

Meta-Analysis of a Blended Learning Approach: Implications for Student Critical Thinking

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ABSTRACT

The purpose of this study is to determine the implications of the blended learning approach to students' critical thinking. Aspects of critical thinking are analyzed from several aspects, namely the media used in the blended learning approach, instruments used to evaluate critical thinking and analysis of critical thinking indicators affected by the blended learning approach. This type of research is meta-analysis. While the method used in this research is descriptive with survey evaluation. The results of the calculation of the effect size show that learning with a blended learning approach has a significant impact on critical thinking. The choice of measurement instruments for critical thinking has an effect on the impact on increasing the value of critical thinking

Keywords: *meta-anaysis, blended learning, critical thinking*

I. INTRODUCTION

21st Century learning is learning that prepares 21st century generations where the progress of Information and Communication Technology (ICT) that is developing so fast has an influence on various aspects of life including the teaching and learning process. One example of the progress of Information and Communication Technology has an influence on the learning process is that students are given the opportunity and are required to be able to develop their skills in mastering information and communication technology - especially computers, so that students have the ability to use technology in the learning process aimed at achieving thinkingskills[1]. In addition, the 21st century learning system is a transition of learning where the curriculum currently being developed requires schools to change teacher-centered learning approaches to student-centered learning approaches. This is in accordance with the demands of the future world where students must have thinking and learning skills. These skills include skills to solve problems (problem solving), critical thinking, collaboration, and communication skills[2].

Learning approach that fits the characteristics of 21st century learning is blended learning. Blended learning is a learning approach that integrates traditional face-to-face learning and distance learning using online learning resources and various communication options that can be used by teachers and students[3]. Blended learning is not entirely online learning that replaces face-to-face learning in the classroom, but to complement and overcome material that has not been conveyed during learning when students study in class[4].

Critical thinking is one of the skills needed in the 21st century. By definition critical thinking can be interpreted as an activity of mental discipline to be able to think reflectively and make sense to be able to evaluate arguments or propositions in making decisions about what to believe and do. Critical thinking has several dimensions namely; the ability to see accuracy, clarity, open thinking, able to suppress the implantive attitude, able to put themselves in various situations and be able to respond very precisely to the feelings and levels of thinking of others[5]. Critical thinking also has six basic elements, namely (FRISCO) focus, reasons, inference, situation, clarity and overview[6]. The core elements of FRISCO thinking are actually analysis, inference, explanation, evaluation, self-regulation and interpretation[7].

Based on what has been described, relating to the type of learning in the 21st century and the skills needed in the 21st century, especially critical thinking, the purpose of this study in general is to find out the implications of the blended learning approach to critical thinking. The implications are reviewed based on the media used in the blended learning approach, an instrument used to evaluate critical thinking. In this research, we will also see which indicators of critical thinking are highly affected by the blended learning approach.

2. METHOD

This research uses descriptive research method with survey research. This research was conducted in three stages. The first stage is the preparation phase. At this stage, the independent variable is blended learning and the dependent variable is critical thinking. Selected forms of publication are international journal indexed by Scopus in English,

published by Sciencedirect and Tylor & Francis. The year of publication of the journal chosen for analysis in this study was 2009-2018. The second stage is the implementation phase. Research data collection was carried out during September 2018. The target variable of this study was the tertiary level (higher education students). The type of research chosen was experimental research, quasi experiment and mixmethod. effect size in this study was calculated using table 1, with criteria according to Cohen formula[8]As contained in table 2. The last or third stage is

data analysis, effect size analysis is carried out based on the target variable that is critical thinking, moderator variables are critical thinking assessment instruments , indicators of critical thinking and the media used to support blended learning used by each journal. Effect size calculation can be done in various ways as shown in table 1. The value of the effect size obtained is then interpreted using table 2.

Table 1 How to Calculate the Effect Size Based on Known Data[8]

Statistical Data	Formula
Average and standard deviation in one group	$ES = \frac{\bar{x}_{post} - \bar{x}_{pre}}{SD_{pre}}$
Average and standard deviation in each group (two groups with post test only)	$ES = \frac{\bar{x}_{experiment} - \bar{x}_{control}}{SD_{control}}$
The average and standard deviations in each group (two groups pre-post test)	$ES = \frac{(\bar{x}_{post} - \bar{x}_{pre})_{experiment} - (\bar{x}_{post} - \bar{x}_{pre})_{control}}{\left(\frac{SD_{pre\ control}^2 + SD_{pre\ experiment}^2 + SD_{post\ control}^2}{3}\right)}$
Chi-square	$ES = \frac{2r}{\sqrt{1-r^2}}; r = \sqrt{\frac{\chi^2}{n}}$
t _{value}	$ES = t \sqrt{\frac{1}{n_{experiment}} + \frac{1}{n_{control}}}$
p	CMA (Comprehensive Meta Analysis Software)

Table 2 Classification of Effect size[8]

Effect Size (ES)	Cohen's standard category
0 < ES ≤ 0,2	Small effect
0,2 < ES ≤ 0,5	Medium effect
0,5 < ES ≤ 0,8	Big effect
ES > 0,8	Very Large Effect

3. RESULTS AND DISCUSSION

A metanalysis study conducted on 20 articles is presented in table 3. In table 3, there are several dependent variables and moderate variables that will be assessed based on the value of the effect of the survey. Based on the data analysis, the effect size values of several articles are obtained as shown in Figure 1. In figure 1 it appears that the highest effect size values are seen in the article Salleh et al (2012)[9] which is 1.79 (very large effect). This article uses the Web-based simulation learning media, Facebook in the process of blended learning. In the process of evaluating critical thinking instruments used using The Delphi Report (American Philosophical Association, 1990) which uses six

elements of critical thinking as a standard in assessment[10]. The lowest value of effect size is in the article Umar &Rathakrishnan (2012)[11]which is 0.132 (small effect. This article uses pbWiki (e-moderators with either social roles (SROT) or pedagogical roles (PROT)) as a medium to support the implementation of blended learning While the instrument used to assess critical thinking uses a micro critical thinking rubric (MiCT) and a macro critical thinking rubric (MaCT). Based on the linearity analysis of the impact of the use of blended learning on critical thinking, it appears that learning with the blended learning approach contributes influence of 96.85% of critical thinking as shown in Figure 1.

Table 3 Meta-Analysis on Blended Learning Towards Critical Thinking.

No	Author (Year)	System	Number of Participants	Critical Test Instrument	Thinking Subjects	Effect Size
1	Salleh et al. (2012)[9]	Web-based simulation learning, Facebook	21	The Delphi Report (American Philosophical Association, 1990)/six elements of critical thinking	Higher Education (Malaysia)	1,79 (Very Large Effect)
2	Sendag&Odabasi (2009)[12]	Moodle - the online instructor-led group	40	a multiple choice content knowledge acquisition scale and the Watson–Glaser critical thinking skills test	Higher Education (Turki)	1,563 (Very Large Effect)
3	Sirisopon et al. (2013)[13]	Web base Instruction	28	The Cornell Critical Thinking Test	Higher Education (Thailand)	1,506 (Very Large Effect)
4	Wannapiroon (2014)[13]	Cloud Learning Management System (CLMS) Blogger, website, storyboard computerized	28	the experts' in-depth interviewing experts' in-depth interviewing form	Higher Education (Malaysia)	1,4 (Very Large Effect)
5	Halpern et al. (2012)[13]	learning game that teaches (ARA), e book	116	ART (Activities-Resources-Technologies)	Higher Education (Colombia)	1,40 (Very Large Effect)
6	Lee et al. (2014)[14]	Web base learning (buletin board)-socratic questioning	46	tag code schame (yang et al. 2005)	Higher Education (koreaselatan)	1,21 (Very Large Effect)
7	Kong (2014)[15]	web-based word processor (Google Docs)	107	The critical thinking test papers were primarily adapted from an established instrument developed by Yeh (2012)	Higher Education (Hong Kong)	1,01 (Very Large Effect)
8	Cavus et al. (2009)[16]	The usefulness of mobile learning systems (UMLS), (MMS), short message service (SMS), electronic mail, or MSN Messenger	40	California Thinking Inventory (CCTDI)	Critical Disposition Scale Higher Education (North Cyprus)	0,957 (Very Large Effect)

9	Yang et al. (2007)[17]	Web-Based Bulletin Board (WBB) dan WeBCT	23	the California Critical Thinking Skills Test (CCTST)	Higher Education students (US)	0,8 (Big Effect)
10	Sadee et al. (2012)[18]	Web-EISEL	490	ART (Activities-Resources-Technologies)	Higher Education (Kanada)	0,787 (Big Effect)
11	Szabo Schwartz (2011)[19]	& Blackboard virtual learning environment	93	Ennis-Weir Test of Critical Thinking (EWCT)	Higher Education (US)	0,76 (Big Effect)
12	Schellens et al. (2009)[20]	computer-supported collaborative learning (CSCL)-EduSite	35	analysis instrument based on Garrison's (1992) five stages of critical thinking	Higher Education (Belgia)	0,747 (Big Effect)
13	Yang et al. (2015)[20]	Moodle, modul	83	The California Critical Thinking Skills Test (CCTST)	Higher Education (Taiwan)	0,74 (Big Effect)
14	Jou al. (2014)[21]	Google services (model SECI) ete, e.g G Plus, G Drive, Blogger, dan G Sites	60	the California Critical Thinking Skills Test (CCTST)	Higher Education (Taiwan)	0,725 (Big Effect)
15	Smith et al. (2018)[22]	Coures Hero (GE110)	157	the California Critical Thinking Skills Test (CCTST)	Higher Education (Hawaii)	0,468 (Medium effect)
16	Williams & Lahman (2011)[23]	ANGEL course management software, computer-mediated communication (CMC)	42	Newman scale (1995)	Higher Education (Amerika)	0,362 (Medium effect)
17	Dunn et al. (2014)[24]	e-modul	165	critical thinking scores according to Nunnally's (1978)	Higher Education (US)	0,3 (Medium effect)
18	Fadhli & Khalfan (2009)[25]	web-based learning (MIS 77 240)		the California Critical Thinking Skills Test (CCTST)	Higher Education (Kuwait)	0,25 (Medium effect)

19	Bagdasarov et al. (2018)[25]	Google Doc, Google Apps, Facebook (HRM 150)	17	The Delphi Report (American Philosophical Association, 1990)/six elements of critical thinking	Higher Education (California)	0,14 (Small effect)
20	Umar&Rathakrishnan (2012)[11]	pbWiki (e-moderators with either social roles (SROT) or pedagogical roles (PROT))	120	a micro critical thinking rubric (MiCT) and a macro critical thinking rubric (MaCT)	Higher Education (Malaysia)	0,132 (Small effect)

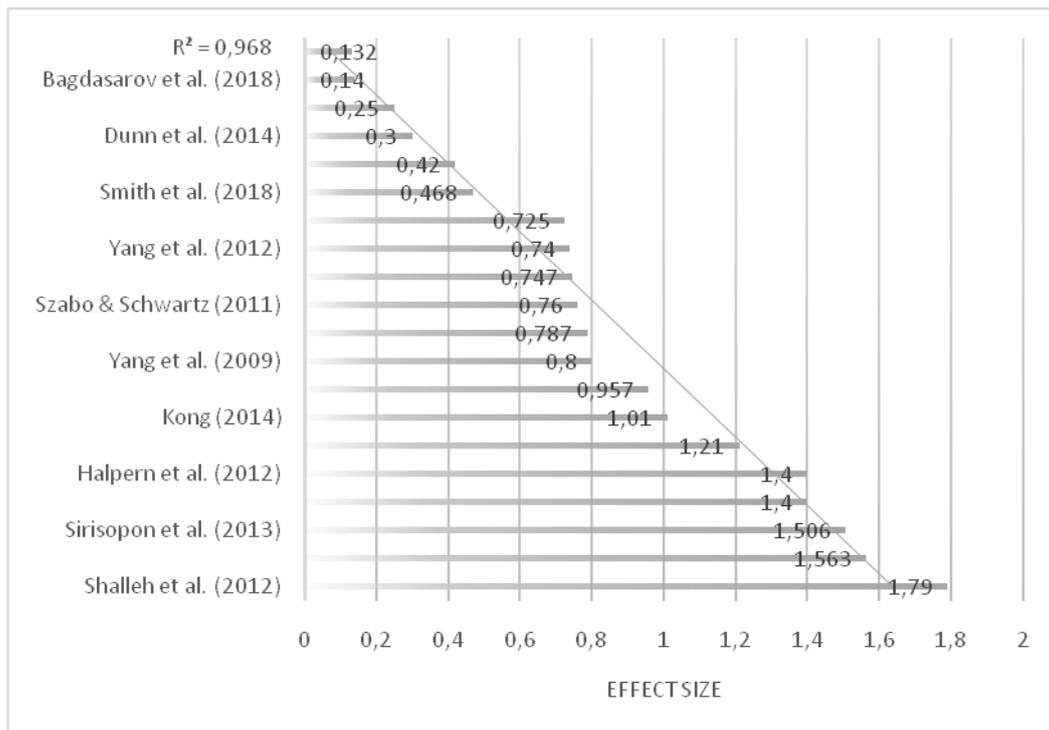


Figure 1 Graphic Effect Size Value of Each Article

Classification of the effect size value of the analyzed article shows the distribution as shown in Figure 2. It appears that the value of the effect size with very large classification is

very dominating, namely as many as 8 articles and only 2 articles which are in small classification.

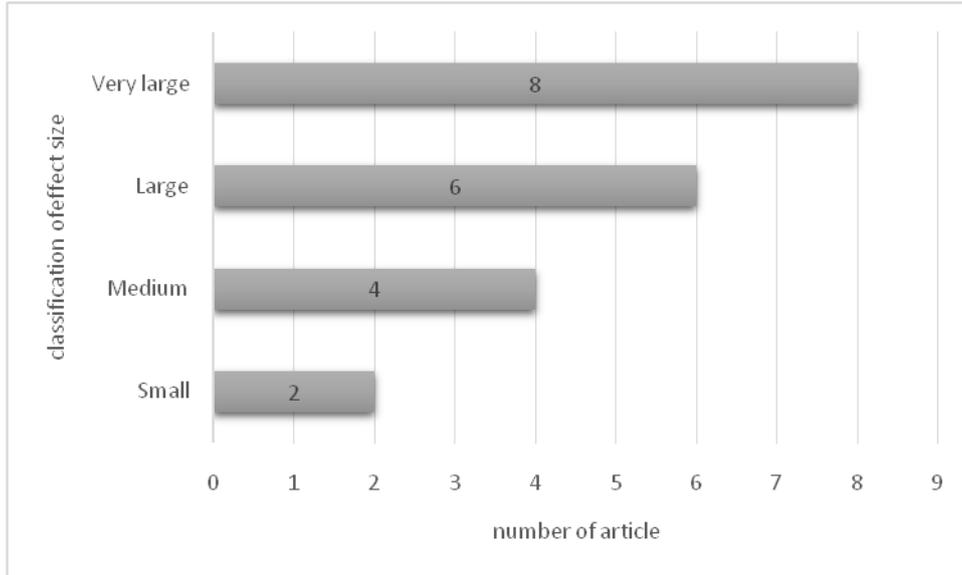


Figure 2 Graph of The Number of Distributions of Each Effect Size Classification

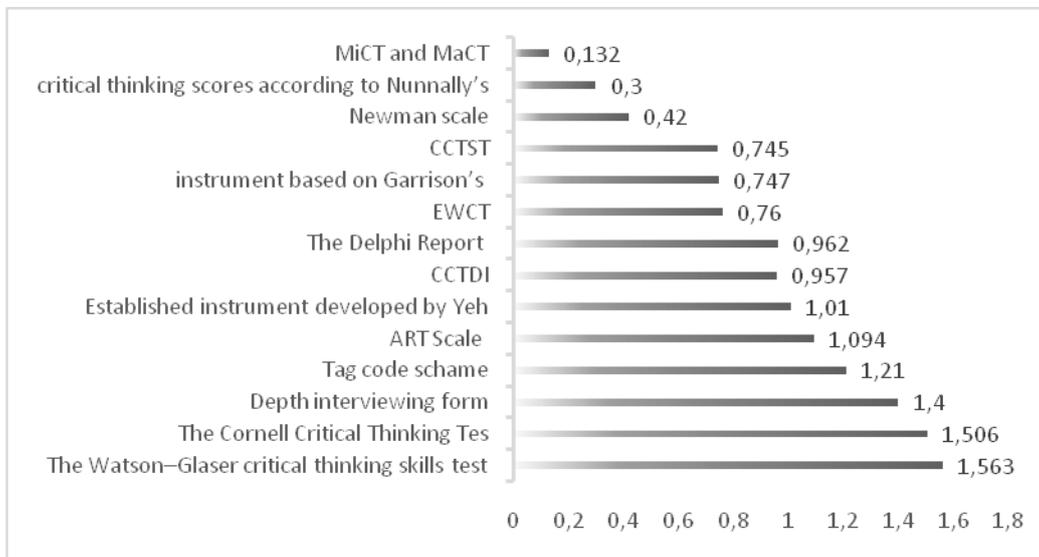


Figure 3 Graph of Relationship Between Critical Thinking Instruments and Effect Size

A review of the moderator variable, the instrument used to measure critical thinking, is shown in Figure 3. The results of the analysis show that the effect size value is quite high seen in the use of "The Watson-Glaser critical thinking skill test" and "The Cornell Critical Thinking Test". The lowest effect size position was seen in the use of "a micro

critical thinking rubric (MiCT) and a macro critical thinking rubric (MaCT)" in the amount of 0.132. This shows that there is an influence of the use of critical thinking assessment instruments to increase the value of critical thinking.

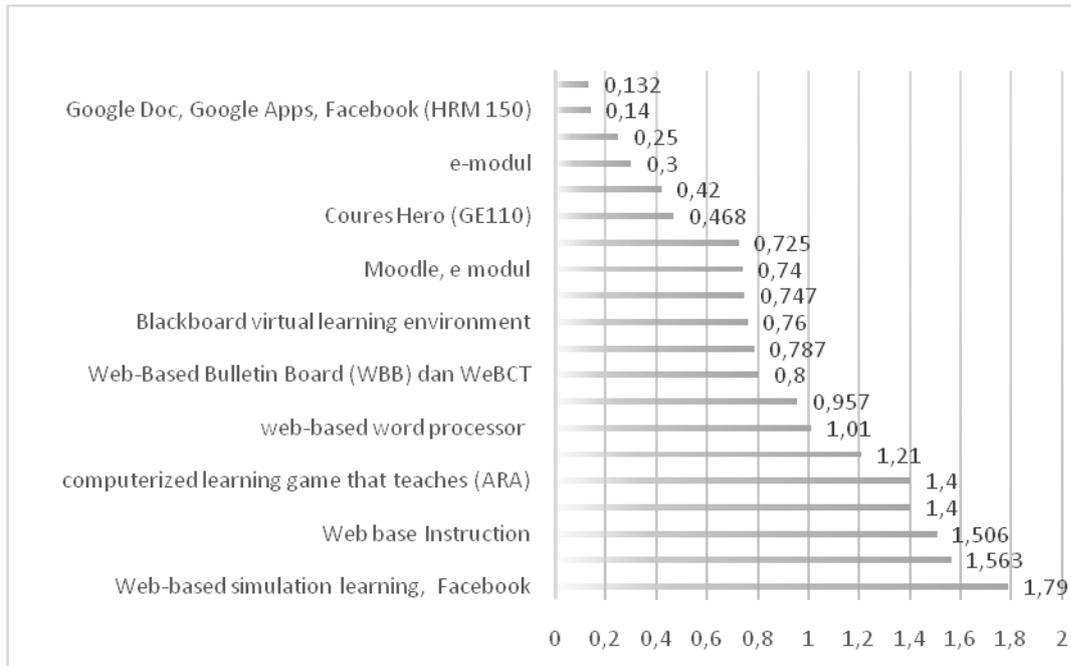


Figure 4 Graphic of The Relationship Between Learning Media and Effect Size

The relationship between the moderator variables of learning media used in the blended learning approach, the effect on increasing critical thinking is presented in Figure 4. It appears that the media used in learning also has an influence. The size of effect size is quite large when learning blended learning using web-based simulation learning.

4. CONCLUSION

The results of the Meta analyst blended learning implications for critical thinking show that; Blended learning has a significant impact on critical thinking. Critical thinking assessment instruments and media used during the learning process with a blended learning approach, are proven to have an impact and influence on increasing critical thinking.

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