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The Use of Constructivism Flipped Classroom to Promote Analytical Thinking in the Technology Course

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Abstract: The flipped classroom has recently been a popular learning approach., In the Thai context, it was found that most of the flipped classroom use was to passively assign students to study content outside of school hours, preventing students from developing advanced thinking skills. Therefore, this research aims to use constructivism to design a flipped classroom and examine the students' analytical thinking results to compare the analytical thinking of the learners in the experimental and control groups by performing a quasi-equivalent control group (design). The participants were divided into a control group receiving (learning in a traditional flipped classroom, and an) experiment group participating in the constructivism flipped classroom. Both groups were 11th grade students. The research found that the experimental group had higher analytical thinking scores than the control group.

Keywords: Constructivism learning environment, flipped classroom, Analytical thinking

1. Introduction

The modern world is known as the era of information due to the rapid contact of news stories, with technological advancements causing economic change. In the 21 century, education management today has adopted innovation and educational technology to increase learning options. To develop learners in the age of globalization to have knowledge and ability to analyze. Synthesize information and news A teaching methodology that emphasizes interpersonal differences. The teaching process changes the role of teachers from being givers. The broadcaster becomes an educational designer to develop different people. The learning trajectory began to enter the era of using "intensive technology" to learn things (Kanjug, 2013). Teachers need to be ready to provide instruction to the changes in time for the advancement of technology today regarding learning patterns or processes.

The advancement of technology affects the student's learning abilities. However, classroom management still encounters many difficulties, such as the organization of teaching activities focusing on the teacher center and teaching styles such as chalk and talk. Those concerns are about how teachers teach the students by ignorance of students' learning preferences. It might affect learners lacking in understanding or unable to create their own body of knowledge. Currently, teaching and learning focus on the learner as a center (Child Center), focusing more on the learners and encouraging all learners to develop according to their potential and interests. It would be more considering the fundamental differences of learners. That is to say, the learners will discover and solve problems by themselves and have more freedom to study. They are able to build a body of knowledge by learning from various situations, both inside and outside the classroom. Teachers, therefore, have to change their roles as facilitators for the learners (Kanjug, 2013).

Additionally, the problem of computational science courses was found to be a new course in basic compulsory subjects from the revision version of the Basic Education Core Curriculum of Thailand. Regarding the curriculum, teachers still need more information about

teaching techniques and innovations to support their teaching. In addition, a few subjects were complex for learners to learn. It is necessary to study according to the specified process and reduce learners boredom, increasing their learning interests with analytical thinking rather than memorization. Otherwise, the learners would misunderstand the learning content and might bring knowledge to solve further other problems.

Regarding the concerns above, instructors need to reshape how they manage their learning classroom corresponding to their learners by, enabling them to learn independently based on technological materials with a suitable learning environment. Teachers can choose a learning management method appropriate for the context of the school and the learner. Therefore, flipped classroom learning is a teaching process that transfers from direct instruction or passive learning to active learning—such as an interactive learning environment that face-to-face learning in class and online self-learning. Teachers would be intellectually guided to enable students to apply their maneuvers and creativity in the subjects.

The inverted teaching and learning management model is different from the traditional teaching and learning model. Flipped classroom teaching and learning will focus more on enabling learners to create knowledge on their own based on skills. Knowledge, ability, and intelligence, according to the rate of learning ability of each person (self-paced learning), are gained from experience provided by teachers through various types of information technology and communication. It is also a characteristic independent of learning from sources outside the classroom regarding ideas and practices (Kanjug, 2013).

On the other hand, analytical thinking is divided into five steps: 1) Matching, 2) Classification, 3) Linking, 4) Conclusion, and 5) Application, which requires reasoning skills. Deep and diverse thinking is thought through and rational considerations by identifying similarities or differences, enabling one to rank, categorize, or categorize knowledge of things, and identifying reasons for data errors. That is, the students would be able to interpret or impart basic criteria of knowledge, specify, be specific, or draw a reasonable conclusion. until it can become new knowledge (Marzano, 2001).

Therefore, this study recognizes the importance of developing the flipped classroom learning environment to promote analytical thinking in the technology course (Computational Science) for secondary school students and aims to solve learning management problems as mentioned above. It is based on the design and development of the conceptual framework, where learners can learn technology and contribute to the linkage of new knowledge.

2. Literature Review

2.1 Constructivism Learning Environment Management System

The theory of constructivist learning is vital to understanding how students learn. The idea that students actively construct knowledge is central to constructivism. Students add (or build) their new experiences on top of their current foundation of understanding. Woolfolk (1993) stated that “learning is active mental work, not passive reception of teaching.” The fundamental principle is that knowledge is constructed, learning is a social activity, learning is an active process, learning is contextual, people learn to learn, learning exists in mind, knowledge is personal, and motivation is key to learning. A learning environment focuses on solving problems and developing a student’s conceptual framework (Jonassen, 1999). The learning process is generated from relation or previous understanding, in which the learners attempt to gather the experiences or situations to form the intellectual model. Therefore, there are important principles in applying the concept of constructivism theory used to design technology and organize learning environments. A constructivism-based learning system is an online management system developed based on elements of constructivist theory (Kanjug et al., 2018).

2.2 Flipped Classroom Learning Environment

The concept is turning the classroom lecture into classroom activities. The lecture should be done outside the classroom or through video and online media. By doing this, students will have more chances to participate and interact with their teachers and friends (Bergmann & Sams,

2012). Teaching science has changed from teaching. Direct instruction or passive learning becomes more active through an interactive learning environment that connects face-to-face learning and online self-study. The teacher will be an intellectual guide. To enable students can apply concepts and creativity in various subjects.

The effective flipped classroom learning management model is based on learning management through constructivist theory (Constructivism), which focuses on learners building knowledge through experience and action through thought processes by linking previous experiences and real contexts to create new knowledge. The learning environment is meaningful for students regarding meaning making by stimulating problem situations (problem-based learning). It allows students to analyze problems and make alternatives. With a wide range of possibilities, decide on a context-appropriate approach to creating work in that learners must discover new knowledge by seeking answers from learning sources, collaborating to learn and solve problems, and exchanging ideas and cognitive processes. The teachers were coaches or guides who advised and encouraged learners to think to create knowledge independently. Reverse learning is another learning environment that integrates teaching and technology, as illustrated in the Learning Environment Framework for Inverted Classrooms (Kanjug, 2013).

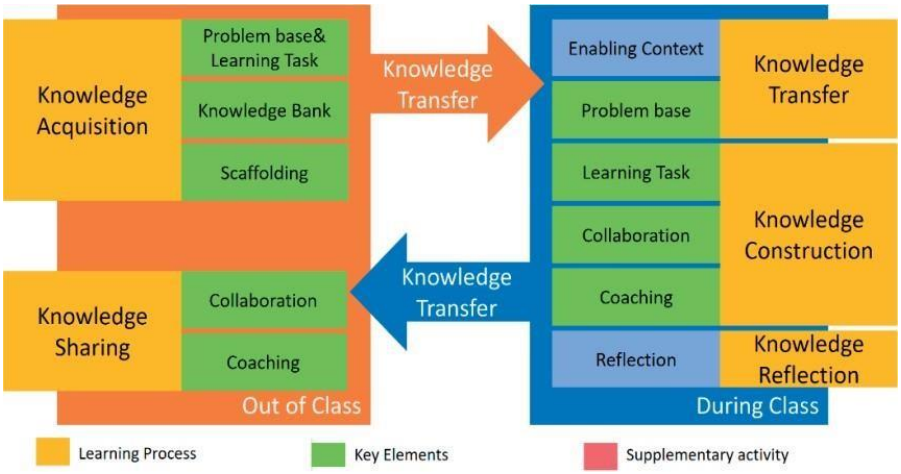


Figure 1. Demonstrate a conceptual framework for organizing the learning environment for the flipped classroom (Kanjug, 2013).

As shown in Fig 1, this learning management conceptual framework focuses on enabling learners to create experiences outside the classroom to gain basic knowledge or understanding of the content. Before expanding knowledge of concepts and depth through classroom activities, the students would go back to review the reflection about what they have learned after completing the course. Through this self-study outside the classroom, the learners will focus on developing the ability to transfer knowledge and experiences through self-learning outside the classroom and hands-on classroom activities (Kanjug, 2013).

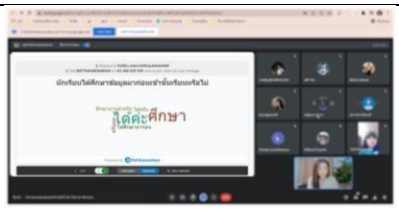
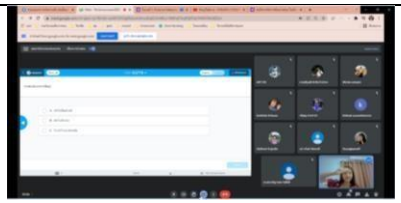
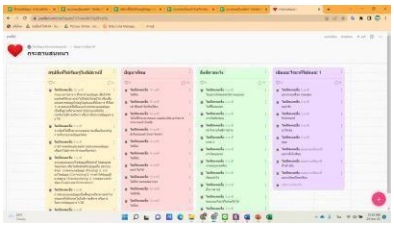
2.3 Analytical thinking

Analytical thinking is a rational expansion of thought. It applies the analytical process and the information's specifics based on knowledge. The original understanding accumulates in short-term memory in a small intelligence structure and independently generates new information. The students would be able to summarize the necessary specifics, characteristics, and unnecessary information (Marzano, 2001).

3. Methodology

3.1 The design Flipped classroom

Table 1: *An example of the learning process in Flipped English reading comprehension Learning classroom adapted from Kanjug et al., 2016.*

Components	Description of the learning process	Example of learning activity
Learning material: SOCIAL Classnet		
Out of Class (Pre-Class) Knowledge Acquisition (1) Problem base & Learning Task (2) Knowledge Bank (3) Scaffolding	The teacher explained how to use online learning. In SOCIAL Classnet format Based on the Constructivism Learning Environment Management System	
Learning material: Teaching reading comprehension as an Active Learning		
In class Knowledge Transfer - Problem base Knowledge Construction - Learning Task - Collaboration - Coaching Knowledge Reflection - Reflection	- 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 of the group. At the same time, the teacher will be a coach to provide guidance.	 
Out of Class (Post-Class) Knowledge sharing - Coaching - Collaboration	- Teachers are supportive, support and advise students. - Teacher and students share their knowledge, opinions, and questions about problems that arise while carrying out classroom activities through social media such as Facebook, SOCIAL Classnet, etc.	 

3.2 Experimental Research

This study aimed to examine the validity of flipped classroom learning materials to promote critical thinking in technology courses (Computational science). It consists of checking internal correctness and external validity check. The study in this phase consisted of two groups of students performing a quasi-equivalent control group design to examine analytical thinking and achievement. Moreover, they investigated the satisfaction of the learning environment. Experts validated the learning environment.

3.2.1 Participant

The two groups are in this study as follows:

- The experimental group: 23 students received the proposed learning environment.
- The Control group: 22 students receive the traditional learning environment.

Experts are the following:

- Expert in computational science and teaching
- Expert in Design and Educational Technology

3.2.2 Research Instrument

- A flipped classroom learning environment quality assessment form aims to measure analytical thinking in technology courses (Computational science) for experts.
- Technology Achievement Measurement Form (computational science)
- Analytical Thinking Ability Test
- Student satisfaction assessment form with a flipped classroom learning environment to promote analytical thinking in technology courses (computational science)

3.2.3 Data Collection and Analysis

1) Test before studying with an analytical thinking test and an achievement measure Technology (Computational Science)
2) Students in the experimental group study in the flipped classroom learning environment. The students in the control group studied in the usual way.
3) Students in the experimental and control groups test after studying with an analytical thinking test. and achievement model Technology (computational science) subjects and students in the experimental group took the satisfaction assessment after learning in the learning environment flipped classroom.

4. Results and Discussions

Regarding the student's analytical thinking, the researcher had to do the test after studying with a form to measure the analytical ability of the learners. It is a four-choice multiple-choice test created by the researcher by measuring the analytical thinking in 5 areas; there are 10 items, divided into 2 items each, with a total score of 25. The results are shown in Table 2.

Table 2. Students' analytical thinking results

Sample Groups	N	$\bar{x}$	S.D.	τ	Sig. (1-tailed)
Experimental group	23	21.85	2.40	9.048	.981*
Control group	22	14.20	3.21		

*.05

In scores of analytical thinking, the experimental group had a mean score after learning activities of 21.85, and the control group had a mean score after school of 14.20. When comparing the scores of the two groups, it was found that the mean scores for analytical thinking were a significant difference at the .05 level. These results reflect that the students have gained more analytical thinking from classroom activities, reinforcing their thinking process to solve problems.

According to the theory of constructivism, learners acquire knowledge by experiencing and developing their wisdom by themselves (Glasersfeld, 1991). Constructivism theory emphasizes developing internal knowledge related to previous experiences (Kanjug, 2004).

Learners should gather their perceptions together with understanding to create their cognitive structure (Chaicharoen, 2011).

The concept is turning the classroom lecture into classroom activities. The lecture should be done outside the classroom or through video and online media. By doing this, students will have more chances to participate and interact with their teachers and friends (Bergmann & Sams, 2012). Teaching has changed from direct instruction or passive learning to active learning in an interactive learning environment that connects face-to-face learning and online self-study. The teacher will be an intellectual guide. To enable students can apply concepts and creativity in various subjects (Kanjug, 2013), it allows students to view the content of the course lectures from media used outside the classroom. In the classroom, it is practiced to do homework problems. It is the concept of a Traditional Flipped Classroom (Patamathammakul, 2012). This study introduces a good combination of constructivist theory and flipped classroom model. Active learning by using new technologies or multimedia helps learners to access the world of knowledge easily, enhance their experience and finally acquire their intelligence.

In summary, this study designed and developed the flipped classroom learning environment to promote analytical thinking in secondary school students' technology course (Computational Science). This development could be beneficial for improving learners' ability to identify problems, analyze and create methods for solving problems by themselves, facilitate self-learning, and gain self-experiences.

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