



Research Article

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The Effects of the SPACE Learning Model on Learning Achievement and Innovation & Learning Skills in Higher Education

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Abstract

The objectives of this research were to develop a flipped classroom design, and to investigate the learning achievements and the innovation and learning skills of undergraduate students who had registered on a software engineering course which used the flipped classroom design. The suitability of flipped classroom lesson plans was evaluated by nine experts. The sample comprised 63 undergraduate students –33 students in the experimental group and 30 students in the control group - who had registered on the software engineering course in the first semester in 2017. The samples were selected by using the cluster random sampling method. The research instruments used were: (1) the flipped classroom lesson plans; (2) a multiple-choice learning achievement test, and (3) an evaluation form for learning and innovation skills rubric scoring. Mean (\bar{x}), standard deviation, and one-way MANOVA were used to analyze data. The results found that: 1) The suitability of the flipped classroom lesson plans was at a high level ($\bar{x} = 4.45$, $SD = 0.73$). 2) The learning achievement results and the innovation and learning skills of undergraduate students who studied software engineering by the use of the flipped classroom design were higher than those of undergraduate students in a normal classroom, with a level of significance of 0.05.

Keywords: Learning Management, Flipped Classroom, Learning and Innovation Skills, Higher Education

1. Introduction

In the 21st century, various learning management strategies have been suggested in order to allow the achievement of learners' goals in an extensive learning society. Strategies have focused on the creation and improvement of knowledge, skills, and capability by oneself, and are widely accepted

as student-centered learning. (Piaget, 1973; Vygotsky, 1978; Lea, Stephenson, & Troy, 2003; de la Sablonnière, Taylor, & Sadykova, 2009; Baeten, Kyndt, Struyven, & Dochy, 2010; Schweisfurth, 2011; Usaci & Niculescu, 2012). In the theory of constructivism, passive learners are transformed into active learners (Piaget, 1973; Vygotsky, 1978). The practice of this theory stimulates learners into creative thinking, problem analysis and solving, and knowledge synthesis. In accordance with this, Thailand's higher education policies have focused on student-centered learning, in order to build sustainable lifelong learning for development (Office of the National Economic and Social Development Board, 2012). Currently, progressive education in the 21st century (NCREL and the Metiri Group, 2003; LEAP, 2007; P21, 2015) focuses on life skills creation of all citizens. Hence, learning management was reformed by the education system of Thailand to focus on more student-centered learning concepts and technology utilization (OHEC, 2008; Office of the National Economic and Social Development Board, 2012). To do so, it was consistent with flipped classroom design (Bergmann & Aaron, 2012). The traditional teaching methods used were transformed into "Learning Space"—learners learn by themselves prior to class, understand the topic in detail, and are able to attain knowledge on their own. Teachers can build knowledge sharing among the learners, promote class activity in practical ways, and create more interaction among the classmates and the teacher (Bergmann & Aaron, 2012; Flipped Learning Network, 2014; Baepler, Walker, & Driessen, 2014; Chen, Wang, & Chen, 2014; Gilboy, Heinerichs, & Pazzaglia, 2015; O'Flaherty & Phillips, 2015; Scott, 2015).

In surveys of the preliminary study stage, the research results revealed that students on a software engineering course were not ready to learn new topics. Hence, the more time teacher spent on lectures, the less time there was for classroom activity. Due to the lack of team working, problem-solving analysis, and creative thinking, old knowledge was not able to be applied to other subjects. This problem appears to be the current situation for the learning management of higher education in Thailand (Banyen, Viriyavejakul, & Ratanaolarn, 2016; Phungsuk, Viriyavejakul, & Ratanaolarn, 2017). As a result, the researchers have developed a flipped classroom design in order to improve learning achievement, and learners were able to apply their knowledge to the learning process. Creative thinking, critical thinking, good communication, and working participation are an important key for learning and innovation skills. The research aimed to study the teachers and undergraduate students of the Bachelor of Science program, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, and to produce skilled computer users for the 21st century.

1.1 Research Objectives

1. To develop flipped classroom design in order to enhance innovation and learning skills for undergraduate students
2. To investigate the learning achievement and the innovation and learning skills of undergraduate students who studied software engineering through the use of flipped classroom design

1.2 Research hypothesis

The learning achievement and the innovation and learning skills of undergraduate students who studied on the software engineering course using a flipped classroom will be higher than those of students who studied with traditional teaching methods.

2. Literature Review

2.1 Design of the 21st Century Class Context

Student-centered learning management aims to focus on learning which is suited to a student's ability and interests. Students participate and take real action in learning until they can apply knowledge by themselves. In accordance with the student-centered learning concept, Lev Vygotsky

expressed that social interaction will be a necessary tool for the development of knowledge quality (Piaget, 1973; Vygotsky, 1978). The Constructionist theory of Seymour Papert, which was acquired from the constructivism theory of Piaget, explained the learning principals to support handmade or self-educating activities. In other words, interaction among external environments and the learners' knowledge and experience can be linked together to create new knowledge (Papert, 1980; Abeysekera & Dawson, 2015; Yap, Neo, & Neo, 2016). Flipped classroom design (Bergmann & Aaron, 2012) is a process that enhances students' learning; moreover, the students can create the meaning of their knowledge after performing activities. Knowledge is developed from the experience. Cooperative learning has meaning for various concepts of learning; a conceptual idea acquired from knowledge or idea sharing within group discussion (Pierce & Fox, 2012; Freeman Herreid & Schiller, 2012; Herreid & Schiller, 2013; Baepler, Walker, & Driessen, 2014; Howitt & Pegrum, 2015; Lai & Hwang, 2016).

To conclude, in student-centered learning designs, the role of the teacher is to be a facilitator and an assistant– to give students a chance to participate in activities. Learning activities for self-improvement are created to allow numerous choices for proper learning. The students can create links between old and new knowledge via using learning process created by the teacher.

The processes form a continuous cycle, supporting mutual learning; this conforms to the current situation of undergraduate students, who constantly need to improve their learning. It can be also called “Active Learning” (Eid & Al-Jabri, 2016; Fidalgo-Blanco, Martinez-Nuñez, Borrás-Gene, & Sanchez-Medina, 2017; Lea, Stephenson, & Troy, 2003).

2.2 Learning and Innovation Skills

21st century learning reform is based on the concept that skill and knowledge in the 21st century does not only focus on core subjects (NCREL and the Metiri Group, 2003; LEAP, 2007; P21, 2015). The most important life skills and working skills in the 21st century are learning and innovation skills, creative thinking, new innovation interests, critical thinking, problem-solving learning, explicit communication, working participation, and co-working appreciation (Marien, 2002; Loveless, Burton, & Turvey, 2006; Newton, 2013; Dwyer, Hogan, & Stewart, 2014; O'Flaherty & Phillips, 2015; Pásztor, Molnár, & Csapó, 2015; Jena, 2015). All of these skills are important for those learning software engineering in knowledge development, and it is necessary to improve learning procedures in order to get in line with the present age. The learning skills of students are flexible, creative, and challenging. As students learn how to solve problem from errors, the experiences gained for living in the 21st century are high-quality.

In conclusion, learning management, which promotes students to “learn how to learn”, is required in order to break the limitation of the traditional classroom, where learning are passive. Lecturers have changed their paradigm for the learning management of active learners and self-learners. Teachers act as advisers. Learners are able to use technology as a tool to seek knowledge and create their work through participatory learning. On passing the particular course, learners gain originality and practical skills. Knowledge from experience can be created by oneself.

3. Methodology

The method and research, and development (R&D) of Borg and Gall was applied to this research study (Borg, Gall, & Gall, 2007). There were three phases of this study; (1) A preliminary study stage, (2) a model development stage, and (3) a model dissemination and implementation stage. This research article was initiated through the preliminary study stage in order to find data or information regarding instructional problems and the current state of guideline models Hence, phase 2 and phase 3 were processed as follows:

3.1 Model Development Stage (Phase 2)

Researchers developed a flipped classroom design to enhance the innovation and learning skills of undergraduate students; the details are presented below.

3.1.1 Expert

A draft itinerary of the learning activities used in the preliminary study stage is shown in Figure 1. Lesson plans were proposed to nine experts, professors who had applied flipped classroom design in their classes. To accurately assess and evaluate, professors who had more than 5 years of experience in teaching software engineering and system design and analysis were required. According to the learning evaluation form, learning management was considered in terms of the components within the lesson plans.

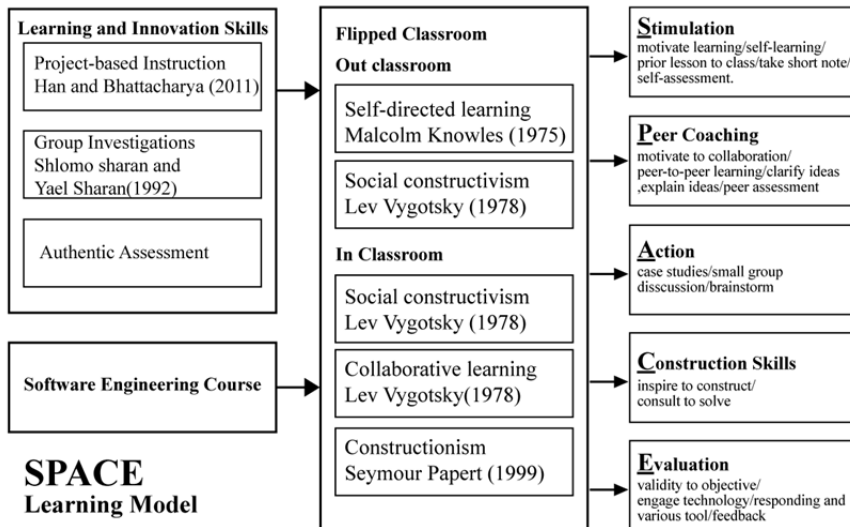


Figure 1: SPACE Learning Model for Flipped Classroom.

3.1.2 Instruments

1. Lesson plans: Six lesson plans were examined by the professors, who were responsible for software engineering and system design and analysis, in details of content validity, accuracy, language used, and learning activities.
2. Flipped classroom 5-scale evaluation form: The evaluation form aimed to study the components of lesson plans, learning objectives, learning points, processes of learning management, media and learning resources, and learning assessments. The form contained 40 items; the IOC value was examined by 5 experts, with the result being a value of 0.60 – 1.00.
3. Learning achievement test: A 4-multiple choice test composed of 45 items. IOC value, which was examined by 5 experts, was 0.60 – 1.00.
4. An evaluation form for innovation and learning skills: A rubric scoring system with 9 items. The IOC value was assessed by 5 experts and was 0.60 – 1.00. There were 5 levels for scoring criteria to assess innovation and learning skills- (4) highest, (3) high, (2) medium, (1) fair, and (0) needs to be improved.

3.1.3 Data collection

1. The result from the preliminary stage was used to create lesson plans, evaluation forms for lesson plans, learning achievement tests, and evaluation forms for innovation and learning skills.

2. The researchers proposed the lesson plans to the experts. After the evaluation, the suitable values of the flipped classroom design was at a high level (\bar{x} = 4.45, SD . = 0.73).
3. Formative evaluation (Dick, Carey, & Carey, 2014) was used to examine the flipped classroom lesson plans. Then, they were applied in the trial procedure, as shown below.
 - In the system analysis and design course, three students and a teacher were selected in order to test their content knowledge. Video content was developed and designed using PowToon, an application for making videos. The length of each clip was approximately 4 – 7 minutes. In the beginning, there was an introduction to the learning activities and of the teacher and students. The duration of the experiment was 1 week. Recommendations were acquired from the students and teacher. The students recommended that “having videos for each chapter was really interesting, but subtitles should be added for reading, and the speed of the videos should be slower”. The teacher said that “for the media I have made, I wish it could be watched online, and students were able to answer the question”.
 - After successful editing, it was trialed using nine undergraduate students, who were not in a sample group, to find errors in the learning media, duration, and learning activities. This took place over about 2 weeks. The recommendations which were acquired from the students and a teacher are presented as follows:
For students, “learning content should be up-to-date and able to be applied in daily life effectively”.
For teachers, “scoring criteria should be consistent with software development procedure and there should be more activities added so that the students can practice the skills needed for software development”.
 - To find instrument quality, the research instruments were tried out on 30 undergraduate students who were not in a sample group. The experiment took 180 minutes per student, and was tested for 6 weeks. The details below show the research methods:
 - a. This was done to clarify the research objectives and the flipped classroom design for the experimental group.
 - b. The students in the experimental group completed a pre-test, consisting of 45 items, for 60 minutes, before they used the flipped classroom design.
 - c. Teachers treated their experimental group according to the SPACE Learning Model; the details are presented below.
 - d. After the flipped classroom design had been used, the undergraduate students in the experimental group took a learning achievement test, containing 45 items, for 60 minutes.

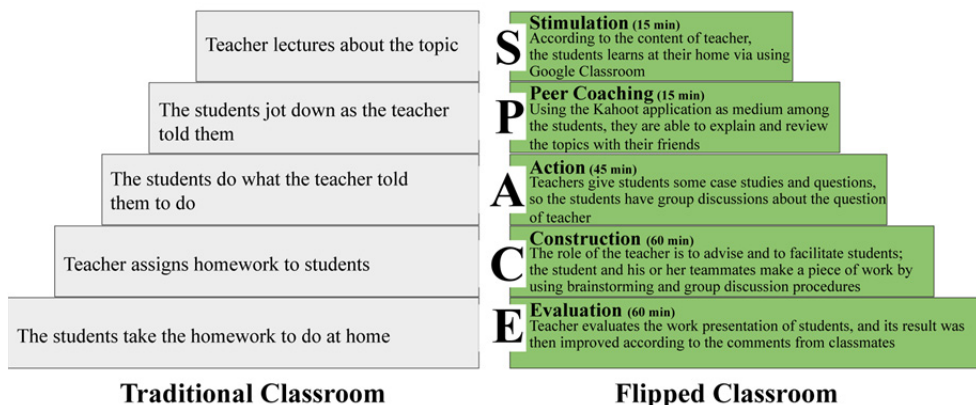


Figure 2: Traditional Classroom VS SPACE Learning Model for Flipped Classroom.

All three procedures of formative evaluation were undertaken. From content analysis, taken by interviewing, the details used for the development of the flipped classroom lesson plans were revealed as follows; the students put an emphasis on adding subtitles, the speed of video presentations, and details being up-to-date. In the tryout session, the students were shy to participate in classroom activities in the first and second experiments. For example, the students rarely gave or shared their opinions to or with their friends. According to the teachers' requirement, students were able to access online videos and give their opinions related to evaluation criteria consistency; moreover, the activities were added to enhance software design skills. The data analysis derived from the quality check of the research instruments comprised validity, reliability, difficulty, and discrimination.

3.2 Model Dissemination and Implementation Stage (Phase 3)

To compare the learning achievement results and the innovation and learning skills of undergraduate students who studied the software engineering course using the flipped classroom design.

3.2.1 Populations and Samples

Selected by using cluster random sampling, the samples comprised 134 undergraduate students who had registered on the software engineering course, Semester 2, 2016, in the Faculty of Science, King Mongkut's Institute of Technology Ladkrabang. From a total of 63 students, they were divided into two sections; 33 students in the experimental group, and 30 students in the control group.

3.2.2 Instruments

1. Flipped classroom lesson plans
The content of the six lesson plans consisted of software requirements, software analysis model 1, 2, 3, software and architectural structure design, and user interface design.
2. Learning achievement test
The test was a 4-multiple choice question which contained 45 items. The 50 percent technique was used to find the difficulty and discrimination values (incorrect = 0 and correct = 1). The difficulty value was 0.27 – 0.63; the discrimination value was 0.27 -0.67. After testing reliability, the alpha coefficient: alpha of Cronbach was 0.80.
3. Innovation and learning skill evaluation form
The form was a rubric scoring criterion which contained 9 items. For example, a scoring guide used to assess against a set of criteria shown in Table 1.

Table 1: Rating scale for learning and innovation skills

Rating Scale	Assessing the learning and innovation skills of the issues
Creatively and Innovation: Creative thinking	
Standard of excellence (4)	Student able to: - Show collaborative with members for support ideas such as use of brainstorming techniques. - Show inspire concept to adapt and/or apply to create something new such as process flow of business flow. - Show how to methods apply the concept to the development of the projects properly.
Approaching standard of excellence (3)	Student able to: - Show collaborative with members for support ideas such as use of brainstorming techniques. - Most show inspire concept to adapt and/or apply to create something new such as process flow of business flow. - Most show how to methods apply the concept to the development of the projects properly.
Meets acceptable standard (2)	Student able to: - Show collaborative with members for support ideas such as use of brainstorming techniques. - Sometimes show interpretation concept to adapt and/or apply to create something new such as process flow of business flow. - Sometimes show how to methods apply the concept to the development of the projects properly.

Rating Scale	Assessing the learning and innovation skills of the issues
Does not yet meet acceptable standard (1)	Student able to: - Show collaborative with members for support ideas such as use of brainstorming techniques. - Little or no inspire concept to adapt and/or apply to create something new such as process flow of business flow. - Little or no how-to methods apply the concept to the development of the projects properly.
Not meeting (0)	Students not able to: Show collaborative with members for support ideas such as use of brainstorming techniques. Show inspire concept to adapt and/or apply to create something new such as process flow of business flow. Show apply the concept to the development of the project.

3.2.3 Data collection

1. This concerned the introduction of the flipped classroom design and the role of teacher and students.
2. Before starting the learning process, both groups of students had to take the learning achievement test.
3. The teacher taught his/her class by using the SPACE Learning Model, which was according to the six lesson plans, taking 180 minutes for each, for 6 weeks; then, the researchers and the teacher observed students' behavior during the class activities and evaluated innovation and learning skills.
4. When the program was successfully completed, the researchers asked both the experimental and control groups to take the learning achievement test.

3.2.4 Data analysis

1. Mean (\bar{x}) and standard deviation (*SD.*) were used to study the suitability of the flipped classroom lesson plans.
2. One-way MANOVA was used to compare the learning achievement and innovation and learning skills of the undergraduate students who were taught using the flipped classroom design.

4. Research Results

4.1 Model Development Stage

The flipped classroom design was derived from the SPACE Learning Model.

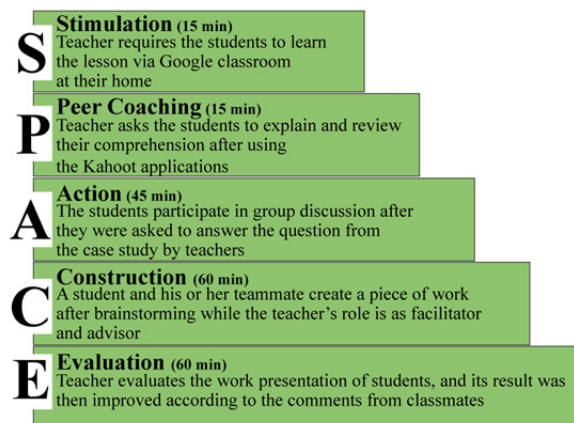


Figure 3: SPACE Learning Model for Flipped Classroom

The data was analyzed by using a flipped classroom learning evaluation which was derived from the SPACE Learning Model, provided by the experts. The results analysis is presented in Table 2.

Table 2: Evaluation of six flipped classroom lesson plans, provided by experts.

Item	\bar{x}	SD.	Suitability
1. Components of lesson plans	4.35	.11	High
2. Learning objectives	4.43	.09	High
3. Learning content	4.56	.11	Highest
4. Learning management	4.53	.07	Highest
5. Media and learning resources	4.47	.09	High
6. Learning evaluation	4.41	.09	High
Total	4.45	.07	High

From Table 2, the sum evaluation of the flipped classroom lesson plans, evaluated by the experts, was on average 4.45 ($\bar{x} = 4.45$, $SD. = 0.07$). The learning content and learning management were at the highest suitability at 4.56 ($\bar{x} = 4.56$, $SD. = .11$) and 4.53 ($\bar{x} = 4.53$, $SD. = .07$), respectively.

4.2 Model Dissemination and Implementation Stage

The average scores of the learning achievement test from the undergraduate students in the control and experimental groups were compared to analyze the data. MANOVA analysis was used to test the preliminary agreement. The test results are presented in Table 2.

Table 3: Test results of preliminary agreement by MANOVA analysis.

	Normal Distribution		Pearson Correlations	Box's M Test (Sig.)	Bartlett's Test (Sig.)	Levene's Test (Sig.)
	Skewness	Kurtosis				
Achievement	-0.281	-1.68	.785**	.739	.000	.966
Innovation and Learning Skills	-0.509	-1.084				.679
Results	Normality	Normality	.785 < .80	Sig. > α	Sig. < α	Sig. > α

$\alpha = .05$

From Table 3, the preliminary testing result by MANOVA analysis and correlation of the findings of variables should be lower than 0.80 (Pallant, 2005) hence, it is able to analyzed using MANOVA and is consistent with preliminary agreements. Therefore, one-way MANOVA was used to analyze the data, and the results are shown in Table 4.

Table 4: Average scores and standard deviations of learning achievements and innovation and learning skills after students were taught (group classification)

Dependent Variable	Independent Variable	n	Scores (100)		F	Sig.	Compare
			\bar{x}	SD.			
Achievement	Experimental	33	89.90	2.30	500.10	.000	E > C
	Control	30	71.70	2.33			
Innovation and Learning Skills	Experimental	33	68.77	6.21			E > C
	Control	30	52.78	7.37			

$\Lambda = .057$, $F = 500.102$, $Sig. = .00$, $\alpha = .05$

E = Experimental, C = Control

From Table 4, the differences in the learning achievement results and the innovation and learning skills between the students in the control group and the experimental group were tested by using Wilks' Lambda, with the result that $\Lambda = .057$, $F = 500.10$, $Sig. = .00 < \alpha (.05)$. The learning achievement results and the innovation and learning skills of both groups of students were significantly different at .05 levels of significance. To conclude, at least one learning method affected the learning achievement results; moreover, at least 1 variable of the innovation and learning skills was

significantly different from other learning methods at .05 levels of significance.

As an overall image, the results show that the learning achievement score of the experimental group was higher than that of the control group. After detailed consideration, the learning achievement score of the experimental group, which was 89.90 ($\bar{x} = 89.90$, $SD. = 2.30$), was higher than the control group's score, which was 71.70 ($\bar{x} = 71.70$, $SD. = 2.33$). The average score for innovation and learning skills for the experimental group, which was 68.77 ($\bar{x} = 68.77$, $SD. = 6.21$), was greater than the control group's score, which was 52.78 ($\bar{x} = 52.78$, $SD. = 7.37$). In conformity with the research hypothesis, the learning achievement results and the innovation and learning skills of the undergraduate students who were taught using the flipped classroom design (the experimental group) was higher than the students' result when taught using traditional classroom methods (the control group).

5. Discussion

The objectives of this research were to develop a flipped classroom design, and to compare the learning achievements and the innovation and learning skills of undergraduate students who had registered on a software engineering course using the flipped classroom design; a discussion session is below.

5.1 SPACE Learning Model

According to the research hypothesis, the learning achievement results and the innovation and learning skills of the undergraduate students who were taught using the flipped classroom design on the software engineering course was higher than the students' result from being taught using traditional classroom methods, at .05 levels of significance. With the flipped classroom design, the learning method focused on student-centered learning and promoted self-education (Bergmann & Aaron, 2012; Brahim & Sarirete, 2015; Gilboy, Heinerichs, & Pazzaglia, 2015). Because of the SPACE Learning Model, the students responded well to learning developments. The model began with a stimulation phase. To enhance and promote self-education responsibility in students, the teacher provided them with interesting and up-to-date media for learning beyond the classroom. Moreover, students would not get bored with learning, and they could review lessons whenever they wanted. Hence, this was the beginning of peer coaching. The classroom activities involved a learner-teacher knowledge sharing method. Teachers encouraged students to share knowledge, give opinions, and explain what content they understood. Using the "Kahoot!" application as a medium to stimulate students and to give them a chance in classroom activities, students were able to review and understand content more. When students had accurate basic knowledge, and it was sufficient for their needs, it led to the action process. In group activities (6-7 students per group), a case study of daily life was given to students, to discuss the solutions to the problems posed; students themselves produced systematic thinking to apply it to their daily life. In order to make students familiar with the construction skills of procedures in system development, teachers usually promoted students' thinking and gave them advice. In practical activities, students learned how to work systematically from their own learning, and had the ability to communicate, think, analyze, and solve problems. They were able to communicate and to work as a team with their classmates. The last part of the learning procedure was an evaluation. Although the teacher evaluated the students' work according to the criteria, the teacher also gave the students a chance to comment on their classmates' work. Those comments could form a good springboard for future work development. Using the flipped classroom design, the teacher had more time to do activities in the classroom, and it was suitable for teaching in higher education, because the students had self-responsibility (Barber, King, & Buchanan, 2015; Binkley, et al., 2012).

The researchers used Google classroom, and the "Kahoot!" application was applied as a medium between the teacher and the learners. The results indicated that students sought new knowledge before arriving for class, and they had a chance to learn from the activities in the classroom with the teacher's advice. Both parts of the details promoted interactive learning,

between learner-learner and learner-teacher. The research of Abeysekera & Dawson (2015) found that the flipped classroom method can produce student learning motivation, learning happiness, and gains in knowledge from video presentations. Because of self-education, authentic learning and improved learning achievement occurred. Also, the results found that students had more interaction among their friends and with the teacher (Baepler, Walker, & Driessen, 2014; Chang & Yu, 2015). The research of Brahimi and Sarirete (2015) expressed that learning beyond the classroom via MOOCs was a flexible form of knowledge allowing access to all data and resources. Thuy, Thai, De Wever, and Valcke (2017) studied the effect of using flipped classroom design in higher education. The results of the study showed it tended to improve the learning efficiency of students (Thuy, Thai, De Wever, & Valcke, 2017). Şengel (2016) studied the effectiveness of flipped classroom design with Problem-Based Learning and cooperative learning, compared with traditional learning design, and the results showed that learners have to adjust themselves to the new system in the beginning. Learners have to be responsible for their own learning (Şengel, 2016). Giving students a chance to learn from classroom activities can reduce the gap between a student and their teammates.

5.2 Enhanced Learning of Innovation and Learning Skills

From the research results, the score of the innovative and learning skills of undergraduate students who were taught using the flipped classroom design on the software engineering course was significantly higher than the score of students in the traditional classroom, at .05 levels of significance, because the flipped classroom design aimed to enhance the students' critical thinking. The learning management also enhanced the students in terms of content knowledge, and aimed to improve their ability by allowing them to take action in classroom activities (Abeysekera & Dawson, 2015; Chen & Law, 2016; Davies, et al., 2013; Dwyer, Hogan, & Stewart, 2014). Hence, the students properly responded to learning skill development. The interactive learning between learners and the teacher, and knowledge sharing, both within and beyond the classroom, were able to improve students' self-education ability. Using technology in classroom activities, students will be enthusiastic and pay more attention to study within the class (Pierce & Fox, 2012; Pohl, et al., 2008; Qian & Clark, 2016; Zhang, Liu, & Wang, 2016). To do the class activities, students will learn how to work systematically. They can produce a piece of work from their thinking procedure by having the learning activities connected to real situations, and they can apply it to their daily life.

This was a part of the process to produce knowledge sharing and transfer. After using brainstorming and group discussion, the research results of Unin & Bearing (2016) found that students can get along well with their teammates, respect teammates' opinions, and share their new concepts or knowledge with their teammates (Unin & Bearing, 2016). The ability to think, analyze, and solve problems occurred in students after learning. Using a case study as an example during learning activities, the students can compare concepts or opinions which are similar to the case study of teachers, such as the components of system development and problem perception. In order to specify possible methods used for that problem solving, the alternatives are compared to find pros and cons; moreover, that option should match problem-solving objectives. The process as mentioned is required in software development, so that students can apply knowledge to their work operations in the future.

Brainstorming and small group discussion technique can improve project presentation quality. The students can achieve the target of communication. Students can give their opinions as it is not too difficult to use new presentation methods, like mind maps, as opposed to paper reports.

While classmates are presenting their works, the other students should listen and in order to produce knowledge using their own ability. Moreover, group members are responsible for their own missions or tasks (Barki & Pinsonneault, 2001; Bell, 2010; Garrido, Morales, & Serina, 2016; Coll, Rochera, & de Gispert, 2014; Scherer & Gustafsson, 2015).

6. Conclusion

Using flipped classroom design enhanced students' 21st century skills, which are necessary skills

for all students to connect and reduce the knowledge gap. The skills that students learned from the educational institute and the skills needed in the 21st century were suitable for learning in higher education. The flipped classroom design heightens students' learning method production, innovation and creative thinking, critical thinking, communication problem-solving, and working participation. The techniques in this procedure improved students' procedure in terms of knowledge-seeking.

Additionally, it could transform the traditional teacher role into that of a facilitator, and the teacher was able to cooperatively learn with the students. Hence, the more the teacher and the students get closer, the more the teacher perceived and understood the learning problems of students.

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