The Study of Teaching and Learning Process by Using Blended Learning Method in Engineering Classroom

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Abstract

The traditional lecture-based classroom which is passive direction without any interaction between learners and learners or between learners and instructor. From this problem, blended learning is adopted widely in educational settings. The blended courses have increased in higher education (HE) over the past decade. This practical action research aims to implementation of blend learning to engineering classroom to gain both learning efficient and positive classroom atmosphere. The population was bachelor students at the school of Telecommunication Engineering, Suranaree University of Technology (SUT). The main classroom activities are the integration of a face-to-face lecture, simulated laboratory and self-studying via computer and electronic mediated. To evaluate the effectiveness of blended learning, we consider statistical analyzation of assessment. Furthermore, students' satisfaction was evaluated for improvement of the next class. The research found that pretest and posttest assessment results of the blend learning classroom are significantly developed. The statistical relation indicated the high opportunities for students to get pass level of the course. Furthermore, the students' satisfaction was significantly higher than the much level.

Keywords: Teaching and Instruction, Blended Learning, Engineering Classroom

Introduction:

At the present day, information and networking technology is rapidly developed including various applied software. Deploying advantages of information and networking technology to education term can assist learners to conveniently access education resource anytime and anywhere. Moreover, it can infinitely expand education and learning opportunities. To develop teaching and learning process, integration of face-to-face based learning (both lecture and laboratory activities) and electronic learning media (e-learning). The objective aims to encourage learners to gain responsibilities, self-controlling, and practical skill-based on the blended learning method.

Telecommunication Networks is one of the compulsory elective subjects in the curriculum of Bachelor of Engineering (Telecommunication Engineering), Suranaree University of Technology. The objective of the course is to gain basic knowledge in terms of data communication and networks and apply to telecommunication networks. The course description is Architecture and standard of telecommunication networks e.g. IEEE 802 standard, current telecommunication network and future trend, wired network, wireless network, core network, access network, the efficiency of various network types, design and application of network.

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From teaching and learning results of the Telecommunication Networks subject in the previous trimester, trimester 2 of the academic year 2018, the lectured based method was deployed in this trimester which was a passive learning method. The observation of the instructor found that there was less attention of students. Besides, the learning pyramid of NTL Institute, USA present that the lecture-based method can lead 5% of learning efficient which is the lowest efficient method as shown in Figure 1.

To encourage students' ability in term of self-study, critical thinking, life-long learning, the blended learning is deploy to the Telecommunication Network subject in the current trimester, trimester 1 of academic year 2019, Furthermore, the practicing skill is embedded to the classroom to gain up to 75% of learning efficient as presented in learning pyramid. This research study the effects of blended learning which include classroom activities, self-learning, laboratory and compare with the lecture-based method in the previous trimester.

Section 2 introduces the objectives of the research. Section 3 demonstrates the literature review related to blend learning. The method is presented in Section 4. Section 5 presents the results of the evaluations. The discussions are presented in Section 6. Finally, Section 7 gives the conclusion.

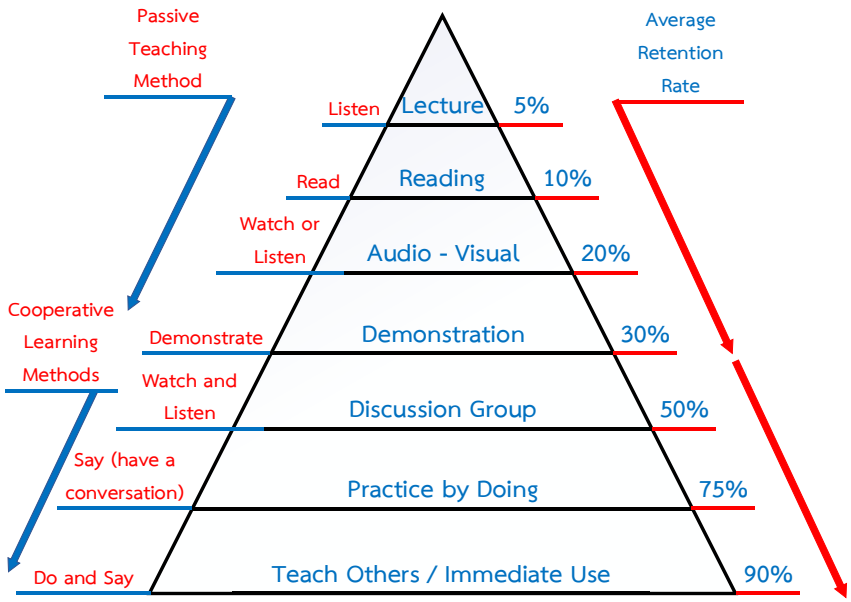

Figure 1: Learning Pyramid (Adapted from Al-Nasr, A. B. A. A., 2017)

Objectives:

1. To compare students' learning output between before and after deploying blended learning technique.

2. To study student' s satisfaction in teaching and instruction based on blended learning technique.

Literature Review:

There are various descriptions of blend learning depended on users and applying. Halverson, L. et. al. (2017) describes that blend learning is merging of online content and face-to-face teaching including classroom interaction. These factors affect learners' reflection and enhancing cooperative learning among learners which can lead to the expansion of knowledge. Okaz, A. A. (2015) said that blend learning is using technology to support the learning of learner. The tasks are set up with related material related to classroom activities. Dias, S. B., and Diniz, J. A. (2014) described that blend learning is merging of

classroom face-to-face activity and computer-mediated activities and embed into learning. The digital media is extra-learning media.

Elements of blend learning were described by Carman (2005). There was integrated of various theory including motivation theory (Keller, 2006) and learning theory of Gagne' , Bloom, Merrill, Clark and Gery (Educational Origami, 2012) . There are five components of blend learning including live event, self-paced learning, collaboration (learners-learners and learners-instructor), assessment and performance support materials.

Method:

This research focused on implementing blend learning into Telecommunication Networks class. There is integrated of face-to-face learning, electronic media and practical laboratory as shown in Figure 2.

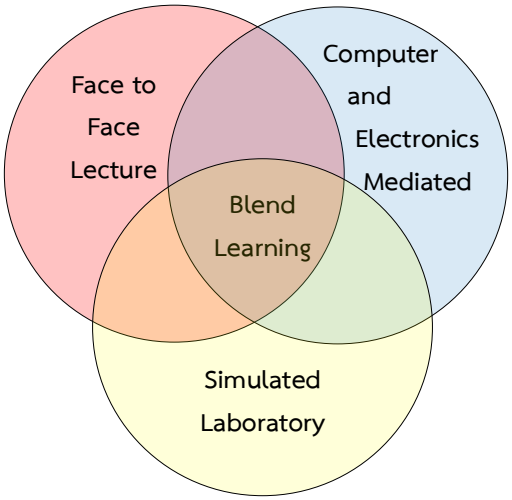

Figure 2: Activities which implemented to blend learning

Classroom activities separated by each lesson of Telecommunication Networks subject were presented in Table 1. The core activities were lecture and laboratory. Google Classroom was the main media of the class to allow student access class content anytime and anywhere. Online video was support media to prepare students before start lesson and review content after the lesson. The group discussion, exercise, and homework were operated and submitted via Google Classroom as well.

Table 1. Blend learning activities separated by lesson.

Lesson/ Activity	Lecture	Simulated Laboratory	Online Video	Online Group Discussion	Exercise	Homework
Lesson 1	✓	✓	-	✓	✓	-
Lesson 2	✓	✓	-	✓	-	-
Lesson 3	✓	✓	✓	✓	-	✓
Lesson 4	✓	✓	✓	✓	-	✓
Lesson 5	✓	✓	✓	✓	-	-
Lesson 6	✓	✓	✓	✓	-	✓

Table 2. Teaching and instruction plan of blend learning in Telecommunication Network subject trimester 1/2019.

Week	Day/Month (2019AD)	Lesson	Topic
1	July, 25	1	Introduction to Telecommunication Network, IP address calculation, Basic router configuration
2	August, 1		
3	August, 1	2	Basic Routing, Static Route, Default Route, Dynamic Route
4	August, 8		
5	August, 15	3	Access control list (ACL), Network address translation (NAT)
6	August, 29		
7	September, 5	4	Basic switch configuration, Spanning tree protocol (STP), Ether Channel
8	September, 12		
9	September, 19	5	Virtual LAN (VLAN), Trunk, Inter- VLAN
10	September, 26		
11	October, 3	6	Wireless LAN configuration, IP phone configuration
12	October, 10		

1. Population and Subjects

The number of subjects or sample size should accurately represent the population. We basically defined sample size using criteria definition method. Ekakul, T. (2000) present that for hundred of population, minimum sample size should be higher than 25%.

1.1 Population in this research are 118 senior undergraduate students from major of Telecommunication Engineering in trimester 1/2019.

1.2 Subjects in this research are senior undergraduate students from major of Telecommunication Engineering who register Telecommunication Network subject. There are 47 students in trimester 1/ 2019 which are recruited by purposive sampling method. The sample size is 40% of total population which higher than the threshold of the criteria definition method.

2. Methodology of the study

Designing tools for data collection are including 1) Achievement tests 2) Evaluation form of satisfaction to blend learning 3) Teaching and instruction plan of blend learning as shown in Table 2. Moreover, we use formative assessments including pre-test and post-test of each class. Furthermore, we evaluate satisfaction of students to blended learning during and end of the trimester. Finally, data was analyzed by comparing the learning achievements of pre/ posttest and learning satisfaction of blend learning

Results:

In this section, we present assessments in perspective of formative assessment (Dixson, D. D., & Worrell, F. C., 2016). Moreover, **feedback** from students was evaluated using a survey evaluation form (Hornstein, H. A., 2017) as follows.

1. Assessment

We deploy a formative assessment by conducting pretest and posttest of each lesson in trimester 1/ 2019. In each test, there are five questions of multiple choices online-based exam. The pretest and posttest score were compared by t-test as shown in **Table 3.** Furthermore, the descriptive statistic of difference between pretest and posttest score is presented in **Table 4.**

Table 3. T-test results for formative assessment between pretest and posttest examination in trimester 1/2019.

Course Detail	Pre-test		Post-test		$\overline{D}$	$S.D._D$	t	Sig.(1-tailed)
	Avg.	S.D.	Avg.	S.D.				
Lesson 1	1.19	0.95	3.19	1.01	2.00	1.47	9.30	.000**
Lesson 2	1.26	1.77	3.04	1.32	1.79	1.49	8.23	.000**
Lesson 3	1.32	0.59	1.62	1.01	0.30	1.14	1.79	.004**
Lesson 4	1.60	1.26	3.94	0.32	2.34	1.29	12.44	.000**
Lesson 5	1.28	1.08	3.09	1.28	1.81	1.86	6.66	.000**
Lesson 6	1.49	1.08	2.51	1.08	1.02	1.57	4.47	.000**

* Statistical significant at 0.05 level,

** Statistical significant at 0.01 level

Table 4. Descriptive statistic of pretest and posttest examination in trimester 1/2019.

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	47	3	15	8.13	2.551
Posttest	47	8	22	17.38	3.392
DiffPrePost	47	0	19	9.26	4.366
Valid N (listwise)	47				

Table 4 presents the difference score between pretest and posttest of blend learning. The total score of both pretest and posttest is 30. The relationship of learning development is indicated as pass and fail opportunities with S-curve graph as shown in Figure 3.

From S-curve in Figure 3., we present relation of difference score between pretest and posttest (which it was affect from blend learning approach) with their pass and fail opportunity in Equation (1) including Table 5 and Table 6.

$$\ln(\text{PASSFAIL}) = \exp(0.07880923299225595 + -4.898328373596791 / \text{DiffPrePost}) \quad (1)$$

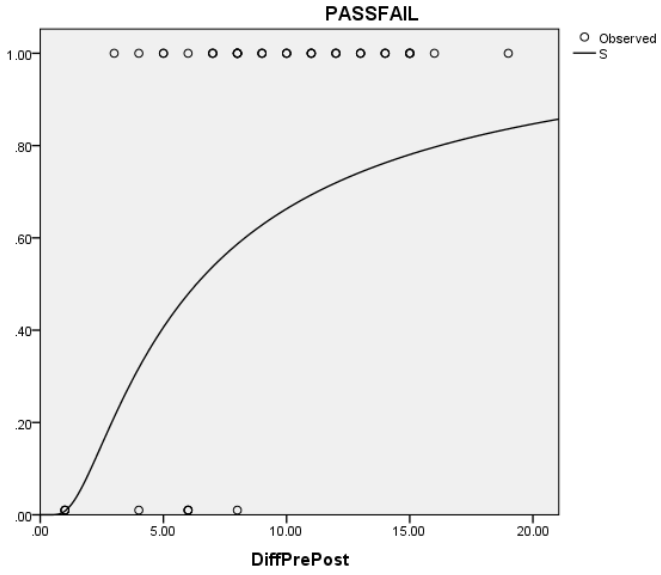

Figure 3: Learning development presented in statistical relation of S-curve.

Table 5. Competencies of forecasting.

R	R Square	Adjusted R Square	Std. Error of the Estimate
.629	.395	.382	1.376

The independent variable is DiffPrePost

Table 6. Coefficient of S-curve equation and statistical significant.

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 / DiffPrePost	-4.898	.903	-.629	-5.422	.000**
(Constant)	.079	.256		.308	.760

The dependent variable is ln(PASSFAIL).

Table 7. Students' satisfaction on teaching and learning process (Test Value = 3.5)

Trimester 1/2019	**N**	**Mean**	**S.D.**	**t**	**Sig. (2-tailed)**
1. Inform objectives and purpose of the course.	47	4.32	0.68	8.49	.000**
2. Organize learning activities focus on student interaction and participation.	47	4.26	0.66	8.09	.000**
3.Deploy media and technology or innovation to classroom.	47	4.42	0.61	10.68	.000**
4. Invite experts from external organization for co-teaching and gain real skill.	47	4.12	0.80	5.49	.000**
5. Variety of teaching technique related to content.	47	4.26	0.75	7.16	.000**
6. Encourage learners to develop critical thinking, Q&A and express opinions.	47	4.14	0.90	5.01	.000**
7. Organize learning activities to motivate self-learning.	47	4.28	0.86	6.43	.000**
8. Promote continuously research and knowledge discovery.	47	4.18	0.80	6.01	.000**
9. Organize learning activities to motivate international environment.	47	4.12	1.00	4.37	.000**
10. Integrate teaching and learning activities with society contribution, research or cultural preservation.	47	4.02	1.04	3.54	.001**

** Statistical significant at 0.01 level

2. Teaching Evaluation

Feedback from student is very important to improve the teaching method of the instructor in the next classroom. There are 10 items of classroom evaluation survey which are students' satisfaction to the instructor of Telecommunication Networks subject. Students evaluated each item on the survey, with 1, 2, 3, 4 and 5 as not at all, little, moderately, much and very much respectively. We compared the evaluation results of blend learning classroom in trimester 3/2019 with a 3.5 score (the much level) as shown in **Table 7.**

Discussion

As seen in Table 3, the statistical parameter including average and S.D. of pretest and posttest score from six lessons in the Telecommunication Networks subject are presented. The average posttest score is higher than the average pretest score in every lesson. Furthermore, we statistically analyze the output of the assessments using t-tests (≥ 0.05) and one-tailed test (≤ 0.01) for formative assessment. The results show that the posttest score of implementing the blend learning method in trimester 1/ 2019 demonstrate significantly higher than the pretest score in every lesson. In addition, Table 3 shows the average posttest score was 17.38 of 30 which higher than half of the total score at 15. This indicated the development of learning by implementing the blend learning method.

We continue to analyze the result of the difference between pretest and posttest by S-curve graph in Figure 3 including competencies of forecasting and coefficient in Table 5 and 6 respectively. R parameter in Table 5 can confirm the competencies of forecasting. The coefficients presented in Table 6 verify the significant as well. The results of our study have the same direction with the research of VictoriaLópez-Pérez M., et. al. (2019). They presented that the use of blended learning has a positive effect in reducing dropout rates and in improving exam marks.

We indirectly evaluated students' satisfaction with the classroom focusing on instructor using an online evaluation survey. From surveying results shown in Table 7, the average students' satisfaction score of trimester 1/2019 is on the much level for every item. In addition, the evaluation score of the blend learning method in trimester 1/2019 is significantly higher than the much level threshold (3.5 scores). This shows the good effect of blend learning to the class environment. Besides our study, the attitude and opinion of undergraduate students to the blend learning method was evaluated in many research works. Bonnapasut, P. (2015) researched at Sripratum University, Thailand. She found that the appropriated evaluation level of students and instructors was in the high respectively. However, the blended learning did not accomplish for postgraduate school level. Kistow, B. (2011) implemented blend learning in the postgraduate classroom and found that it is very important for postgraduate students to interact with their peers and engage in classroom discussion.

Conclusion

This research presented the study of teaching and learning process by using blended learning method in the engineering classroom. We conducted blend learning into the Telecommunication Network class in trimester 1/ 2019. The core activities in our blend learning method were a face-to-face lecture, simulated laboratory and self-studying via computer and electronic mediated. There were formative assessments and students' satisfaction. The results showed that blend learning lead significantly higher posttest output of formative assessment comparing to the pretest. The statistical relation indicated the high opportunities for students to get pass level of the course. Besides, the students' satisfaction score of blend learning method was in a much level. This can present the success of blend learning implementation to the engineering classroom.

Recommendation

1. Application;

The blend learning activities including a face-to-face lecture, simulated laboratory and e-learning can gain both learnings efficient and positive classroom atmosphere. This founding can use to improve and design the subjects in engineering courses especially for subjects in the last year. The laboratory should be embedded into the course to gain attraction from students. For example, the pure lecture subject may be improved to lecture and laboratory subjects. Student can improve practical skill before graduate

and start work. Furthermore, the lecture method can be supported by e-learning in some content which can reduce the working load of instructors. However, the face to face classroom is still necessary for the active way for engineering courses.

2. Future Works;

The future work we will consider the implementation of project-based learning into the Telecommunication Network classroom. The project-based learning activities may gain learning efficiency up to 90% as presented in the learning pyramid.

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