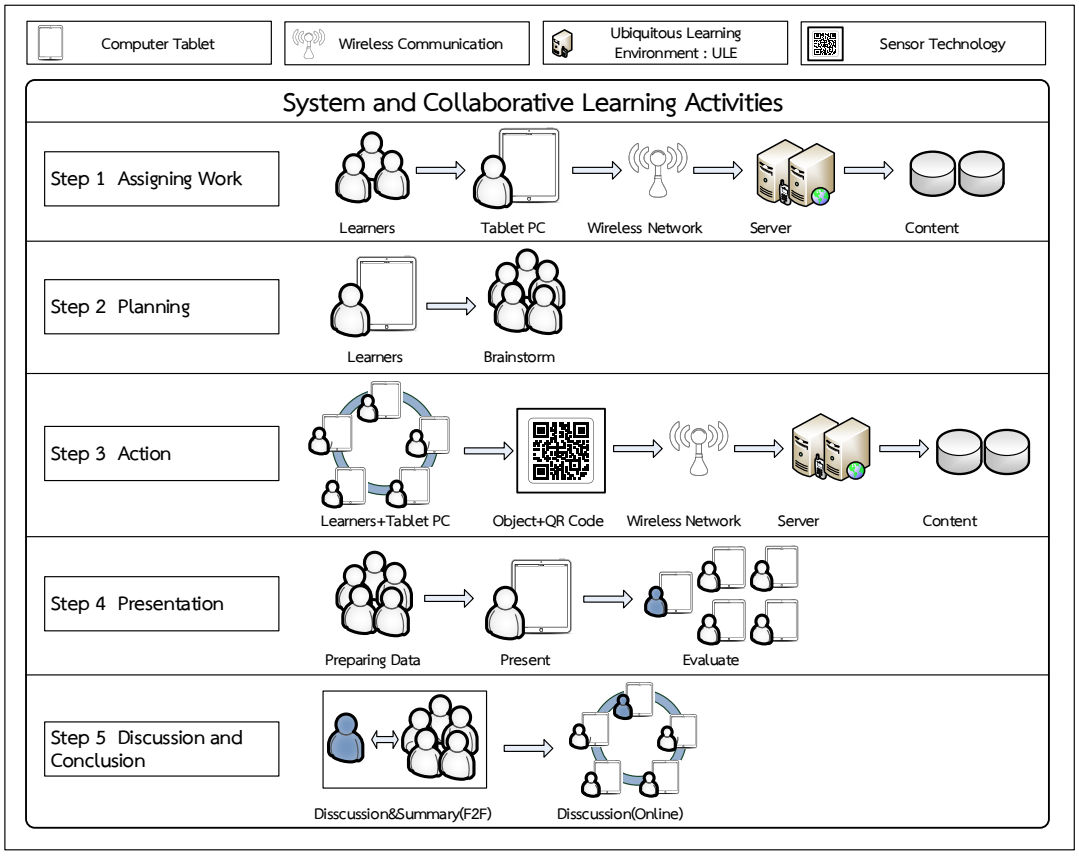

Figure 1 : System and Collaborative Learning Activities

Step 2: Planning - The learners have to set up a meeting to plan for an agreement, research deadlines, purposes, the scope of the contents, the research title, procedures, and the division of responsibilities for members. Each member must express ideas, consult, discuss, interrogate, dispute, suggest and exchange ideas with each other to determine or identify titles to be presented with regard to an issue of interest. Moreover, they have to propose action plans for the group. These have to be submitted to the instructor in order to determine the scope of the contents, to remove unnecessary or inconsistent content, to add missing content, or fulfil defective content and to let the members suggest what they want to know additionally with regard to the topic. In this step, the learners can mutually plan their actions by internal communication involving chatting and group discussion through the tablet computer.

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Step 3: Action - Each member will be responsible for the learning and tasks assigned by the group. After that, the learners will study the content from the surrounding environment. When the learners are interested or required to learn any content that exists in the surrounding environment, they will use the computer tablet to take an image of the QR codes attached to the objects they want to learn about. The objects are computer devices such as input device, output device, communication devices, mainboard, CPU, RAM etc. Then, the program will decode the QR codes and link to the learning content related to their objects of interest through the computer tablet. When the learners have learned the content, they will be able to share and exchange their knowledge with the other group members. Therefore, the undergraduates can learn simultaneously as a result of interaction with the other group members and will be able to exchange the researched information obtained from several sources by analysis and synthesis of the knowledge so obtained. Then, the group members will exchange their opinions, discuss the topic, and extract the knowledge of the group. The group will take control of the process of learning by themselves.

Step 4: Presentation - Members of each group will jointly prepare and present the learning content according to the action plan as determined by the group. Each group will be asked to evaluate the presentations of the other groups and also of their own group. The evaluation will be conducted through the computer tablet that are connected to the network system.

Step 5: Discussion and conclusion – This step involves questions between the instructor and the learners, or between the members of each group. The instructor and the learners will cooperate to conclude the lesson and evaluate the learning results in terms of their groups, in order to identify any defects and to suggest corrective action for group operations to make them more effective. The discussion and conclusion can be implemented in the classroom between the instructor and the learners. Also, the discussion and conclusion can be implemented by using the computer tablet in chatting and group discussion, to increase the convenience of learning even more.

2) The results of a comparison of the learning results before and after learning through the system involving collaborative learning activities in u-Learning environments by using computer tablet with QR-code are shown in Table 1.

Table 1 Comparison of learning results before and after learning through the system and collaborative learning activities in u-Learning environments by using computer tablet with QR-code

Test score	N	Total Score	$\bar{x}$	S.D.	t	sig
Before learning	29	20	6.52	2.21	10.90	.000**
After learning	29	20	12.52	2.68		

** With statistical significance at the level of .05, df = 28

From Table 1, it can be seen that the undergraduates who learned through the system involving collaborative learning activities in u-Learning environments by using computer tablet with QR code had a higher learning achievement than before learning, with a statistical significance at a level of .05.

3. The opinions of the undergraduates towards the system and towards collaborative learning activities in u-Learning environments by using computer tablet with QR code are represented in Table 2.

Table 2 The opinions of the undergraduates towards the system and towards collaborative learning activities in u-Learning environments by using computer tablet with QR code.

Evaluation report	$\bar{x}$	S.D.	Opinion
Learning system	**4.48**	**0.64**	**High**
1. Display of learning contents on tablet computer	4.28	0.59	High
2. Linking to contents by using tablet computer with QR code	4.52	0.63	Highest
3. Quickness of display	4.55	0.52	Highest
4. Interaction through tablet computer	4.59	0.68	Highest
5. Systemic content presentation helps viewing continuity of contents	4.45	0.78	High

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Table 2 The opinions of the undergraduates towards the system and towards collaborative learning activities in u-Learning environments by using computer tablet with QR code. (continued)

Evaluation report	$\bar{x}$	S.D.	Opinion
Learning activities	4.35	0.70	High
1. Step of assigning work	4.38	0.78	High
2. Step of planning	4.34	0.72	High
3. Step of action	4.41	0.82	High
4. Step of presentation	4.38	0.56	High
5. Steps of discussion and conclusion	4.24	0.64	High
Overall system and learning activities	**4.42**	**0.67**	**High**

From Table 2, it can be seen that the opinions of the undergraduates towards the system and towards collaborative learning activities in u-Learning environments by using computer tablet with QR code were at a high level ($\bar{x}$ = 4.42, S.D. = 0.67).

Research Discussion

1) The undergraduates who learned through the system incorporating collaborative learning activities in u-Learning environments by using computer tablet with QR code had higher learning achievements than before learning with a statistical significance at a level of .05. This is because u-Learning environments can help students learn content of interest according to their learning context. Moreover, during the class, each group of learners was also able to help one another to achieve group outcomes. According to the research by Moushir (2008), the form of collaborative learning which boosts u-Learning will support learners while working or doing something in a specific place. Moreover, learners will be able to share knowledge, interact, collaborate in learning, and share their experiences. As a result, it contributes to a higher learning achievement on the part of learners. In addition, Judy, Chih and Hwang (2010) also found out that undergraduates who learned through collaborative learning spent less time on work assigned by an instructor than did students in a regular class.

2) The undergraduates who learned through the system incorporating collaborative learning activities in u-Learning environments by using computer tablet with QR code had highly positive opinions due to the fact that it was a new form of learning in that they were able to undertake learning activities and access learning contents through the use of computer

tablet. This could help create continuity in learning, consistent with the research of Judy, Chih and Hwang (2010) who found that most undergraduates had good opinions and attitude when it came to applying collaborative learning activities in u-Learning environments. In addition, Mandula et al. (2011) also found that undergraduates were satisfied with the use of portable devices and sensor technology in u-Learning.

Recommendations for further research

1) Recommendations for applying the research results

1.1) Educational institutions which are applying a system incorporating collaborative learning activities in u-Learning environments should prepare to use the tools and infrastructure system required in such an environment, as well as develop the learners' skills with regard to information technology and communications before they begin the class.

1.2) Educational institutions which are applying the system and collaborative learning activities in u-Learning environments should set up meetings to describe the system and the learning activities, as well as to make teachers, undergraduates and other stakeholders aware of the benefits of applying the system and incorporating collaborative learning activities in u-Learning environments in order to encourage those involved to have a positive attitude toward the system and towards learning activities.

1.3) In terms of the development of learning materials through portable devices, such material should be developed in such a way that it is of an appropriate size that fits on portable devices due to the fact that portable devices are actually small in size. Therefore, the development must be designed in such a way as to be of an appropriate size to allow screen touching to link contents and applications in various segments.

2) Recommendations for further research

The system and collaborative learning activities in u-Learning environments should be development by arranging other learning activities.

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