

Efficiency and effectiveness of blended learning for critical thinking development in thai vocational students

Eficacia y eficiencia del aprendizaje mixto para el desarrollo del pensamiento crítico en estudiantes profesionales tailandeses

DEECHAI, Wichian ¹ & SOVAJASSATAKUL, Thanongsak ²

Received: 01/03/2019 • Approved: 13/05/2019 • Published 10/06/2019

Contents

1. Introduction
 2. Literature review
 3. Methodology
 4. Results
 5. Conclusion and discussion
- Bibliographic references

ABSTRACT:

The sample group in this research on the efficiency and effectiveness of blended learning was 110 vocational students at a Technical College in Thailand, obtained from cluster random sampling. They were divided into three groups: a group used to find out the efficiency of a blended learning model, a group with whom the blended learning method was implemented (experimental group), and a group with whom the traditional learning method was implemented (control group). The research tools used were a blended learning model for critical thinking development, a critical thinking test, and a learning achievement test. Data were analyzed using mean, standard deviation, E1/E2, and One-way MANOVA. The findings illustrated that the blended learning model for critical thinking development was in accordance with the criteria ($E1/E2=81.26/82.63$). When implementing the blended learning model for critical thinking development in classroom teaching, it was found that the critical thinking scores and the learning achievements of the students with whom the blended learning model was implemented were higher

RESUMEN:

El grupo de muestra en esta investigación sobre la eficiencia y la eficacia del aprendizaje mixto fue de 110 estudiantes de formación profesional en una Escuela Técnica de Tailandia, obtenidos de un muestreo aleatorio por grupos. Se dividieron en tres grupos: un grupo utilizado para conocer la eficacia de un modelo de aprendizaje combinado, un grupo con el que se implementó el método de aprendizaje combinado (grupo experimental) y un grupo con el que se implementó el método de aprendizaje tradicional (grupo de control). Las herramientas de investigación utilizadas fueron un modelo de aprendizaje combinado para el desarrollo del pensamiento crítico, una prueba de pensamiento crítico y una prueba de logro de aprendizaje. Los datos se analizaron utilizando la media, la desviación estándar, E1 / E2 y MANOVA de una vía. Los hallazgos ilustraron que el modelo de aprendizaje combinado para el desarrollo del pensamiento crítico estaba de acuerdo con los criterios ($E1 / E2 = 81.26 / 82.63$). Cuando se implementó el modelo de aprendizaje combinado para el desarrollo del pensamiento crítico

than those implemented traditional learning method. Furthermore, the students were satisfied with the blended learning model at a high level.

Keywords: Blended Learning Model, Critical thinking, learning achievement, Vocational students

en la enseñanza en el aula, se encontró que los puntajes de pensamiento crítico y los logros de aprendizaje de los estudiantes con los que se implementó el modelo de aprendizaje combinado fueron mayores que los implementados en el método de aprendizaje tradicional. Además, los estudiantes estaban satisfechos con el modelo de aprendizaje combinado a un alto nivel.

Palabras clave: Modelo de aprendizaje combinado, pensamiento crítico, logros de aprendizaje, estudiantes vocacionales

1. Introduction

The advancement of technology and communication affects rapid change in the world. Therefore, preparation for these changes in diverse dimensions is necessary. Currently, instructional management emphasizes critical thinking skills and high-level knowledge to move forward and develop the nation sustainably and stably. This is consistent with the Twelfth National Economic and Social Development Plan (2017-2021) of Thailand, in which development strategies were set to strengthen and develop the potential of human capital by enhancing their knowledge and skills and their competency to live, relying on the development of school-age children and teenagers to have systematic critical thinking, creativity, and working skills to be ready to enter the labor market (NESDB. 2017). This was in line with Thailand's 20-Year National Strategy (2018-2038) in terms of human resource development and potential construct, which focuses on the development of learning skills to conform with the 21st Century skills, particularly critical thinking and synthesis skills, the ability to resolve complex challenges, having immunity to problems or crimes, creativities, teamwork skills, and thinking flexibility (Royal Thai Government Gazette, 2018). Similarly, the Educational Development Plan of Ministry of Education (Office of the Permanent Secretary, 2016) in the learning process highlights on the learner's ability to analyze, synthesize, and resolve problems and their teamwork skills. This is consistent with the essential skills in the 21st Century and Vocational Certificate Curriculum 2013 (2013), which aims at the learner pursuing knowledge; having creativity, critical thinking skills, management skills, and problem-solving skills; being able to search for new approaches and methods for self-development; and applying knowledge to work consistently in careers and for constant development (Office of the Vocational Education Commission, 2013).

Learning as an integral part of education is a process that involves the students acquiring knowledge, skills, and values for their adolescence process (Kamarga, 2002). Blended learning is distinct, because it combines the strength of face-to-face communication with online communication, such as stimulation tests and evaluation labs (Garrison & Vaughan, 2008). Blended learning methods respond to the increasingly diverse demands of students and provide participatory and meaningful learning experiences. Werth & Werth (2013) stated that blended learning increased students' participation in the learning process and supported collaborative learning. It made the learning environment less stressful, by providing a place to practice skills beyond the classroom. A study reporting the impact of blended learning on students and teachers found that blended learning, as reported by teachers, indicated an increase in student academic ability, student engagement, and communication. Marsh (2012) explained that the flexibility that blended learning offered in terms of learning formats, styles, and the usage of technological tools to help both aspects of learning, face-to-face or online, helped students meet their individual needs and developed skills that were necessary for 21st Century learning, such as critical thinking.

Such a situation reflects the significance of blended learning and critical thinking. Therefore, the researcher was interested in developing a blended learning model for critical thinking and learning achievement development in Thai vocational students. The researcher evaluated the demand for critical thinking and learning achievement development in vocational students and teachers (Deechai et al., 2019) and applied the results to develop a blended learning model. Then, the model was implemented with a focus group by experts (Deechai & Petsangsri, 2019). Moreover, this research looked for the efficiency and effectiveness of the blended learning model in order to obtain an appropriate blended

learning model for critical thinking development that matched the actual state of vocational students, which affected the development and promotion of critical thinking and learning achievement of them.

1.1. Research objective

To study the efficiency and effectiveness of a blended learning model for critical thinking development in vocational students.

1.2. Hypothesis

Achievement of the students with whom the blended learning model implemented with was higher than those with whom the traditional learning method was used on.

2. Literature review

2.1 Blended learning

Singh (2003) stated that the concept of blended learning was rooted in the idea that learning was not just a one-time event; learning was a continuous process. Blending provides various benefits over using any single learning delivery medium alone. International Association for K-12 Online Learning (2008) mentioned that blended learning included online learning fostering the best traits of interaction in classroom and live-teaching allowing deliberate learning between students. This was in line with the Department of Education and Early Childhood Development (2012), who stated that blended learning referred to the planned implementation of a learning model that integrated student-centered, traditional in-class learning with other flexible learning methodologies using mobile and web-based online (especially collaborative) approaches in order to realize strategic advantages for the education system. According to Carman (2005), blended learning consisted of live events, online content, collaboration, assessment, and post-assessment which led to learning development. Clark (2003) proposed that the blended learning process should consist of learning demand and learner evaluation, learner evaluation, learning development planning, evaluation strategy development, hardware and software preparation, and operational process, monitoring, and evaluation.

2.2 Critical thinking

Critical thinking is to think deliberately, based on logic, and emphasizing whether a decision that is made is good or not. It focuses on four main aspects: logical thinking, which is good thinking with supportive reasons; deliberate thinking, by considering the reasoning of oneself and others; determinate and concentrated thinking for reasonable reasons, and thinking to make decisions to react (Ennis, 1985). This is consistent with Paul et.al (2000) and the Critical Thinking Learning Development of Plymouth University (2010), who gave definitions for critical thinking as thinking that questions and answers systematically with consideration and control, using logic to upgrade the completeness or quality of thinking which was out of the box, but naturally. Facione & Facione (1996) said that critical thinking components were interpretation for understanding and conveying meaning, analysis for relation determination, assessment to identify reliability, conclusion for creditability and confidence, explanation of others' reasoning, and self-control. Ennis (1990) stated that critical thinking skill measurement could be measured by the Cornell Critical Thinking Test: Level X, which comprises four components: Inductive Thinking, Judging Credibility of Observation Reports, Deduction Thinking, and Assumption Identification.

2.3 Media/Innovation efficiency identification

Dick & Carey (1985: 5) stated that one of the steps of developing and conducting formative evaluation was to apply the obtained data to lesson improvement. There are three sub-

steps; one-to-one evaluation, small-group evaluation, and field evaluation. Then, development and conduction of summative evaluation that concludes the developed lesson for instruction revision is done. Brahmawong (2013) mentioned that efficiency identification was the analysis of process efficiency (E1) calculated from the percentage of scores during learning, and the efficiency of achievements (E2) calculated from the percentage of scores after learning. Korteling et al. (2013) said that there were many types of measurement methods that might be used to assess the possible beneficial effects of new ways of training on transfer or training effectiveness, such as methods based on measurement of trainee (learning) performance, methods focusing on synthetic training devices or the overall training program itself, and ratings or questionnaires focusing on subjective evaluations completed by trainees.

3. Methodology

3.1. Population and sample group

The population was 110 vocational students studying Curriculum for Certificate of Vocational Education Semester 2, Academic year 2018, at a technical college in Thailand, obtained from simple random sampling with the lottery method. They were divided into three groups:

- A group used to find the efficiency of the blended learning model: 30 students
- An experimental group who learnt with the blended learning model: 40 students
- A control group who learnt with the traditional learning model: 40 students

3.2. Research tool

1) Content of the Industrial Materials Course, Curriculum for Certificate of Vocational Education, Office of Vocational Education, Ministry of Education, Thailand, involving the content of industrial materials, metal and nonmetal materials, fuel materials, lubrication and cooling materials, construction materials, and electrical materials.

2) Blended learning model for critical thinking development in Thai vocational students, consisting of the following steps and learning activities:

Table 1
Steps and learning activities of blended learning model for critical thinking development

Step	Learning activity
1. Problem: P	Identify problems, conclusion, and reasoning. Questioning appropriate to the situation. Agreement identification.
2. Individual Thinking: I	Retrieval, reference, making decisions, connection, classification, prediction, and identification.
3. Cooperative Thinking: C	Reference, logical conclusion, inductive reasoning, deductive conclusion, and prediction.
4. Discussion: D	Identifying the missing connection of events series, realizing unsolved problems, selecting information relating the solution to the problem, primary agreement identification, and identifying possible hypothesis.
5. Evaluation: E	Logical conclusion, decision making, selecting appropriate alternatives, and appropriate application.

The appropriateness of the blended learning model for critical thinking development was found to be at a high level ($\alpha = 4.49$) (Deechai & Petsangsri, 2019).

3) Critical thinking test: a 4-choice objective test, with 40 questions. IOC was 0.78 -1.00. The reliability of the test after testing with students studying Curriculum for Certificate of Vocational Education was 0.88, difficulty (p) was 0.47-0.83, and discrimination (r) was 0.20–0.53.

4) Learning achievement test: a 4-choice objective test, with 40 questions. IOC was 0.89-1.00. The reliability of the test after testing with students studying Curriculum for Certificate of Vocational Education was 0.89, difficulty (p) was 0.53-0.87, and discrimination (r) was 0.20–0.53.

5) 5-rating scale questionnaire about the satisfaction of students towards the blended learning model for critical thinking development. IOC was .78-1.00 and reliability was 0.93.

3.3. Experiment and data collection

The researcher experimented and collected data during June-August 2018, following the following steps:

1) Blended learning model

The researcher followed the teaching steps from introducing and clarifying details, processed teaching, and summarizing results. The blended teaching model for critical thinking development was utilized. The model comprised five steps: proposing problems, individual thinking, focus group thinking, discussion, and evaluation. Prior to the planning, the researcher asked the students to complete the critical thinking and learning achievement tests. After learning with blended learning, the students completed the same test again, but the choices were focused differently from the previous test. Also, the students would be asked about their satisfaction towards blended learning model.

1.1) Finding the efficiency of blended learning model by implementing it with 30 vocational students.

1.2) Studying the critical thinking and learning achievements by implementing the blended learning model with 40 vocational students (experimental group).

2) Traditional learning model

For the traditional learning model, the researcher followed the teaching process from introducing and clarifying details, processed teaching, and summarizing results. The traditional learning model was used with 40 vocational students (control group). Pre-testing and post-testing to measure critical thinking and learning achievement, using the same test as that in the blended teaching model, was conducted.

3.4. Data analysis

1) The efficiency of the blended learning model for critical thinking development was analyzed using process efficiency analysis (E1) and result efficiency analysis (E2). Criteria for efficiency was $E1/E2 = 80/80$.

2) The mean score of critical thinking and learning achievements after learning between the students learning with the blended learning model and those with the traditional learning model were compared by analyzing them with one-way MANOVA.

3) The satisfaction of students towards the blended learning model was analyzed by analyzing mean (\bar{X}) and standard deviation (SD). area, were analyzed using the Priority Needs Index Modified (PNIModified) approach.

4. Results

1) Research findings on the efficiency of the blended learning

model for critical thinking development

Table 2
Efficiency of blended learning model
for critical thinking development

Efficiency	n	Score	Total score	Mean	Percentage
Process (E1)	30	15	4388	12.19	81.26
Result (E2)		40	1983	33.05	82.63

2) Comparative results of post-learning scores of critical thinking and learning achievements of the experimental group and the control group

Table 3
Mean and standard deviations of students'
critical thinking and learning achievements

Dependent variable	Total 40 Scores							
	Experimental group (n=40)				Control group (n=40)			
	Pre-learning		Post-learning		Pre-learning		Post-learning	
	M	SD.	M	SD.	M	SD.	M	SD.
Critical thinking	23.80	2.36	32.23	2.63	21.58	2.50	23.43	2.31
Learning achievements	27.23	3.42	34.03	4.10	20.75	3.14	26.10	3.44

Table 4
Primary agreement test for one-way MANOVA

Statistical test	Primary Agreement	Data Analysis	Results
Variance matrix- - Covariance using Box's M Test	Sig > a	.532	Variance matrix and covariance was equal.
Variable relations using Bartlett's Test	Sig < a	.000**	Dependent variables were unrelated to cause Multicollinearity.

**Sig. < .01

Table 5
Variance analysis for testing difference

Source of Variance	Statistical test	F	Sig.

Intercept	Pillai's Trace	5125.537	.000**
	Wilks' Lambda	5125.537	.000**
	Hotelling's Trace	5125.537	.000**
	Roy's Largest Root	5125.537	.000**
Classification	Pillai's Trace	125.117	.000**
	Wilks' Lambda	125.117	.000**
	Hotelling's Trace	125.117	.000**
	Roy's Largest Root	125.117	.000**

**Sig. < .01

Table 6

Statistical test for the difference of critical thinking and learning achievements between the experimental and the control group

Source	Dependent Variable	SS	Df	MS	F	Sig.
Corrected Model	Critical thinking	1548.800	1	1548.800	253.396	.000*
	Achievements	1272.012	1	1272.012	88.834	.000*
Intercept	Critical thinking	61938.450	1	61938.450	10133.611	.000*
	Achievements	72180.113	1	72180.113	5040.894	.000*
Classification	Critical thinking	1548.800	1	1548.800	253.396	.000*
	Achievements	1272.013	1	1272.013	88.834	.000*
Error	Critical thinking	476.750	78	6.112		
	Achievements	1116.875	78	14.319		
Total	Critical thinking	63964.000	80			
	Achievements	74569.000	80			
Corrected Total	Critical thinking	2025.550	79			
	Achievements	2388.887	79			

**Sig. < .01

Table 7
Satisfaction of students towards the blended learning model for critical thinking development

Aspect	Students (n=40)		Level of satisfaction	Rank
		SD		
1. Learning activities	4.40	0.55	High	3
2. Content	4.46	0.51	Highest	1
3. Teacher	4.44	0.51	High	2
4. Media and learning sources	4.46	0.53	Highest	1
5. Measurement and assessment	4.44	0.53	High	2
Total	4.44	0.53	High	-

5. Conclusion and Discussion

The findings illustrated that the efficiency of the blended learning model for critical thinking development in students was in accordance with the criteria ($E1/E2=81.26/82.63$).

Therefore, it was concluded that the developed blended learning model for critical thinking development in students was efficient enough to be implemented with instructional learning to enhance the critical thinking and learning achievements of Thai vocational students.

It could be seen that, after implementing the blended learning model with the students and comparing the scores with those resulting from the traditional learning model, those learning with the blended learning model for critical thinking development had higher scores than those learning with the traditional learning model. Additionally, it was found that the students' satisfaction towards the blended learning model was at a high level.

This was because the researcher had studied documents, textbooks, and Thai and international researches in order to develop the model. Moreover, the appropriateness of the developed model was tested by experts in a focus group before using it with the sample group.

The experts had examined the details, gave advice, and evaluated that the model was appropriate at a high level. This was in line with Marsh (2012), who stated that the flexibility that blended learning offered, in terms of learning formats, styles, and the usage of technological tools, to help both aspects of learning, face to face or online, helped students meet their individual needs, and developed skills that are necessary for 21st century learning, such as critical thinking.

Blended learning creates an effective learning environment that motivates students to collaboratively and individually construct knowledge and develop critical thinking skills. Blended learning fosters external thinking styles by allowing students to interact with each other. It also integrates the internal thinking style by providing effective tools for students who prefer to learn alone (Yang & Wu, 2012).

Wannapiroon (2013) studied the development of a research-based blended learning model to enhance graduate students' research competency and critical thinking skills, and discovered that the competency of students in research and critical thinking skills after learning with the blended learning model was higher than before learning with it, with statistical significance. Similarly, Utami (2018) found out that the students of an experimental group who learnt with a blended learning model had higher learning achievements than those of a control group who learnt with the traditional learning model. This was consistent with the research of Means et al. (2013), the Effectiveness of Online and

Blended Learning: A Meta-Analysis of the Empirical Literature.

The meta-analysis found that, on average, students in online learning conditions performed modestly better than those receiving face-to-face instruction. The advantage over face-to-face classes was significant in those studies contrasting blended learning with traditional face-to-face instruction, but not in those studies contrasting purely online with face-to-face conditions. Karamizadeh et al. (2012) conducted the Study of Effectiveness of Blended Learning Approach for Medical Training Courses and revealed that there was a significant relationship between scores before and after learning; the scores after learning were significantly higher than those before learning.

Most students had the highest opinion of the blended learning model. Moreover, there was a significant relationship between a computer access model and the satisfaction towards the blended learning method. The results showed that the blended learning model was efficient for academic learning. Kintu et al. (2017) examined blended learning effectiveness: the relationship between student characteristics, design features, and outcomes.

Multiple regression analysis results showed that blended learning design features (technology quality, online tools, and face-to-face support) and student characteristics (attitudes and self-regulation) predicted student satisfaction as an outcome.

The results indicated that some students' characteristics/ backgrounds and design features were significant predictors for student learning outcomes in blended learning.

Bibliographic references

Alonso, F., López, G., Manrique, D. and Viñes, J.M. (2005). An instructional model for web-based e-learning education with a blended learning process approach. *British Journal of Educational Technology*, 36(2), 217–235.

Brahmawong, C. (2013). Efficiency of Medial or Teaching Aids Testing. *Silpakorn Educational Research Journal*. 55(1). 7-20.

Deechai, W. and Petsangsri, S. (2019). Model of Blended Learning to Enhance Critical Thinking Skills of Vocational Students. *International Journal of the Computer, the Internet and Management*, 27(3), (in press)

Deechai, W., Sovajassatakul, T., & Petsangsri, S. (2019). The Need for Blended Learning Development to Enhance the Critical Thinking of Thai Vocational Students. *Mediterranean Journal of Social Sciences*, 10(1), 131-140. Doi: 10.2478/mjss-2019-0013

Department of Education and Early Childhood Development. (2012). *Blended learning A synthesis of research findings in Victorian education 2006-2011*, Melbourne: Ultranet and Digital Learning Branch, Department of Education and Early Childhood Development. www.education.vic.gov.au/researchinnovation/

Facione, N. & Facione, P. (1996). Externalizing the critical thinking in knowledge development and clinical judgment. *Nursing Outlook*, 44,129-136.

Garrison, R., & Vaughan, H. (2008). *Blended learning in higher education: Framework, principles and guidelines*. San Francisco, CA: Jossey-Bass.

International Association for K-12 Online Learning. (2008). *Blended Learning: The Convergence of Online and Face-to-Face Education*, http://www.inacol.org/research/promisingpractices/NACOL_PPBlendedLearning-lr.pdf

Kamarga, H. (2002). *Belajar Sejarah Melalui e-learning: Alternatif Mengakses Sumber Informasi Kesejarahan*. Jakarta: PT Intimedia.

Kintu, M.J., Zhu, C. and Kagambe, E. (2017). Blended learning effectiveness: the relationship between student characteristics, design features and outcomes, *International Journal of Educational Technology in Higher Education*, 14(7), DOI 10.1186/s41239-017-0043-4

Korteling, J.E., Oprins, E.A.P.B. & Kallen, V.L. (2013). *Measurement of Effectiveness for Training Simulations, (Report RTO-SAS-095)*. Soesterberg, The Netherlands: TNO Human Factors Research Institute.

- Marsh, D. (2012). *Blended learning creating learning opportunities for language learners*. New York: Cambridge University Press.
- Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). The Effectiveness of Online and Blended Learning: A Meta-Analysis of the Empirical Literature. *Teachers College Record*, 115(3), 1-47.
- NESDB. (2017). *The twelfth national economic and social development plan (2017-2021)*. Bangkok: Office of the National Economic and Social Development Board, Office of the Prime Minister, Thailand, https://www.nesdb.go.th/nesdb_en/ewt_w3c/ewt_dl_link.php?nid=4345
- Office of the Basic Education Commission. (1997). *Theory of Learning for Thinking Process Development*. Bangkok: Idea Square Printing.
- Office of the Education Council. (2017). *National Strategy Plan (2017-2036)*. Bangkok: Office of the Education Council, Ministry of Education.
- Office of the Permanent Secretary. (2016). *Educational Development Plan of Ministry of Education No. 12 (2017-2021)*. Bangkok: Office of the Permanent Secretary, Ministry of Education.
- Office of the Vocational Education Commission. (2018). *Vocational Courses*. [Online] Available: <http://www.vec.go.th/en-us/aboutvec/vocationalcourses.aspx>
- Singh, H. (2003). Building Effective Blended Learning Programs. *Educational Technology*, 43(6), 51-54. <http://asianvu.com/bookstoread/framework/blended-learning.pdf>
- Susaoraj, P. (2008). *Thinking Development*. Bangkok: 9119 Technique Printing Limited Partnership Printing House.
- Utami, I.S. (2018). The effect of blended learning model on senior high school students' achievement. *SHS Web of Conferences* 42, DOI <https://doi.org/10.1051/shsconf/20184200027>
- Wannapiroon, P. (2013). Development of Research-Based Blended Learning Model to Enhance Graduate Students' Research Competency and Critical Thinking Skills. *Procedia - Social and Behavioral Sciences*, 136, 486 – 490.
- Werth, L., & Werth, E.P. (2013). Educational technology: Perceptions and use by a sample of K-12 teachers. *ISTE (International Society for Technology in Education) Conference Proceedings*. San Antonio, TX.
- Yang, Y. T. C., & Wu, W. C. I. (2012). Digital Storytelling for Enhancing Student Academic Achievement, Critical Thinking, and Learning Motivation: A Year-Long Experimental Study. *Computers & Education*, 59, 339-352. <http://dx.doi.org/10.1016/j.compedu.2011.12.012>
- Watson, G., Glaser, E. M. (1964). *Manuel of Critical Thinking Appraisal*. New York: Harcourt, Brace & World, Inc.

-
1. Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand, e-mail: deechi19@hotmail.com
 2. Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand, e-mail: thanongsak.so@kmitl.ac.th
-