

Designing Learning Environment to Encourage the Engineering Design in the setting of FLIPPED Classroom for Design and Technology Courses

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Abstract: This study uses the constructivist learning environment (CLE) as the basis for designing and developing a learning environment including learning management system (LMS) which occurs in pattern of online learning environment called SOCIALClassnet. The objective of this study are designing and developing the LMS to encourage the engineering design in the setting of flipped classroom for first trimester 2019 of Design and technology course. Subjects of this study are 30 students of Mathayom 1 , Nong Waeng Withthaya School, Thailand. The study design is one group pretest-posttest. The results are analyzed as quantitative and qualitative data. The framework of LMS that encouraging the engineering design in the setting of flipped classroom is consists of 1) Problem-based learning 2) Resource of knowledge 3) Cognitive tools 4) Case-related situation 5) Scaffolding 6) Coaching 7) Social support. Verifying efficacy by experts and the evaluation process are 1) Learning environmental design, knowledge content, media and technology and assessment 2) Capability in engineering design 3) Learners' opinions in knowledge content, media and design 4) Learning achievement

Keywords: Constructivism learning environment, flipped classroom, engineering Design

1. Introduction

Using technology to connect the data is more often in 21st century, allowing us to access more information quickly and easily. In the aspect of educational management, social context adaptation is necessary. However, there are some problems occur in the classroom such as teacher-centered learning environment and lack of timing for learning activities due to overtime work. For instance, financial work, supplying, academic e.g. On the other hand, the learners are lack of attention, lack of learning skills and lack of motivation, so the learning achievement is low.

The process of engineering design are consists of these steps 1) Problem identification 2) Data gathering and problem listing 3) Designing the methods of problem solving 4) Testing, evaluation and amendment 5) Presentation. All of these steps could be alternate and work as iterative cycle.

According to problems as above, teachers have to seek for more knowledge and new teaching patterns to encourage self-studying in the setting of flipped classroom. The principle is to change from passive learning to active learning environment that emphasizes self-studying from provided media and technology which based on individual competence (Issara Kanjug, 2013)

The study uses the constructivist learning environment (CLE) as the basis for designing and developing a learning environment including learning management system (LMS) called SOCIAL Classnet.

As the importance and necessity of this kind of learning, the researcher is interested in alternating Designing and Technology course into flipped classroom pattern to facilitate capability of engineering design in Mathayom 1 student.

2. Literature Review

2.1 Constructivism Learning Environment Management System

Knowledge is not only derived from passive gain but could be created from a person who understands and gains from experience. If these two principles are applied, the education results will be outspread. (Von Glasersfeld,1991). The learning process is generated from relation or previous understanding which the learners attempt to gather the experiences or situations to form the intellectual model. (Issara Kanchak, 2004) The theory that notices about learning process which establishes relation from self-experiences is so-called Cognitive structure.

2.2 Flipped Classroom Learning Environment

As a result that teaching methods which change from learning in class to dynamic and interactive learning, the teachers have to guide learners to apply their knowledge and motivate them to study. Flipped classroom is a teaching method that facilitate the learners to achieve new knowledge from new tools. They will take time with their learning tools or gadgets and discuss the topic within groups.(Brame,2013) The role of teachers is to help learners to understand the principles not just memorizing and also not just offering information. It was changed from whole class interaction into one-on-one interaction. (Wijarn Panich, 2013)


2.3 Engineering design




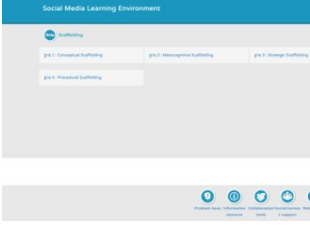
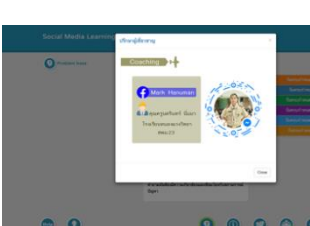
Engineering design is a part of education which combines science, technology, engineering and mathematics. It emphasizes on problem solving by using knowledge including the product development which will effects our work and living. Engineering design process is started with identifying problems then analyzing and creating tools to solve that problems.

3. Methodology

3.1 Constructivism Learning Environment Management System to Flipped Classroom Design


Table 1: Component of Constructivism Learning Environment Management System to Flipped Classroom Design



Principles and theories	Design principles	Example of design shot
1) Activating Cognitive Structure and Reading Comprehension	It was illustrated the relationship between theories and the components as follows: cognitive constructivism (Piaget, 1992); cognitive conflict, OLEs(Hannafin,1999),engineering design process has the following 6 steps : Problem identification, Related information search, Solution design, Planning and development, Testing, evaluation and design improvement , Presentation	

2) Supporting Cognitive Equilibrium and Reading Comprehension	It illustrates the relationship between theories and elements: constructivism (Piaget, 1992); OLEs (Hannafin, 1999), CLEs Model (Jonassen, 1999); Cognitive tools. The designing of the components was called Cognitive tools which to support their mission to solve complex problems. And Relate Case was supporting to encourages students personalize the experience to close the case and to expand the view to change the perception; Constructivist Constructivist (Vygotsky, 1978); Zones of similar development This element of design is called a collaboration tool to encourage students to share experiences between students, teachers, and experts in order to expand their perspectives.	  
3) Supporting and Enhancement for Reading Comprehension	It was illustrated the relationship between theories and the components as follows: Social Constructivist (Vygotsky, 1978); zone of proximal development, OLEs(Hannafin,1999); conceptual, metacognitive, procedural and strategic scaffolding. The design of that element is called Providing instruction to learners by students to learn according to constructivist theory by emphasizing the teacher to be a coach rather than teaching or entering information for one-sided students Which holds support for the promotion of advice to learners for the mission to be accomplished.	 

3.2 The Design Flipped classroom

Table 2: An example of learning process in Flipped English reading comprehension Learning classroom adapted from Kanjug, I., Na-ngam, C. & Kanjug, P. (2017)

Components	Description of learning process	Example of learning activity
Learning material : SOCIALClassnet		
Out of Class	<ul style="list-style-type: none"> The teacher explained how to use online learning. In SOCIALClassnet format Based on the Constructivism Learning Environment Management System 	
Knowledge acquisition 1) Problem base 2) Information resource, 3) Scaffolding		

Learning material : Teaching reading comprehension as an Active Learning		
In class Knowledge acquisition Knowledge Transfer)1) Problem base	<ul style="list-style-type: none"> • Students answer questions online in the class. The teacher created the online quiz. In order to achieve the learning process in the classroom in the order of steps. • Students collaborated to learn and exchange ideas with members within the group. At the same time, the teacher will be a coach to provide guidance. 	
Out of Class Knowledge sharing - Coaching - Collaboration	<ul style="list-style-type: none"> • The teacher is the supporter of the guidance while the student is in doubt. • Teacher and students share their knowledge, opinions, questions about problems that arise while carrying out classroom activities through social media such as Facebook, Twitter, SOCIALClassnet, etc. 	

3.3 Pilot Study

3.3.1 Participant

- Experts 1)Content experts 2)Media and technology experts 3)Experts in learning environment design
- Target groups of Mathayom Suksa 1 students, Nong Waengwittaya School, Thailand, number 30

3.3.2 Research Instrument

Research tools are consists of

- 1) Experimental tools : learning environment in the setting of flipped classroom to encourage knowledge of engineering design in Design and Technology course
- 2) Tools for collecting data :
 - Test for assessing learning achievement
 - Test for assessing capability of engineering design
 - Interviewing form for engineering design
 - Learners' opinions survey

3.3.3 Data Collection and Analysis

1. Gathering information about constructivist conceptual framework, flipped classroom and engineering design
2. Synthesize the framework to use as a basis of creating instructional media
3. Design and developing learning environment in the setting of flipped classroom and then proposed to experts for evaluation
4. Quantitative and qualitative data analysis
 - Evaluating efficacy of learning environment using analytical study
 - Statistics for assessing capability of engineering design using mean, standard deviation and percentage
 - Test for assessing learning achievement using posttest
 - Learners' opinions survey

4. Result and Discussion

Pre-test and Post-test of Mathayomsuksa 1 students had an average score of 10.10 points and 22.60 points, respectively. When comparing between before and after learning, it was found that the post-test scores of students were significantly higher than before learning. Statistical at the level of .05

t-test

Paired Samples Statistics

		Mean	N	Std. Deviation
Pair 1	Pre-test	10.10	30	2.06
	Posttest	22.60	30	3.06

Paired Samples Test

		Paired Differences			t	df	Sig.(2-tailed)	Sig.(1-tailed)
		Mean	Std. Deviation	Std. Error Mean				
Pair 1	Posttest - Pretest	12.50	2.81	0.51	24.3376	29	0.0000	0.0000

Figure 1. Result of Learning Achievement Evaluation Pre-test, Post-test and T-Test.

Pre-test and Post-test of Mathayomsuksa 1 students show average scores of 10.10 points and 22.60 points, respectively. Statistical analysis of learning achievement evaluation by using paired T-test shows significantly higher post-test scores with P-value less than 0.05. These results reflect that the students have gained more knowledge from classroom activities which reinforce their thinking process to solve problems.

According to the theory of constructivism, learners acquire knowledge by experiencing and getting through process of developing their wisdom by themselves (Ernst Von Glasersfeld, 1991). Constructivism theory emphasizes the developing of internal knowledge which relates to previous experiences (Kanjung, 2004). Learners should gather their perception together with understanding to create their own cognitive structure (Chaicharoen, 2011).

When combining with flipped classroom model, the environment of studying is changed from passive learning to active learning. The principles of this model is converting the teacher-driven pattern to student-centered learning (Noona et al., 2013) Flipped classroom is one of teaching strategies which stimulate active learning of learners. Teachers may play role in order to guide learners to apply their knowledge and build up their concept for solving problems (Kanjung, 2013). Not only memorizing theories or information, but understanding the concepts or main idea is the principle of flipped classroom (Panich, 2013).

This study introduces good combination of constructivist theory and flipped classroom model. Active learning by using new technologies or multimedia help learners to access to the world of knowledge easily, enhance their experience and finally acquire their intelligence.

5. Conclusion

This study is designed to evaluate the learning environment in the setting of flipped classroom to encourage engineering design in Design and Technology course for Mathayom 1 student. This could be benefit for improving learners capability of identifying problems, analyzing and creating methods for solving problems by themselves and also facilitating self-learning and gaining self-experiences.

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