THE EFFECT OF WEB-BASED LEARNING SYSTEM USING PROJECT-BASED LEARNING OF IMAGINEERING TO ENHANCE CREATIVE CONSTRUCTION OF MULTIMEDIA SKILLS AND COOPERATIVE SKILLS

ผลการใช้ระบบการเรียนรู้บนเว็บแบบโครงงานเป็นฐานด้วยจินตวิศวกรรม เพื่อเสริมสร้างทักษะการสร้างผลงานมัลติมีเดียเชิงสร้างสรรค์และทักษะการเรียนแบบร่วมมือ

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Abstract

The objectives of this research were 1) to analyze and synthesize the effect of web-based learning system using project-based learning of Imagineering to enhance creative construction of multimedia skills and cooperative skills, 2) to study the results of evaluation on creative multimedia works of the students learning with the developed web-based learning system, 3) to study the results of evaluation on creative construction of multimedia skills after the students had learned with the developed web-based learning system, 4) to study the results of evaluation on cooperative skills after the students had learned with the developed web-based learning system, 5) to study the learning achievement of the students after learning with the developed web-based learning system, 6) to study the satisfaction of the students on the use of web-based learning system, and 7) to summarize the results of the developed web-based learning system. The sample group were 21 third-year undergraduate students in Department of Electronics Engineering Technology, College of Industrial Technology. They were obtained by cluster random sampling. The research tools for data collection were a web-based learning system using project-based learning, an instructor's system or administrator's system, a learning achievement test, an evaluation form for authentic assessment (rubric), and a questionnaire. The statistics utilized for data analysis were mean, standard deviation and t-test for dependent variables.

The research results were as follows:

1. The results of evaluation on creative multimedia works of the students learning with the developed web-based learning system are at high level.

2. The results of evaluation on creative construction of multimedia skills after the students had learned with the developed web-based learning system are at high level.

3. The results of evaluation on cooperative skills after the students had learned with the developed web-based learning system are at high level.

4. According to the comparison of learning achievement scores before and after learning, it is found that the average learning achievement scores of the students after learning are higher than before learning with statistical significance of 0.01.

5. According to the study results on the learners' satisfaction toward the developed web-based learning system, it is found that the learners' satisfaction is at very high level.

Keywords: Web-based Learning System using Project-based Learning; Imagineering; Creative Construction of Multimedia Skills; Cooperative Skills

บทคัดย่อ

งานวิจัยครั้งนี้มีวัตถุประสงค์เพื่อ 1) วิเคราะห์และสังเคราะห์ผลการใช้ระบบการเรียนรู้บนเว็บแบบโครงงานเป็นฐานด้วยจินตวิศวกรรมเพื่อเสริมสร้างทักษะการสร้างผลงานมัลติมีเดียเชิงสร้างสรรค์และทักษะการเรียนแบบร่วมมือ 2) ศึกษาผลการประเมินผลงานมัลติมีเดียเชิงสร้างสรรค์ของนักศึกษาที่เรียนด้วยระบบการเรียนรู้บนเว็บ 3) ศึกษาผลการประเมินทักษะการสร้างผลงานมัลติมีเดียเชิงสร้างสรรค์หลังเรียนของนักศึกษาที่เรียนด้วยระบบการเรียนรู้บนเว็บ 4) ศึกษาผลการประเมินทักษะการเรียนแบบร่วมมือหลังเรียนของนักศึกษาที่เรียนด้วยระบบการเรียนรู้บนเว็บ 5) ศึกษาผลสัมฤทธิ์ทางการเรียนหลังเรียนของนักศึกษาที่เรียนด้วยระบบการเรียนรู้บนเว็บ 6) ศึกษาความพึงพอใจของนักศึกษาต่อการใช้งานระบบการเรียนรู้บนเว็บ และ 7) สรุปผลการใช้งานระบบการเรียนรู้บนเว็บที่พัฒนาขึ้น กลุ่มตัวอย่างคือ นักศึกษาระดับปริญญาตรี ชั้นปีที่ 3 สาขาเทคโนโลยีอิเล็กทรอนิกส์ วิทยาลัยเทคโนโลยีอุตสาหกรรม จำนวน 21 คน ได้จากการสุ่มแบบแบ่งกลุ่ม เครื่องมือที่ใช้ในงานวิจัย ได้แก่ ระบบการเรียนรู้บนเว็บแบบโครงงานเป็นฐาน ประกอบด้วย ระบบผู้เรียนและระบบผู้สอนหรือผู้ดูแลระบบ แบบวัดผลสัมฤทธิ์ทางการเรียน แบบประเมินตามสภาพจริง แบบสอบถามความพึงพอใจ ค่าสถิติในการวิเคราะห์ข้อมูล ได้แก่ ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน และสถิติค่าที

ผลการวิจัยพบว่า

1. ผลการประเมินผลงานมัลติมีเดียเชิงสร้างสรรค์ของนักศึกษาที่เรียนด้วยระบบการเรียนรู้บนเว็บที่พัฒนาขึ้นอยู่ในระดับมาก
2. ผลการประเมินทักษะการสร้างผลงานมัลติมีเดียเชิงสร้างสรรค์หลังเรียนของนักศึกษาที่เรียนด้วยระบบการเรียนรู้บนเว็บที่พัฒนาขึ้นอยู่ในระดับมาก
3. ผลการประเมินทักษะการเรียนแบบร่วมมือหลังเรียนของนักศึกษาที่เรียนด้วยระบบการเรียนรู้บนเว็บที่พัฒนาขึ้นอยู่ในระดับมาก
4. ผลการเปรียบเทียบคะแนนผลสัมฤทธิ์ทางการเรียนจากการทำแบบวัดผลสัมฤทธิ์ทางการเรียนก่อนเรียนและหลังเรียน พบว่า นักศึกษามีคะแนนเฉลี่ยผลสัมฤทธิ์ทางการเรียนหลังเรียนสูงกว่าก่อนเรียน อย่างมีนัยสำคัญทางสถิติที่ระดับ 0.01
5. ผลการศึกษาความพึงพอใจของผู้เรียนต่อการใช้งานระบบการเรียนรู้บนเว็บที่พัฒนาขึ้น พบว่า นักศึกษามีความพึงพอใจต่อการใช้งานระบบการเรียนบนเว็บที่พัฒนาขึ้นอยู่ในเกณฑ์ระดับมากที่สุด

คำสำคัญ: ระบบการเรียนรู้บนเว็บแบบโครงงานเป็นฐาน จินตวิศวกรรม ทักษะการสร้างผลงานมัลติมีเดียเชิงสร้างสรรค์ ทักษะการเรียนแบบร่วมมือ

1. INTRODUCTION

The learning approach that encourages the learners to study and practice anything by themselves based on their skills and interest is regarded as the most popular learning pattern at present. It is also corresponding to the development principles that provide the learners with learning skills in the 21st century. With the combination of different specific skills, the skills mentioned are believed to make the learners successful in both career and life. To apply the learning skills in the 21st century, the learners must be developed and equipped with knowledge and understanding in the essence of academic contents, critical thinking, problem-solving thinking, creative thinking, and ability to communicate and cooperate efficiently with others [1]. Project-based Learning is an approach of learning that encourages the learners to study and practice anything by themselves based on scientific processes and with suggestions and advice from the instructors in order to bring about the solutions to different issues [2]. To accomplish a personal or group project, the learners need to rely on the processes and collaboration from the group members in terms of problem solving, decision, and practice.

The Imagineering is a new concept of learning management that is in compliance with the quality development of learners in the 21st century, focusing on the ability of self-learning, creativity, and innovation [3]. The concept of Imagineering is a synthesis of Imagineering process from Walt Disney [4], Imagineering trend of Breda University of Applied Science [5], the concept of Imagineering club [6][7] ABC model in Imagineering teaching [8], the use of Imagineering in the class of computer media [9], Imagineering process used in working [10], Imagineering model [11], and five steps of ABU Robot Contest [12]. As a result, the Imagineering process of six aspects and 17 steps was derived; thereby, Nilsook and Wannapiroon [13] summarized the process as follows: (1) imagination aspect refers to the ability to find out an interesting topic for the project based on brainstorming and imagination, (2) design aspect refers to the ability to search for information from documents or experienced individuals, and to plan and design the project by means of drafting, making a storyboard, etc., in order to derive the project model, (3) development aspect refers to the ability to conduct the project step-by-step, (4) presentation aspect refers to the ability to verify and publicize the project by means of presentation, (5) improvement aspect refers to the ability to improve/edit, and summarize the group project, and (6) evaluation aspect refers to the ability to evaluate and consider both personal and group project to see whether the quality of the project is satisfactory or not. According to the six aspects of Imagineering process, it is considered a guideline to develop the learners in the 21st century, focusing on the ability of self-learning, creativity, and innovation. The recent problems among Thai students include the lack of analytical thinking and inability to do very satisfactory jobs.

Referring to the aforementioned principles and theories, this research aimed to study the effect of web-based learning system using project-based learning of Imagineering to enhance creative construction of multimedia skills and cooperative skills. This is to utilize the system as a tool to encourage the learners to possess creative construction of multimedia skills and cooperative skills, which are the characteristics the students in the 21st century should have. The study applied the concepts and principles of project-based learning and Imagineering, and then used them as instructional tools to develop instructional activities that comply with the relevant learning processes and principles so that the learners can learn and have those skills.

2. RESEARCH OBJECTIVES

1. To analyze and synthesize the effect of web-based learning system using project-based learning of Imagineering to enhance creative construction of multimedia skills and cooperative skills.
2. To study the results of evaluation on creative multimedia works of the students learning with the developed web-based learning system.
3. To study the results of evaluation on creative construction of multimedia skills after the students had learned with the developed web-based learning system.
4. To study the results of evaluation on cooperative skills after the students had learned with the developed web-based learning system.
5. To study the learning achievement of the students after learning with the developed web-based learning system.
6. To study the students' satisfaction toward the use of web-based learning system.
7. To summarize the results of the developed web-based learning system.

3. HYPOTHESIS

1. The results of the developed web-based learning system can enhance creative multimedia works of the students at high level.
2. The results of the developed web-based learning system after learning can enhance creative construction of multimedia skills of the students at high level.
3. The results of the developed web-based learning system after learning can enhance cooperative skills of the students at high level.
4. The learning achievement of the students after learning with the developed web-based learning system is higher than before learning with statistical significance at 0.01 level.
5. The learners' satisfaction toward the developed web-based learning system is at high level.

4. RESEARCH METHODOLOGY

This research was the study of the effect of the developed web-based learning system. Thereby, the methodology was divided into the following five steps.

Step 1: Prepare the research tools. In this step, the following tools for the test as well as the environment that was suitable for the instruction were prepared.

1.1 The conceptual framework of the web-based learning system used project-based learning of Imagineering to enhance creative construction of multimedia skills and cooperative skills.

1.2 Web-based learning system used project-based learning of Imagineering to enhance creative construction of multimedia skills and cooperative skills. The system was divided into two parts: (1) Learner system, and (2) Instructor system and administrator system.

1.3 Learning achievement test as well as pre-test and post-test before and after learning the whole eight lessons. The test was in the form of four choices, and it was composed of three levels, i.e. difficult, moderate, and easy. The learning achievement test was evaluated in terms of Index of Consistency (IOC) by five experts in the fields of computer; and it was evaluated in terms of Difficulty, Discrimination and Reliability by undergraduate students, who had studied the subject of 030513152: Multimedia and Animation Technology.

1.4 Evaluation forms for authentic assessment (Rubric) were used to evaluate the instructional activities by means of rating scale of four levels. The forms includes: (1) evaluation form on creative multimedia works, (2) evaluation form on creative construction of multimedia skills, and (3) evaluation form on cooperative skills.

The scores of authentic assessment (Rubric) with rating scale of four levels were analyzed based on the score range in Table 1.

Table 1 Mean score range and meaning [14]

Score range	Meaning
2-25 – 3.00	Creative multimedia works/creative construction of multimedia skill/ cooperative skill of the students are at very high level
1-50 – 2.24	Creative multimedia works/creative construction of multimedia skill/ cooperative skill of the students are at high level
0.75 – 1.49	Creative multimedia works/creative construction of multimedia skill/ cooperative skill of the students are at moderate level
0.00 – 0.74	Creative multimedia works/creative construction of multimedia skill/ cooperative skill of the students are at low level

1.5 Questionnaire with five point scales asked about the learners' satisfaction toward the developed web-based learning system. The scores of questionnaire with five point scales asking about the satisfaction were analyzed based on the score range in Table 2.

Table 2 Mean score range and meaning [15]

Score range	Meaning
4.50 - 5.00	Very high satisfaction
3.50 - 4.49	High satisfaction
2.50 - 3.49	Moderate satisfaction
1.50 - 2.49	Low satisfaction
1.00 - 1.49	Very low satisfaction

Step 2: Test the developed web-based learning system with users [16] to find out its efficiency. The test consists of (1) Individual testing, (2) Group testing, and (3) Field trial testing.

Step 3: Apply the developed web-based learning system to the sample group, who were studying the subject of 030513152: Multimedia and Animation Technology in the second semester of 2015 academic year.

Step 4: Collect the data on learners' satisfaction toward the developed web-based learning system.

Step 5: Analyze and summarize the results of the developed web-based learning system.

5. RESEARCH RESULTS

To study the effect of web-based learning system using project-based learning of Imagineering to enhance creative construction of multimedia skills and cooperative skills, the sample group of 21 third-year undergraduate students were tested .The results of data analysis were divided into five parts as follows:

1. For the evaluation on creative multimedia works of the students learning with the web-based learning system, the authentic assessment on the students' multimedia group works was conducted by means of evaluation form with four rating scales called Rubric. The results of evaluation are shown in Table 3 and mean score range and meaning are shown in Table 1.

Table 3 The results of evaluation on creative multimedia works of the students

Aspects of evaluation	Results		Quality level
	$\bar{x}$	S.D.	
Creative Originality	2.03	0.89	High
Amazing	2.00	0.81	High
Value of Work	2.06	0.97	High
Design	2.36	0.90	Very high
Meticulously	2.30	0.92	Very high
Unity	2.36	0.93	Very high
Overall quality of creative multimedia works	2.21	0.90	High

According to Table 3 which shows the results of evaluation on creative multimedia works of the students learning with the developed web-based learning system, it is found that the overall quality of creative multimedia works is at high level ($\bar{x}$=2.21,S.D.=0.90).

2. For the evaluation on creative construction of multimedia skills of the students learning with the web-based learning system, the authentic assessment on the students' multimedia group works was conducted by means of evaluation form with four rating scales to measure the skills. The instructors evaluated the creative construction of multimedia skills of individual students based on six aspects and 17 steps of Imagineering learning process for use in the construction of creative multimedia works. The results of evaluation are shown in Table 4 and mean score range and meaning are shown in Table 1.

Table 4 The results of evaluation on creative construction of multimedia skills of the students

Aspects of evaluation	Results		Quality level
	$\bar{x}$	S.D.	
Using and sharing of resources	1.96	0.59	High
Mutual design and decision	1.85	0.66	High
Collaboration	2.03	0.61	High
Presentation and group interaction	1.96	0.61	High
Mutual improvement and summary of performance	2.30	0.60	Very high
Mutual performance evaluation	1.98	0.71	High
Overall level of creative construction of multimedia skills	2.02	0.64	High

According to Table 4 which shows the results of evaluation on creative construction of multimedia skills of the students learning with the developed web-based learning system based on questions about six aspects, it is found that the overall level of creative construction of multimedia skills of individual students is at high level ($\overline{x}$=2.02, S.D.=0.64).

3. For the evaluation on cooperative skills of the students learning with the web-based learning system, the evaluation forms were employed for authentic assessment with four rating scales to measure the skills. As to the synthesis of instructional activities, the researcher synthesized them from Imagineering learning process and made them corresponding to the five elements of cooperative learning of Johnson & Johnson [17][18]. The results thereof are summarized in Table 5 and mean score range and meaning are shown in Table 1.

Table 5 The results of evaluation on cooperative skills of the students learning with the developed web-based learning system

Aspects of evaluation	Results		Quality level
	$\bar{x}$	S.D.	
Using and sharing of resources	2.12	0.62	High
Mutual design and decision	2.27	0.60	Very high
Collaboration	2.14	0.64	High
Presentation and group interaction	2.16	0.63	High
Mutual improvement and summary of performance	2.18	0.60	High
Mutual performance evaluation	2.25	0.64	High
Overall level of cooperative skills	2.18	0.62	High

According to Table 5 which shows the results of evaluation on cooperative skills of the students learning with the developed web-based learning system based on questions about six aspects, it is found that the overall level of cooperative skills of individual students after learning is at high level ($\overline{x}$=2.18, S.D.=0.62) .

4. The results of comparison of learning achievement scores of the students were derived by having the students learn the contents and take the learning achievement test after learning with the developed web-based learning system. The summarized analysis results of learning achievement scores before and after learning are presented in Table 6.

Table 6 The results of comparison of learning achievement scores before and after learning

Achievement scores	n	Total scores	$\bar{x}$	S.D.	t	Sig.
Achievement scores before	21	50	18.43	6.49	6.631	0.00**
Achievement scores after	21	50	34.81	11.04		

** p < 0.01

Considering the average learning achievement scores in Table 6 which shows the results of comparison of learning achievement scores before and after learning, it is found that the average learning achievement scores of the students after learning are higher than those before learning. This represents that the learning with the developed web-based learning system enables the learners to have better learning achievement. Once considering the t value, whereby t = 6.631, and p-value or sig. of 0.00**, which is lower than the default value of 0.01, it shows that the learning achievement of the learners after learning with the developed web-based learning system is higher than before learning with statistical significance of 0.01.

5. For the results of the study of learners' satisfaction on the utilization of the web-based learning system, the results of evaluation are summarized in Table 7 and mean score range and meaning are shown in Table 2.

Table 7 Summary of learners' satisfaction on the utilization of the developed web-based learning system (overall elements)

Aspects of evaluation	Learner's satisfaction		Level of satisfaction
	$\bar{x}$	S.D.	
Overall contents	4.66	0.52	Very high
Overall design of web-based learning system	4.51	0.59	Very high
Overall efficiency	4.49	0.56	High
Overall satisfaction	4.55	0.56	Very high

According to Table 7, it is found that the students' overall satisfaction on the utilization of the developed web-based learning system under the three aspects of evaluation is at very high level ($\bar{x}$=4.55, S.D.=0.56).

6. RESEARCH DISCUSSION AND CONCLUSION

According to the research results, the important issues for discussion have been found as follows:

1. The results of evaluation on creative multimedia works of the students after learning with the developed web-based learning system are at high level. This may be because the researcher applied Imagineering, the new learning process, in the instructional management, which is in compliance with the development of characteristics of the learners in the 21st century, focusing on self-learning, creativity, and ability to create innovation as well as creative works. This also corresponds to the academic article of Nilsook and Wannapiroon [13], the Imagineering instructional management suitable to certain age of learners helps encourage the learners to create the things that come from their imagination in a systematic manner. Besides, this is in accordance with the research of Kangvaravoot [19], who found that the application of Arts Evolution, the concepts that enhance proficiency of imagination, to manage the creation of novel and constructive works from imagination, can further develop the ideas to create new knowledge and innovation of higher quality.

2. The results of evaluation on creative construction of multimedia skills of the students after learning with the developed web-based learning system are at high level. This may be due to the application of project-based learning, an approach of learning that encourages the learners to study and practice anything by themselves according to their skills and interest and based on scientific processes with suggestions and advice from the instructors in order to bring about the solutions to different issues. This conforms to the

research of Niyomthai [20], who found out that the use of project-based learning theories in the blended learning management can increase the learners' operation skill and problem-solving skill greater than general vocational learning model. Moreover, Jansukwong [2] found that the creative thinking skill, teamwork skill, and product quality of students, who worked on the project activity plans that applied a creative problem-solving process, were higher than the group that worked on the normal project activity plans with statistical significance of 0.01.

3. The results of evaluation on cooperative skills of the students after learning with the developed web-based learning system are at high level. This may be because the learners were encouraged to attend instructional activities together in small groups both in class and on the website. This kind of instructional management focuses on the application of small group activity, and shares the learners' knowledge on the webboard, leading to the enhancement of interaction among learners of the same and different groups in order to achieve the targets, with the project-based learning method consisting of outstanding and popular instructional process that enhances teamwork skill. This is also corresponding to Laisema [21], who found that the instructional management, in which the learners work together in small groups based on the developed collaborative learning system, can increase the cooperative skill of the learners. Furthermore, this complies with Pumtonwong [22], who found that the instructional management on the website with cooperative learning can enhance the group work skills of learners.

4. The learning achievement scores of the students after learning are higher than before learning, with statistical significance of 0.01. This result may come from: 1) the design of lessons based on management of project-based learning activities on the Internet network can increase the learning achievement of the students after learning. This is in compliance with the research of Satiman [23], who found that the self-directed learning of the students employing project-based learning activities on the Internet network is higher than before learning, with statistical significance of 0.01. In addition, it is complying with the research of Boonlert [24], who found that the management of instructional activities by using various tools, can increase the learning achievement after learning to be greater than before learning; 2) the design of lessons based on web-based instruction design in order to create learning has effects on learning achievement development by using a variety of multimedia and tools that enable the learners to study by themselves all the time via the website; 3) the instructor provided learning style and motivation that were important to the individuals' differences. This greatly influenced the student learning. This is in compliance with Katsuda and Lynch [25], who insisted that learning styles and motivation are important to the individuals' differences, which influence student learning. These attributes have also been demonstrated to be the key determinants of effective learning and mastery of knowledge and skills in language education.

5. The learners' satisfaction toward the use of developed web-based learning system is at very high level. This result may come from: 1) the instructor provided various learning activities on the website, which were challenging to the learners and satisfied the different ability of each individual; 2) the learners could study freely by themselves, resulting in active learning; 3) the system encouraged the learners to work in group with collaboration.

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